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PACIFIC NORTHWEST LABORATORY
MONTHLY ACTIVITIES REPORT
JULY 1967

Division of Production
and
Hanford Plant Assistance
Programs

by the
Staff of Battelle-Northwest
S. L. Fawcett, Director

August, 1967

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PACIFIC NORTHWEST LABORATORY
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-2-

BNWL-521

TABLE OF CONTENTS

	<u>Page</u>
Direct AEC Sponsored Programs - Summary	3
Direct AEC Sponsored Programs	4
Assistance to Douglas United Nuclear - Summary	6
Assistance to Douglas United Nuclear	13
Assistance to Isochem - Summary	45
Assistance to Isochem	50
Technical Assistance to the Hanford Plant - Summary . . .	70
Technical Assistance to the Hanford Plant	71

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PACIFIC NORTHWEST LABORATORY

MONTHLY ACTIVITIES REPORT

DIVISION OF PRODUCTION AND HANFORD PLANT ASSISTANCE PROGRAMS

R. S. PAUL

DIRECT AEC SPONSORED PROGRAMS

Summary

Columbia River Studies

The computer model of the Columbia River was used to study the effect of the proposed Ben-Franklin Dam. The model predicts density currents appearing intermittently during the spring and fall which could result in slightly increased temperatures as a result of the dam. During most of the year the dam would be expected to approximately double the travel time of reactor effluent to the Tri-Cities water intakes.

Mechanisms of Environmental Exposure

The final phase of a statistical study of fishing habits of Tri-City residents was completed.

1405 Analyzer

Following completion of initial field tests by the AEC-DIA, the instrument underwent minor changes and recalibration to improve performance.

DECLASSIFIED

-4-

321

DIRECT AEC SPONSORED PROGRAMS

Columbia River Studies

Effect of Reactor Effluent on the Quality of the Columbia River Water

(R. T. Jaske, Environmental and Radiological Sciences Department)

The computer model of the Columbia River flow was used to assess the effect of the proposed Ben-Franklin Dam on the reactor effluent plume in the river. The mathematical model included the portion of the river from River Mile 385 to River Mile 348, the proposed site of the dam, and was tested against 1966 experience. Both a reservoir level of 385 feet and of 400 feet were examined. The presence of the dam is expected to result in slightly cooler water at high river flows according to the prediction of the computer model. During the season immediately preceding the spring high water and during the late summer months there will be intermittent appearance of a density current within the pool behind the dam. The model predicts that this density current will result in a temperature increase of 1 to 1½ °C for a 385 foot dam and of 2 °C for a 400 foot dam. In general, the model tends to indicate that impoundment will result in relatively small temperature changes. It predicts an increase in the mean travel time of reactor effluent from roughly 30 hours at present to about 60 hours in the case of the 385 foot pool and about 75 hours in the case of the 400 foot pool. These increased travel times are projected for conditions of no density current. The appearance of a density current in the pool would lower travel times to approach those presently experienced.

Mechanisms of Environmental Exposure

(J. F. Honstead, Environmental Studies Section)

Electronic equipment in the new mobile whole-body counter was prepared and modified by the vendor and is now installed in the truck. The new installation includes shock mounting provisions to reduce problems associated with movement of the truck.

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ASSISTANCE TO DOUGLAS UNITED NUCLEAR

Summary

Mission 1

An irradiated Mark I outer component seen bubbling in the N-basin was found to have a cracked closure. Investigation showed that cracks in the closure had been caused by preirradiation handling damage but did not reveal how close to failure the damaged component was.

Several inner component end cap unbond indications have occurred during postirradiation nondestructive testing in N-basin. No positive correlation has been made between these indications and the results of radiometallurgical visual and destructive examinations.

Chemical burnup analyses of high exposure Mark I components indicated that fuel exposures were about 15% greater than calculated from reactor and "vessel" data. The outer component attained 8900 MWd/T (1.03 at.%) and the inner attained 6950 MWd/T (0.80 at.%).

A 400°C stress rupture test at 25,000 psi hoop stress indicated 3.32% maximum circumferential strain after 6198 hours at temperature. The test is now at 6433 hours which surpasses its predicted life of 6300 hours that was obtained from a graph of hoop stress vs. log time at failure for 400°C stress rupture tests.

Modifications to the NDT equipment in the 333 Building to permit testing of new fuel designs was completed. Previously used ceramic crystals are again being employed for thin-clad bond testing since the BNW-developed higher frequency crystals were found to be incompatible with the present equipment. Further work to adapt the systems to the higher frequency transducers was planned.

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The microstructure of an Fe-Si bearing driver element that experienced 3.6% fuel ΔV at 2950 MWd/T exposure showed microcracking in the hot control zone. A similar element containing Fe-Al additions that experienced 1% fuel ΔV at 2870 MWd/T exposure did not show evidence of microcracking.

Stress relaxation data indicated no detectable differences between the original and irradiated 2% niobium "W" springs after 1000 hours at 190°C.

Mission 4

A process for preparing target elements of graphite-neptunium oxide compacts is being developed.

Work proceeded during the month on the preparation of neptunium oxide-graphite target elements by a process in which a graphite core is soaked in a neptunium nitrate solution, dried, and the neptunium nitrate calcined.

Mission 5

Measurements were made of the control system effectiveness in the NPR exponential assembly with a 3-to-1 driver-to-target loading.

Difficulties encountered with ENDF/B library processing programs continued to delay general use of the system.

Difficulties with the ENDF/B library processing programs will be published shortly.

A system of three General Atomic codes designed to generate multigroup constants in the slowing down energy region is being adapted to local use.

Codes to generate scattering kernels for water from the gaussian model now appear to work properly.

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- 12 -

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Satisfactory field evaluation studies on the experimental miniature dose rate instrument, which provides ranges from 10 to 300 mR/hr with selectable signal alarm points, served to complete this project.

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-13-

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Mission 1 - Basic Production Mission

Examination of Cracked Mark I Closure Welds
(J. W. Goffard, Metallurgy Design Unit)

The outer welds of two inner components and one outer component appeared to be cracked when viewed in N-Reactor basin. The outer component was observed to release gas bubbles from the crack. These three irradiated fuel pieces were sent to Radiometallurgy for evaluation.

Close examination of the inner component closures failed to yield any visual evidence of the cracks that had seemed apparent in the previous cursory basin examination. It was concluded that the suspect cracks were probably artifacts resulting from the appearance of shadows or marks under difficult viewing conditions in the basin.

Close examination of the closure of the outer component which had been seen to release gas bubbles revealed a network of radial and circumferential cracks in the outer Be-Zr weld bead. These cracks were associated with a preirradiation mechanical damage area of the closure. Metallographic study showed the presence of oxide or filming in the cracks but did not allow a determination as to whether or not the damage was pre- or postautoclave in origin. Cracks were found to extend more than 0.1 in. into the braze but had not propagated through the 0.22 in. closure thickness to the fuel. It is possible that bubbles seen coming from the crack were the corrosion product hydrogen released from the crack network.

Examination of NDT Unbond Indications
(J. W. Goffard, Metallurgy Design Unit)

Three Mark I inner components yielded sites of end cap unbondedness during postirradiation nondestructive testing in N-basin. The components were sent to Radiometallurgy for correlation of the test indications with the findings of visual and destructive evaluations.

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-15-

BNW-521

BURNUP AND CONVERSION DATA
HIGH EXPOSURE MARK I ASSEMBLY

Outer Component (Calculated average exposure = 7840 MWd/T)

<u>Exposure, MWd/T</u>		<u>Ratio,</u>	<u>U</u>		<u>Pu</u>	<u>Ratio,</u>
<u>Center</u>	<u>End</u>	<u>End</u>	<u>Isotopic</u>		<u>Isotopic</u>	<u>Pu</u>
		<u>Center</u>				<u>U</u>
8900	10030	1.125	U ²³⁴	0.006		0.0048
			U ²³⁵	0.38	Pu ²³⁹	63.5
			U ²³⁶	0.100	Pu ²⁴⁰	26.1
			U ²³⁸	99.51	Pu ²⁴¹	8.23
					Pu ²⁴²	2.12
				99.996		99.95

Inner Component (Calculated average exposure = 5995 MWd/T)

6950	8250	1.185	U ²³⁴	0.007	Pu ²³⁹	71.5	
			U ²³⁵	0.475	Pu ²⁴⁰	20.9	0.0044
			U ²³⁶	0.086	Pu ²⁴¹	6.15	
			U ²³⁸	99.38	Pu ²⁴²	1.11	
				99.948		99.66	

N-Reactor Simulation

(R. D. Benham, Systems Analysis and Simulation Unit)

Work continued in preparation for Direct Digital Control of the overall analog simulated N-Reactor. Interface requirements were outlined and study of the operation of the PDP-7 continued.

Present plans are to put together the data obtained on the main header pressure transient runs made over the last six months into a summary report. Some additional runs may be required depending on the analysis of the present data. The objective of this work was to determine what parameters required adjustment to match the main header pressure response during a turbine trip of the simulation with plant data.

considerations involving the pre- and post-irradiation measurements of the canned fuel elements, with the post-irradiation measurements corrected for can wall corrosion. Work is under way to apply the program to the data in production test PT-A040, with particular emphasis directed at comparing the results from the program with the results obtained for ten test pieces from water displacement tests in the laboratory.

A charging design was completed for evaluating the effect of four fabrication processes upon fuel element distortion during irradiation. The test pieces are to be charged in twelve tubes using two experimental designs:

- (1) A series of Graeco-Latin squares in the middle positions of the tubes, where the most severe conditions for dimensional distortion are anticipated, blocking out positions, tubes, ingots, and treatments.
- (2) A series of Latin squares in the remaining positions, blocking out positions, tubes, and treatments and randomized over ingots.

The results from the two experimental designs will be combined through standard weighted analysis of variance techniques.

The normalized weasel curve fitting program was modified to take into account off-centered charges in the process tubes. Since the simplification in the normal equations resulting from the orthogonality of the terms in the sine series fit to the data with centered charges could no longer be used with the off-centered charges, it was necessary to solve the normal equations in their entirety through standard methods of matrix inversion.

The effect of three process variables upon the decontamination of aluminum dummy elements was evaluated to provide a basis for selecting a process for the large scale decontamination of reactor process tubes. Experiments were conducted in the laboratory using a 2^3 factorial design, which was analyzed graphically by means of half-normal probability plots.

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again rose, due to increased heat loss by radiation. In this high temperature region (above 300°C at a spray rate of 0.10 in./min, above 360°C at 0.23 in./min), the efficiency of utilization of the spray was only 15%. That is, the rate of heat loss was equal to that with no spray plus 15% of the heat required to convert the impinging spray to saturated vapor.

K-Reactor Boilout Experiments

(D. S. Rowe, Thermal Hydraulics Analysis Unit)

In this study, methods are being developed to predict accurately the rate of coolant ejection from a process channel following a loss-of-coolant flow accident and to define heat removal rates from the fuel during the coolant ejection. Two specific incidents leading to the loss-of-coolant are being considered, upstream plugging and a front header break. Laboratory experiments are being accompanied by analytical work to enable the extrapolation of the results to a wide variety of coolant conditions and accidents.

In the experimental phase of this program, a series of tests was completed to determine the flow, temperature and pressure response of a K-Reactor process channel to a complete plugging of the inlet coolant flow. In these tests, an electrically heated model of a K reactor fuel column was used. This fuel model was 1.512 in. OD, 0.440 in. ID and 28 ft long and was provided with simulated self-supports. It was placed in a Zircaloy process tube with typical downstream flow hardware. The heated length of the test section was fabricated from various metal alloys of selected resistivity to give step changes in the axial power generation simulating the normal cosine variation.

Two types of tests were performed. The first type simulated the occurrence of upstream plugging during decay power levels. At these power levels (100-300 kW), boiling did not begin in the simulated process channel until 15 to 30 seconds following the plugging. About 1 to 2 minutes were required for the test model to reach a temperature of 800°F (430°C). The second type of test simulated upstream plugging during

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three iterations when the convergence requirement is 10^{-4} . Only two iterations are required when the criterion is 10^{-3} .

The results of both methods are in good agreement, but the iterative method is more readily adapted to the solution of the boilout problem. Computer time requirements are about the same for either method. If the spatial increment is doubled, the computer time required to calculate the transient to a specific point in real time is reduced to one-fourth.

The revised code was tested by applying it to the case of a pipe rupture at the end of a straight, horizontal unheated duct, 5 ft long and 0.145 ft diameter. The initial and boundary conditions were as follows:

• Initial Conditions:

$G = \text{constant} = 833 \text{ lb/ft}^2 \text{ sec}$
 $P_1 = \text{constant} = 600 \text{ psia, dropping to } 599.4 \text{ at exit}$
 $H = \text{constant} = 204 \text{ Btu/lb}$

• Boundary Conditions:

Inlet $P = P_1 = 600 \text{ psia}$ (assumes a very large header)
Outlet $P = P(t) = 584.7 \exp(-4 \times 10^6 t^2) + 14.7$
(drops to 14.7 in about 1.5 msec)
Inlet $H = \text{constant} = 204 \text{ Btu/lb}$

Using the iterative method described above with the convergence criterion for all variables equal to 0.001 and a 0.5 ft spatial increment, approximately 3.7 sec of computer time was necessary to advance the solution one time increment of roughly 0.035 milliseconds. Using the same method but iterating only once and meeting no specified convergence criterion, the machine time was reduced to 1.6 sec per time increment. The results of the two approaches were in good agreement. After 70 time increments, the poorest agreement was a difference of less than three percent in pressure. Mass velocities and enthalpies agreed to within less than one percent.

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this includes a carriage-mounted preamplifier and pulser, and replacement of the LEL RF amplifiers with some integrated circuit video amplifiers now on order.

Difficulties were experienced in attempting to test new billet configurations at receiving inspection with the billet enrichment tester. An intolerable count instability occurred upon use of a new sodium-iodide crystal and photomultiplier tube designed to fit inside the new billets. The old composite pickup was reactivated and used in a different position relative to the billet for successful testing. New quality acceptance count limits were established.

Vibration Test

(L. T. Lamb, NDT Systems Engineering Unit)

The vibration tester for N-Reactor Mark I fuel design was completed. A report describing its operation and the initial test data is being prepared.

Fuel Core Crack Tester

(T. J. Davis, NDT Systems Engineering Unit)

Work on a basic fuel core crack tester was nearly completed. A standard is currently being fabricated and transducers are in the final stage of production.

Mission 2 - Coproduct Mission

Examination of Cracked Closure of Ceramic Target

(J. W. Goffard, Metallurgy Design Unit)

A 1.3 in. diam coproduct ceramic target appeared in N-basin to have a 3/4 in. circumferential crack in the Zr-2 fusion weld closure. The piece was sent to Radiometallurgy for evaluation. Visual examination of the component failed to show a cracked closure. Penetrant dye testing of both ends of the component (to avoid misidentification possibility) was negative. The interface region between the outer Zr-2 can and the inner aluminum can was tested for the presence of gas pressure

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The endurance limit testing of a single end-support spider at room temperatures continued. Very high cycle fatigue tests of the end-support spider indicate an endurance limit of between six and ten pounds.

Mission 4 - Pu²³⁸

Preparation of Neptunium Target Elements

(C. H. Bloomster, Fuel Process Development Unit)

A graphite-NpO₂ dispersion target element is being developed in support of a study to produce Pu²³⁸ which has very low Pu²³⁸ contamination. Pu²³⁸ is an alpha-emitting power source which could be readily shielded for applications within the human body, such as an artificial heart, provided gamma radiation from contaminating isotopes such as Pu²³⁶ is low. One of the sources of Pu²³⁶ contamination in an Al-Np alloy target is a γ -n reaction resulting from high-energy gammas emitted by thermal-neutron capture by aluminum. Graphite does not give rise to high-energy gamma emission, and would be an attractive substitute to aluminum.

Based on previous work on graphite-PuO₂ compacts for critical experiments, a process is being developed for cold-pressing NpO₂-graphite compacts. The development work is concerned with determining and lowering the gas content and gas release rate from the graphite compacts, obtaining uniform distribution of neptunium oxide in the compacts, and determining the thermal stability of the compacts. The neptunium target elements will operate in the 300-500°C temperature range, somewhat above preliminary estimates of operating temperature.

In early development work, oxide-graphite compacts were pressed up to 15 wt% oxide, twice the probable oxide concentration required, and graphite compacts were pressed to the exact size required. Some difficulty with laminations occurred in the initial pressing but sound compacts were prepared by crushing and repressing. Since it may be desirable, later, to fabricate a tubular shape, holes were drilled through some trial compacts. No difficulties were encountered, except for some minor flaking.

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2. Drying on a horizontal rotating mandrel under a heat lamp.
3. Calcination under an argon atmosphere in a tube furnace at 1850°F.

This cycle requires 16 hours to carry out and must be repeated 3-4 times to achieve the desired loading. Since only two elements can be treated simultaneously in the available equipment, 6-8 weeks will be required to complete impregnation of the eight target elements. Although the process is satisfactory for preparing the limited number of target elements required for the forthcoming test, the long time cycle probably renders it impracticable for production-scale use.

Mission 5 - Other Isotopes

Buckling Measurements in an NPR-Like Exponential Assembly (G. D. Seybold, Analytical Physics Unit)

Three control rod measurements were analyzed in the NPR exponential assembly. Each measurement contained six boron carbide control rods (32 in. x 36 in. centers). The pile loading consisted of a 3/1 ratio of sixty standard process tubes containing 0.947 wt% enriched metallic uranium clad with Zircaloy-2 and twenty tubes of lithium-aluminum target material. The fuel is 23.3 in. Mark-I tube-in-tube NPR geometry. Aluminum process tube coolant channels were filled with deionized water.

Lithium-aluminum target tubes consisted of sixteen target increments giving a nominal test length of 96.96 in. Each increment was 6.060 in. by 1.430 in. in diameter. Three point fitting procedures were used for like-lattice cell positions. The results of the control rod measurements assure that the extrapolation distances (λ_A, λ_B) do not change significantly from the measurement where no control rods were present. Results of λ_B^* which constitutes a rough check on λ_B are also reported. These results of λ_B^* are obtained from three measurement points and are necessarily in larger error than those of λ_B .

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Code Development
(Theoretical Physics Unit)

Scattering Kernel for Water (C. W. Lindenmeier and A. G. Gibbs)

Codes for generating scattering kernels for water from a spectral function composed of a sum of gaussians currently appear to operate properly. Since such a technique requires numerically performing a double integration, two separate approaches depending on which integration is performed first were investigated. Both approaches are feasible and produce results that agree within the expected numerical accuracy of the codes. Experimental data are being collected to fit the parameters required in the spectral function. When this is complete, scattering kernels will be generated for reactor analysis use.

BNW Master Cross Section Library (K. B. Stewart)

All of the isotopes that have been modified or added to the BNW Master Library since it was published in 1965 (BNWL-CC-325) have been printed on duplimat paper and will be published shortly as a supplement.

ENDF/B Neutron Cross Section Library (K. B. Stewart)

Several important isotopes used in reactor physics calculations were listed as containing serious but easily correctable errors. These errors have been corrected and the production of cross section libraries for THERMOS, HAMMER, and MC² has been attempted. Several of the processing codes contain errors that prevent the use of the ENDF/B Library until the processing codes can be successfully debugged.

Programs GAND, GAF, and GAR (K. B. Stewart)

The General Atomics computer codes GAND, GAF, and GAR have been received and are being converted for use at BNW.

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additions of Zr, Mo, Nb, Al, Si, Fe, P, and C. The postirradiation annealing was done at 625, 725, and 800°C on declad wafers of the rods to obtain more information on the influence of alloying and preirradiation heat treatment on uranium volume changes in the temperature ranges where fission gas swelling occurs. Density measurements were obtained before and after annealing the samples.

Pre-anneal density measurements showed general agreement with "R"* values calculated previously from bulk volume measurements of each fuel element. Where there is a difference, the density measurements on declad wafer samples give a lower "R" value than the bulk fuel element volume.

The "R" values calculated from density measurements made after the postirradiation annealing still require further analysis but some interesting results are apparent at this time.

Certain alloys containing silicon, namely U + 850 ppm Si, U + 500 ppm Mo + 350 ppm Si + 455 C, and U + 313 ppm Si + 962 ppm Al + 525 ppm C, showed much less swelling during postirradiation annealing at temperatures up to 800 C than did any of the other alloys. The U + Si, and U + Si-Al-C were irradiated in the β heat treated condition and the U + Mo-Si-C was irradiated in the $\beta + \alpha$ heat treated condition. These alloys had shown better than average resistance to swelling in the original irradiation testing. These alloy specimens need more study to determine the relationships of composition, heat treatment and good swelling resistance. Specimens from two others of the alloys, U + 1050 ppm Fe + 890 Al + 471 C irradiated in the ρ , $\rho + \alpha$, and δ heat treated conditions, and U + 390 ppm Fe + 800 Al + 400 C irradiated in the β , $\beta + \alpha$, and δ heat treated conditions showed low increases in "R" values after postirradiation annealing at 625 and 725°C. The "R" values jumped to much larger values when postirradiation

$$* R = \frac{\rho_{\text{initial}} - \rho_{\text{final}}}{\rho_{\text{final}}} \times 100 \times \frac{1}{\text{at.\% BU}} = \% \Delta V/\text{at.\% BU}$$

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indicating that the forging operation homogenized the buttons as well as eliminating porosity. Hopefully this will be confirmed metallographically and by X-ray diffraction. All button material will be held for use in studies to be conducted at a later date.

Fabrication of duplex aluminum tubing was completed in June. The tubing will be evaluated in the hot die sizing process. The tubing consists of 40 mils AlSi composition with 15 mils of X-8001 composition on the external side. The tubing meets the dimensional specifications for KVE tube cladding. An excellent bond was achieved between the X-8001 and the AlSi at all positions along each tube. About 14 feet of tubing was produced. Enough castings are available to make another 50 feet if the original 14 feet perform well in the hot die sizing process.

A specially prepared sample of a hot die size bond was subjected to electron microprobe analysis. It was hoped that some new information about the bond structure would be gained. However, compound layers of less than two microns thickness were not detectable, even with an electron beam size of about one micron. Layers greater than two microns width were detected but their composition could not be accurately determined. The microprobe study did indicate the total diffusion width.

Development of Coatings for AlSi and HDS Fuels
(R. V. Bowersock, Fabrication Development Unit)

Methods of providing a corrosion resistant external surface on aluminum clad fuels have been under investigation. The major areas under investigation were (1) the evaluation of spray coatings, (2) coating of both HDS and AlSi process components with zirconium by vapor deposition, and (3) the fabrication of Zircaloy-2 sleeved components. Progress made in each of these areas is summarized below.

Thin coatings (3-6 mil) of nickel aluminide (Metco process No. 405) and of AlSi eutectic were applied to X-8001 aluminum dummy elements by standard metallizing wire techniques. It

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zirconium coating was evident in the specimens heated to 500°C; however, no spalling of the coating was observed. No visible diffusion was noted for the specimen heated to 400°C; however, the coating appears to be bonded which is not the case for the as-coated specimens. These observations are in agreement with data obtained from Zircaloy-2 X-8001 aluminum sandwich specimens tested under the same conditions. The diffusion layer formed at 600°C was 1.6 mils thick whereas at 400°C the coupons were adherent to each other but the bond layer could not be resolved at 500X magnification.

In early stages of a study of the use of Zircaloy-2 sleeves, five to six mil Zircaloy-2 foil was fabricated by hot rolling 15 mil sheet sandwiched between 304 stainless steel. This material was to be formed into thin wall tubing by electron beam seam welding. Jigging required for welding was designed and fabricated. However, required maintenance associated with the welding chamber has prevented the completion of this phase of the work. Further work has been deferred.

Aluminum Alloys

(J. C. Tverberg, Primary Fabrication Unit)

The presence of a nonuniform distribution of the second phase of the Al-Fe-Ni alloys under evaluation for resistance to ledge and groove corrosion has necessitated the fabrication of a direct chill casting apparatus. This device will permit the molten aluminum to be directly cast into a chill mold, then the ingot is to be withdrawn into a water spray while the center is still molten. This should result in uniformly quenching the second phase into the structure, thus avoiding the large intermetallic particles along the grain boundaries. The first castings made on the apparatus indicate several design changes are necessary. These changes include a better means of withdrawal of the ingot to prevent rough surfaces, a higher rate of heat removal, and a means to control the pouring rate. The pour-rate control will be with a graphite cone mounted into an inverted conical pour basin. As soon as the casting variables are determined, the candidate alloys will be remelted and direct chill cast into extrusion billets.

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This $1/v$ mass of copper was used to determine the thermal utilization of the cell poisoned to unit multiplication, f' :

$$f' = \frac{\sum_i (\text{Abs})_{\text{fuel}}}{\sum_i (\text{Abs})_i + (\text{Abs})_{\text{poison}}} .$$

The infinite medium neutron multiplication constant, k , is defined as the ratio of the thermal utilization of the unpoisoned cell divided by the thermal utilization of the poisoned cell:

$$k_{\infty} = \frac{f}{f'} .$$

Experimental results for the wet supercell and the dry supercell are tabulated below:

Lattice	Condition	Mo	$M_{1/v}$	f	f'	k_{∞}
6x6	wet	65±15	67.44±15.56	0.5698±0.0005	0.5678±0.0005	1.0035±0.0008
5x5	wet	2 ⁶⁰ ₃₇	2.07 ^{62.25} _{38.39}	0.5698±0.0005	0.5698 ^{0.0019} _{0.0011}	1.0001 ^{0.0033} _{0.0020}
6x6	dry	-26±28	-27.32±29.42	0.5705±0.0005	0.5715±0.0010	0.9984±0.0018
5x5	dry	-237±13	-249.01±13.66	0.5705±0.0005	0.5792±0.0005	0.9850±0.0008

Differences in the values between the 5x5 and the 6x6 loadings are believed to be partly due to end effects in the PCTR supercell measurements. A three dimensional calculation to evaluate a correction for this effect is in progress.

Separate Large Bismuth Target PCTR Experiment
(A. D. Vaughn, Heavy Moderator Reactor Physics Unit)

The experimental measurements with the dry lattice of bismuth overbore target and 0.95 wt% enriched uranium fuel (3/2 fuel-to-target ratio) were completed. The measurements with the lattice cells containing coolant are being made.

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THERMAL LATTICE PARAMETER VARIATION WITH GRAPHITE WATER CONTENT

<u>Lattice Parameter</u>	<u>Dry</u>	<u>50 ppm</u>	<u>100 ppm</u>
$\overline{nf}$	1.5532	1.5488	1.54444
f	9.0334-1	9.0069-1	8.9804-1
$\overline{n}$	1.7194	1.7196	1.7197
$\delta N^{(a)}$	2.8270	2.8408	2.8540
$\delta \phi^{(b)}$	2.3904	2.3992	2.4078
$\overline{v\Sigma_f}$	6.7411-3	6.7333-3	6.7255-3
$\overline{\Sigma_a}$	4.3401-3	4.3474-3	4.3548-3

- (a) thermal neutron density disadvantage factor
(b) thermal neutron flux disadvantage factor

The actual graphite water content is somewhere between 50 and 100 ppm and the variation due to humidity changes during a PCTR experiment should not exceed 10%. This conformation coupled with the results in the table above for a typical lattice lead to the conclusion that humidity variations during a PCTR experiment will cause negligible perturbations to measured thermal lattice parameters.

Mission 8 - Nuclear Safety

Response of Hanford Reactor Systems to Seismic Excitation
(F. R. Vollert, Engineering Materials & Mechanics Section)

Working in concert with Earth Sciences, this program is intended to establish the transfer function between seismic disturbances in the basalt bedrock, the glacio-fluviatile deposits on which facilities are built, and the reactor structures. Also, the dynamic response of existing reactor structures will be obtained by analysis of artificially or naturally excited vibrations.

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On the basis of laboratory studies, the water treatment conditions were restored to pH 6.6 and zero zeta potential and 1 ppm activated SiO₂, aged only 1.7% of gel time, was applied. A continuing decrease in effluent As⁷⁶ concentration has been observed since initiation of this treatment.

Process Technology

Be-Zr Braze Alloy Process Development (J. C. Tverberg, Primary Fabrication Unit)

A program was started with the objective of producing outer tube braze rings with improved control of the contamination from the atmosphere, melting environment and raw materials. To accomplish this goal, vacuum consumable arc melting is being used. The raw materials were compacted on a 700-ton press into octagonal sponge bars which are welded into an electrode bar. Primary melting of the electrodes resulted in ingots of excellent quality. These ingots will be remelted in the skull furnace and cast into a tube which will be parted into braze rings. The major advantages of the vacuum consumable arc melting process are:

1. A purifying effect during the primary melt in that volatile impurities are removed by the high arc temperature and reduced pressure.
2. There is no contamination from a melting crucible as the freezing melt makes its own crucible and mold.
3. Because the leak rate of the furnace is carefully controlled and the pressure is so low, very little atmosphere contamination will result.
4. The raw materials were selected to provide the highest available purity. Thus the impurities introduced through the raw materials are held to an absolute minimum.

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of the catalyst and the sodium sulfite into the cross-tie line water will effectively scavenge the oxygen in the water. Testing showed that adequate scavenging is obtained independent of which material is injected first and is also obtained if the materials are mixed and then injected.

Corrosion in Single-Pass Decontaminating Solutions

(A. P. Larrick, Water Reactor Corrosion and Chemistry Unit)

BNW and N-Reactor personnel cooperated on in-reactor single-pass decontamination tests with inhibited phosphoric acid solutions. BNW is monitoring and evaluating corrosion during the tests. Data are currently being evaluated for a 14-tube decontamination test conducted this month. Visual examination of the corrosion samples revealed only minute localized corrosion adjacent to welds. Uniform corrosion was minor.

Thermal Mapping

(J. R. Eliason, Geochemical and Geophysical Research Unit)

The Columbia River Model at the Albrook Hydraulic Laboratory at Pullman was scanned with infrared sensing equipment while it was being operated at the same flow conditions as existed in the Columbia River during the infrared overflight made in September, 1966. The data are presently being evaluated. Initial results indicate that this technique will be extremely useful for evaluating thermal patterns in models.

Several techniques for presenting and evaluating infrared scanning data are being evaluated in conjunction with the Systems Analysis and Simulation Unit. The possibility of displaying the intensity levels as different colors is being examined using a modified color television set for the display unit. Optical resolution comparable to the black and white displays has been obtained. The color display appears to have several advantages over black and white in that intensity variations can be discriminated which are not detectable in the black and white displays. The color display unit being used is limiting the evaluation of the color systems potential because of problems encountered in modifying the television system.

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ASSISTANCE TO ISOCHEM

Summary

Mission 1

Work is nearly complete on the development of new specifications for Porex (NPH) diluent. Further studies were made of the use of advanced analytical techniques for characterization of NPH.

It has been found that the extractability of the rate-accelerating material obtained from the aci-form of 1-nitropropane is not as high as was indicated in last month's report.

Laboratory studies of possible new techniques for the determination of Np and Pu in Purex HAW were started.

The whole-cell and whole-tissue extraction was made by

ing 65 wt% HNO₃ or equivalent composed of 304-L stainless steel containing 1.3 wt% Ni base metal welded with 308-L welding wire.

Stress cracking occurred in mild steel (ASTM, A-7) weldments exposed for seven weeks to 500 nano₃ solution at about 100°C. The cracks were not methodically

The first series of tests was completed on Polyox, a friction reducing agent (FRA). The friction reduction capability of the material was less than claimed in the literature. A literature search indicates that mechanical agitation will reduce the friction reducing capabilities of FRA. Mechanical degradation of FRA will be evaluated in the next series of tests.

A developed high resolution, solid state detector measurement system is being used to investigate X-ray and gamma spectra from CCW, CAW, and ICW liquid samples.

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Laboratory support of the 234-5 americium recovery process was continued, with investigation of the effect of varying fluoride ion concentrations.

Studies are being made of the use of wet oxidation, with and without γ -radiation, for the destruction of TBP and NPH.

The feasibility of recycling Purex process condensates is being studied with the goal of reducing the amount of activity discharged to underground cribs. As part of this study, pulse column runs are being made in the 324 Building Demonstration Unit to determine the effect, if any, of using condensate from the uranium product concentrators as make-up water for the stripping solutions used in the immediately preceding 1C and 2E columns. The first condensate tested was 2UD, the condensate from the 2DU concentrator. Although pilot plant runs are still in progress, the results with the condensate used as 2EX appear comparable to the performance obtained with demineralized water with respect to dispersion, flooding characteristics, and transfer characteristics.

The 103-A reactor test stand for simulating underground in-tank circulation was operated with a center circulator with 15 combinations of tank diameter and circulator diameter.

An interim report is being written on the performance of the gamma scanner investigation of 103-A tank. The data do not indicate any hot spots in the tank.

Research on the use of a type 626 G-M tube with respect to saturation level indicates that this tube is an attractive candidate for use in lateral surveys.

The second pH flow cell system is being checked for stability and drift in a nonradioactive environment prior to exposing the system to a radiation source of about 1.6×10^6 R/hr. A prototype flow cell is being prepared for plant tests.

Coefficients for a regression equation for strontium absorption were determined by laboratory experimentation. Research

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and a fibrous filter analyzer. The particle size was on the order of several microns, a size larger than previously anticipated.

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-50-

ASSISTANCE TO ISOCHEM

Mission 1 - Basic Production Mission

Purex Diluent Studies

(M. L. Ravenscroft, E. C. Martin and D. Meier, Heavy Element Chemistry Unit)

Work on revision of specifications to permit open purchase of NPH is nearly complete. In addition to slight revisions for viscosity, density and flash point specifications, new or modified tests were developed for quality control on composition and extraction behavior. Aromatic content will be determined by UV absorption as opposed to the conventional chemical tests. The test conditions will need to wait on better identification of "typical" aromatics present since the extinction coefficient varies over an order of magnitude but approximately 0.2 wt% aromatics will produce an optical absorption of 0.7 (at 240-290 mμ) in a 0.1 cm cell using a dilution of 1:4 with isooctane or methyl cyclohexane. Olefins will be determined by infrared absorption as described in a previous progress report. Surfactants will be determined by measuring the interfacial tension against 0.1M NaOH. This specification can be relaxed if the test shows that the surfactant is removed by the normal solvent washing procedure.

Refined calculations of olefin production by irradiation indicate a G value of 1.0 for total olefin and suggest that the olefin production per cycle in the Purex Plant will be negligible, approximately five micro-moles per liter.

Current work is concerned with the test for alcohols and with gas chromatography, infrared and nuclear magnetic resonance identification of the non-paraffin constituents. Separation of the latter by silica gel chromatography and further separation of the residue by preparative gas chromatography has produced four fractions which are different from each other chemically and can now be identified at least as to basic structure and functional groups.

Fundamental Mass Transfer Studies

(P. C. Owzarski, Engineering Analysis Unit)

The first continuous run of single drop extraction (formation and withdrawal of the drop) was made. UNH (0.068M) was transferred from the organic drop to water at room temperature. Pumping frequencies ranged from 2 to 0.5 cps. Schlieren photographs showed high density streamers falling from the drop and the drop vibrated while forming. Installation of a recently received pump is expected to produce a smoother pumping cycle so that conclusions regarding presence of interfacial turbulence can be made.

Analytical procedures using the Beckman Model spectrometer were worked out for both aqueous and organic phases.

To get true interfacial concentrations optically when interfacial turbulence does not occur, either a simple one-dimensional concentration gradient or a plane of symmetry must be assured. Later interferometry would be applicable here.

Corrosion of Boron-Bearing 304-L Stainless Steel

(R. F. Maness, Materials and Process Chemistry Unit)

The corrosion resistance of weldments prepared from 1/2 in. thick 304L bar stock containing 1.3 wt.% boron and 308L filler metal were evaluated in boiling 65 wt.% nitric acid solution. Severe knife-line attack occurred in all cases. Incomplete tests indicate much less preferential attack in boiling 50 wt.% nitric acid. Similar weldments prepared via metal inert gas welding utilizing high silicon 308L rod were also evaluated in boiling 65 wt.% nitric acid. Preferential weld metal attack resulting from voids present in the weld metal as well as knife-line attack occurred.

Stress Corrosion Cracking of Mild Steel

(R. F. Maness, Materials and Process Chemistry Unit)

Three mild steel weldments (ASTM, A-7) with restrained seam welds were exposed to 50 wt.% sodium nitrate solution at

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schedule 40 pipe with a pressure gauge at the entrance to and exit from the 10-ft section of pipe, a positive displacement flow meter, and a thermometer.

The system was calibrated with distilled water at 80°F. Tests were run with 15 different concentrations, ranging from 0.5 to 800 ppm of Polyox. The following procedure was used to check out the Polyox:

- a. Add incremental amounts of Polyox to water in the 400 gal tank while pump was running.
- b. Allow water to flow through system for 15 to 30 minutes to provide complete mixing.
- c. With a ball valve vary the flow from 5 gal/min to maximum flow (approximately 30 gal/min) in 5 gal/min increments.
- d. Measure and record flow rate, inlet pressure, outlet pressure, and temperature at each flow rate.

No increase in flow rate or decrease in pressure drop was achieved until 60 ppm had been added to the water. Changes in differential pressure are supposed to be attained with as little as 1 ppm. At 600 ppm Polyox the maximum flow rate for the system was 30.5 gal/min at a differential pressure of 23 psi. The maximum flow rate for the distilled water was 28 gal/min at a differential pressure of 26.5 psi. The effect of the friction reducing agent was much less than claimed in the literature.

A literature search was started after the initial tests were run. Two articles indicate that the friction reducing capabilities of materials such as Polyox are reduced by harsh mechanical mixing of the solution as would take place in a centrifugal pump. A second series of tests will be run to evaluate the friction reducing capability of Polyox as a function of the time it is in the water going through the centrifugal pump.

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treated first with water to dissolve the NaOH and then with HNO_3 to dissolve the bismuth; under these conditions generally 15 to 20% of the Po^{210} was not accounted for even after acidification of the NaOH solution. This difficulty has been resolved by dissolving the NaOH portion in hydroxyacetic acid rather than in water; under these conditions the polonium material balance is typically about 94%.

A statistically designed experiment is in progress with the present batch equipment to determine the effects and possible interactions of the three main process variables--contact time, contact temperature, and ratio of NaOH to bismuth. This experiment is about half complete and is proceeding without difficulty. It is anticipated that the information gained will be useful in establishing optimum operating parameter values in counter-current systems.

The feasibility of DBBP solvent extraction for recovery of Po^{210} from acidified (HNO_3) NaOH phase was demonstrated. In this case, a 2-gram piece of irradiated bismuth was contacted 30 minutes at 500°C with 8 grams of NaOH. The resulting NaOH was dissolved in water and, from the resulting water solution, a PAFS solution of the composition $2.9\text{M } \text{HNO}_3$ - $2.5\text{M } \text{NaNO}_3$ containing about 10^{11} d/m/l Po^{210} was prepared. This solution was contacted (10 minutes, 25°C , A/O = 1.25) with the proposed extractant, 30% DBBP in NPH. The $\text{Po } E_a^0$ was 1.2, a value high enough to permit countercurrent extraction recovery and in reasonable agreement with that expected from earlier work.

Solvent Extraction Purification of Bismuth

(W. W. Schulz, Materials and Process Chemistry Unit)

A dibutyl carbitol (DBC) solvent extraction process for recovering Po^{210} from HNO_3 solutions of irradiated bismuth was developed previously. Recycle of the bismuth fraction is necessary for economic reasons. To avoid excessive radiation exposure during bismuth recycle and fabrication operations it may be necessary to remove troublesome radioactive impurities such as neutron activated stainless steel corrosion products. One way of removing such impurities is by solvent extraction purification of the bismuth fraction prior to precipitation of

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Apparatus for the determination of the entrainment of plutonium compounds during evaporation of solutions was assembled and initial trial runs performed using uranyl nitrate solutions. The total amount of uranium carried away from the evaporating solution with an air sweep of 100 cm/sec ranged from $(3-20) \times 10^{-5}$ of that initially present in the solution. Only a small fraction of this was carried through the vessel to the condenser and filter downstream.

Procedures were developed to safely perform similar experiments with plutonium nitrate. Samples of the dried salt so prepared will be subject to heating tests to evaluate the release rate.

Nuclear Safety Orientation

(C. L. Brown, Critical Mass Physics Section)

A 9-hour Nuclear Safety Orientation Course was held for 28 technical graduates and college summer employees. Six 1½ hour classes were held over a two-week period. The course included discussions of factors that affect criticality, the critical parameters for uranium and plutonium, the principles of safety, and the potential consequences of a criticality accident.

Criticality of Solutions in Matrixes of Fixed Poisons

(R. C. Lloyd, Critical Mass Physics Section)

Plans are proceeding in connection with experiments for determining the critical concentrations of plutonium solutions in large cylindrical vessels 18 to 30 in. diam and 42 in. long containing borosilicate glass Raschig rings or borated stainless steel. Off-site fabrication has begun on the requisite vessels, with the first of six vessels expected to be complete during August.

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The experiment was carried out with 50 gal/ton Purex waste. NTA, tartaric acid, hydroxyacetic acid, and sodium hydroxide were added to give the following molar compositions:

	<u>Run I</u>	<u>Run II</u>
NTA	0.26	0.36
Tartrate	0.025	0.025
Hydroxyacetate	0.20	0.20
pH	~4.5	~4.5

At this point, the Sr and rare earths from the solids leaching were added and the pH readjusted to 4.5. This was extracted with an equal volume of NPH containing 0.4M D2EHPA and 0.3M TBP. Contact time was five minutes.

The results are:

	<u>Distribution E_a^O</u>		<u>Material Balance %</u>	
	<u>Sr</u>	<u>Ce</u>	<u>Sr</u>	<u>Ce</u>
Run I	2.4	23	91	101
Run II	2.4	29	103	97.8

The distribution ratios for cerium are quite adequate but those for strontium are somewhat marginal for satisfactory plant operation.

234-5 Waste Treatment and Americium Recovery

(L. A. Bray and L. M. Butcher, Fission Product Chemistry Unit)

Support of the 234-5 americium recovery and waste processing activities continued. Details were communicated to the customer. It was found that variable concentrations of fluoride ion in the plant streams are probably the explanation for previously puzzling discrepancies between plant and laboratory behavior. Plutonium extraction coefficients were decreased by F^- whereas those of americium were not.

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in the 2E Column is between 80 and 90 cycles/min at a 1 in. pulse amplitude over the volume velocity range of 880 to 1120 gal/hr-ft². Attempts to run at the design flowsheet A/O ratio of 0.91 were only moderately successful because of a tendency for process upsets or poor interface control to cause wide variations in the uranium profile. This behavior was attributed to the close approach to an operating diagram "pinch." Subsequent runs with the A/O increased to 1.0 were much less sensitive to operating variables.

B-Plant Evaporator Studies

(W. J. Van Slyke, Engineering Development Unit)

Studies were made to modify the pilot evaporator to evaluate the use of dip tubes lined with a nonwetting material as an aid in minimizing tube plugging for the B-Plant evaporator. The evaporator was also converted to permit continuous operation. Design work is well under way for a steam-tube side bundle to evaluate the arrangement of the B-Plant titanium bundles which will be in their evaporator at startup.

B-Plant Solvent Quality

(W. W. Schulz, Materials and Process Chemistry Unit)

A cyclic irradiation test is under way to determine the effects on physical and chemical properties of a D2EHPA-TBP-NPH solvent of (a) periodic washing with dilute Na₂CO₃ to remove accumulated M2EHPA and (b) periodic addition of virgin D2EHPA and TBP. In this experiment the D2EHPA extractant is irradiated while in intimate (stirred) contact with a sequence of aqueous solutions so as to simulate a solvent cycle in the current B-plant flowsheet for processing PAW solution. Irradiation times are chosen to approximate the solvent radiation dose expected in plant operation. To date only the first three cycles of irradiation have been completed. In agreement with previous results, very little D2EHPA was destroyed in the first three cycles; nevertheless, the strontium extraction capacity of the extractant decreased about 20%. Gratifyingly, however, a single wash of the irradiated solvent with a dilute Na₂CO₃ solution completely restored the strontium extraction capacity. Further

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level changes over a wide range. The high temperature rating for this tube (300°C) makes it an attractive candidate for use in lateral surveys.

Radiation Effects on pH Sensing

(R. D. Dierks, Process Systems Development Unit)

As reported earlier, the irradiation of an operating pH flow cell system was terminated due to the failure of one of the electrodes. The total irradiation received by the electrode assembly was estimated at 4.4×10^8 R, received at a rate of about 6×10^5 R/hr. Another similar system was assembled to continue the observation of the effects of radiation on pH measurement. The system is currently being checked for stability and drift in a nonradioactive environment. Following this initial referencing, the unit will be exposed to a radiation source at about 1.6×10^6 R/hr.

A prototype flow cell was received from the Technical Shops and is being prepared for a series of plant tests.

Soil Chemistry

(B. F. Hajek, Water and Wastewater Research Unit)

The previously reported regression equation for strontium sorption on soil from a simulated 340 Building waste (pH 8) was evaluated for three additional solutions. These experiments were conducted to evaluate the use of this equation for solutions at high pH levels and with competing ion concentrations different from those used to establish regression equation coefficients. The data showed that at pH levels greater than 10 the predicted K_d multiplied by 10 satisfactorily predicts experimental results. The predicted K_d 's also were satisfactory for trace strontium adsorption from multi-cation solutions containing 100 ppm Na, 6 ppm K, 20 ppm Ca, 10 ppm Mg (solution 1) and 50 ppm Na, 20 ppm K, 30 ppm Ca, 20 ppm Mg (solution 2). The predicted K_d 's were 40.0 and 24.8, respectively, the experimental K_d 's were 38.7 and 24.7.

The pH, calcium and sodium ion concentration, K_d and conductivity of twenty actual wastes samples were determined.

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Organic Waste Disposal

(K. C. Knoll, Water and Wastewater Research Unit)

Hydroxyacetic acid waste from 234-5 processes is partially neutralized with Na_2CO_3 to a pH of 3.5-4.0 before release to ground. It was reported last month that hydroxyacetic acid would easily remove radionuclides from the soil. This month partially neutralized acid was examined once again. Results from the two acids were similar, the 0.25M hydroxyacetic acid with a pH of 3.8 easily removed from the soil the previously deposited Pu^{239} , Am^{241} and Sr^{85} but very little Cs^{137} .

The fact that the soil could take up some of these isotopes from the hydroxyacetic acid if the spiked acid was put through the soil is unexplained at this time. This system involves two ion-exchangers and their interactions are not predictable.

Process Technology

Np-Pu²³⁸ Processing

(T. S. Soine, Chemical Separations Unit)

Most of the analytical results for the C-Cell reprocessing of the N-Reactor Np-Al targets have been received and a material balance picture was developed. For the entire campaign, the neptunium charged into the over-all cycle was measured as 4832 grams. Based on dissolver solution analyses, neptunium, plutonium and fission products received were equivalent to 4916 grams of original neptunium, a BPID of +84 grams. Of the 4302 grams of neptunium and 501 grams of plutonium-238 found in the dissolver solutions, 72 grams Np and 30 grams Pu were measured discards to process wastes. The BPID across the C-Cell process was -160 grams Np and -6.4 grams Pu^{238} . The BPID's represent analytical errors and/or unaccounted-for process losses. They will be subjected to further investigation.

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and a fibrous filter analyzer. The particle size indicated by the cascade impactor and the fibrous filter analyzer was on the order of several microns, a size larger than previously anticipated. This relatively large size has made it impracticable to use the fibrous filter analyzer in this study.

In addition to isothermal withdrawal, cascade impactor samples were withdrawn under conditions which would favor either condensation of water on the suspended particles or evaporation of the suspended drops. This was done by maintaining the air temperature within a surrounding shroud either hotter or cooler than the stream temperature of 97°C. A comparison of the indicated particle sizes for these tests with the size indicated for withdrawal at 97°C should allow the influence of sampler temperature on particle size to be assessed. Numerical interpretation of these tests await receipt of radiochemical analyses.

The particle loading will be approximated by analyzing the sodium leached from membrane filter samples. The mass loading will be calculated on the basis of an estimate of the solids concentration of the drops at the sampling point.

ITS Condensate Studies

(L. L. Ames, Water and Wastewater Research Unit)

Four 10 cc AW 500 columns were fabricated and loading to one percent breakthrough was begun. Approximately 50 liters of ITS condensate would have been required to load each column. Algal or bacterial growth in the tops of the columns occurred, leading to excessive back pressures after about three-fourths of the waste volume passed through, or about ten days of continuous loading had passed. These columns were of little value for elution studies, so the refiltered condensate was made 0.2 N NaNO_3 to cut down loading time and column fouling. About 12.5 liters or four days were required for AW 500 loading. Elution characteristics will not be changed appreciably by the addition of the NaNO_3 . Four additional columns will be loaded and a small factorial experiment concerned with temperature, flow rate and eluting cation concentration effects on cesium elution will be designed.

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TECHNICAL ASSISTANCE TO THE HANFORD PLANTSummaryEnvironmental Evaluations

Oil reaching the Columbia River from a leaking pipeline at 100-N was detected in concentrations up to 0.2 ppm in raw water samples obtained from downstream areas.

A permanent calibration grid for aerial survey equipment was marked off west of the 100-B Area. Aerial surveys indicated magnesium and sodium peaks over the Columbia River.

A fuel element rupture in the KW Reactor gave a larger than normal release of fission products to the Columbia River, resulting in I^{131} concentrations at Richland ranging up to 100 pCi/l.

A scavenging process for reducing radionuclide concentrations in 340 Building wastes was successfully demonstrated on a 10,000 gallon batch at the 340 Building. Based on experimental results, no problems were anticipated in supernate sludge disposal at Ischem facilities.

Dosimetry Studies

A study was completed and recommendations made regarding the feasibility of pursuing the three-filter neutron activation dosimeter concept. Development work on a portable neutron survey instrument continued as did studies on the performance of possibilities of thermoluminescent and glass materials in dosimetry work.

Instrumentation

Achievement of correct operation of the advanced laundry monitoring system continued and drawings and the technical report are being prepared.

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-71-

TECHNICAL ASSISTANCE TO THE HANFORD PLANT

Environmental Evaluations

(J. F. Honstead, Environmental Studies Section)

Oil Contamination in Columbia River at 100-N

Samples of oil from the 100-N storage tank and from the shoreline catch basin were examined for solubility in river water. The sample taken from the catch basin which had seeped through the soil was found to be approximately twice as soluble in water as that taken directly from the storage tank. Oil concentrations of between 0.1 and 0.2 ppm were detected in samples of raw river water obtained from 181-D and 181-F.

Aerial Survey

A permanent calibration grid for calibrating aerial survey equipment was surveyed and marked west of the 100-D Area. About 400 Cs¹³⁷ sources will be used on the grid to permit instrument calibration. Results from aerial surveys over the Columbia River with existing equipment show distinct energy peaks which can be related to the presence of Mn⁵⁶ and Na²⁴. The results indicate a sevenfold difference in the Mn⁵⁶ measured in the vicinity of the reactor area and that from the Kennewick-Richland stretch of the river.

Environmental Evaluation

Recent whole body counting of DUN personnel assigned to the 100-N Area showed body burdens of several radionuclides of reactor effluent origin at levels somewhat higher than those normally measured in Tri-City residents. The source is believed to be drinking water containing traces of 100-B and 100-K effluent. The values obtained are generally less than 1% of the maximum permissible body burdens for occupational exposure and therefore do not contribute a great deal to the overall radiation dose assessments of these employees. Routine measurement of radioactive materials in air, raw water and drinking water were scheduled to assist with the

A 10,000 gallon batch test of the scavenging process was carried out in one of the neutralization tanks in the 340 Building. No operational difficulties were encountered in this test and the sludge behaved in much the same manner as in the 500 gallon experiments. At the beginning of pumping, sludge was withdrawn for the first 20-30 seconds and the effluent then became clear and remained so until the tank was pumped down to between 400-500 gallons. The initial sludge withdrawal and the final 400-500 gallons were routed to a tank trailer designated for this purpose. Supernatant liquid which composed the remaining 95% was loaded on two other tank trailers. Sludge from the test went to tank storage and the supernate to crib disposal.

Analyses of the results of this test are still under way. The scavenging process shows great promise as an interim waste treatment measure in the 340 Building.

Personnel Dosimetry

(H. V. Larson, Personnel Dosimetry Section)

There were 520 bioassay samples submitted for plutonium analysis during the month, including 59 from new employees who had either previously worked with plutonium or who were assigned to work with plutonium in their assignment at Hanford. There was no new plutonium deposition case confirmed by evaluation of bioassay data. Also, 169 samples were submitted for uranium analysis, 184 for tritium analysis, and 5 for strontium analysis.

Special external exposure evaluations were performed for 41 Hanford contractor employees; however, no exposure over permissible limits was revealed.

Special occupational exposure summaries were prepared in response to requests from new employers of 15 former Hanford employees, under provision of AEC regulation 10 CFR 20 and AEC Manual Chapter 0524.

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badge would be useful primarily in areas where the neutron energy spectrum is well known.

Thermoluminescent Dosimeter

The thermoluminescent dosimetry program continued this month with the modification of the instrument to increase the sensitivity and reliability. New phototube and integrator units were installed as well as a new digital voltmeter. Another set of glass-TLD dosimeters exposed at various locations in the environs was returned to be read out. This study has shown the superior performance of glass and TLD for use in long-term exposure measurements.

Portable Neutron Survey Instrument

The program to develop a neutron-gamma survey instrument continued with a checkout of the amplifier after troubles with the power supply. Measurements using the PuF_4 and PuBe sources are planned as soon as the new "canned" proportional counter is working with the amplifier.

Internal Dosimetry

The expected urinary excretion of plutonium from chronic injection or inhalation of plutonium oxide or nitrate aerosols was developed. The equations developed were sent to Computer Sciences Corp. for calculation of results for the complete range of aerosol sizes and for other parameters.

A patient who had a complete thyroidectomy was measured in a shadow shield whole body counter after being given $100/\mu\text{Ci}$ of I^{131} . The distribution and retention of iodine in a person having no thyroid is not well known.

By using a slit collimator in a linear scan, the areas containing most of the activity 24 hours after ingestion were found to be the salivary glands, stomach, and bladder. At 96 hours, a scan showed the highest peak of activity in the area normally occupied by the thyroid. By use of a collimated

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Biological Services
(H. A. Kornberg, Biology Department)

The dead eggs in each of the 35 lots of young chinook salmon reared under different increments above the base Columbia River temperatures (Priest Rapids) were examined. The eggs were divided into four stages. Stage 1 included infertile eggs and eggs in which embryo development was not definite. Stage 2 included developing embryo up to but not including the eyed stage. Stage 3 included eyed embryos where the length of the embryo was less than half the egg circumference. Stage 4 included embryos whose length was equal to or more than half the egg circumference.

The highest egg mortalities occurred in those lots 79°F and 711°F above the base temperature. The eggs showing the highest mortality were those in Stage 4 indicating that considerable embryo development continued before death. In the medium temperature range, egg mortality was not excessive; mortalities occurring after hatching.

Studies were initiated to determine the severity of exposure to Columnaris disease organisms experienced by young blueback salmon during migration from rearing areas to the ocean and for adults during upstream migration from the ocean to spawning grounds. Fish were sampled during downstream migration at Little Wenatchee, Okanogan, Priest Rapids, McNary, Bonneville and Astoria. Gill swabs and blood sera were obtained from each sampled fish. Plate counts were negative for the pathogen from Okanogan, downstream through the McNary sampling site. Positive gill plates were obtained from approximately 10% of the samples at Bonneville and Astoria. Low anti-columnaris titer values were found in about one-third of the fish during downstream migration. This finding suggests that residual antibodies are carried by some of these fish from columnaris exposure suffered during summer and fall of the previous year.

Adult blueback salmon were sampled during upriver migration at Astoria, Cascade Locks and McNary. A significant increase in columnaris isolates was obtained during upstream

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Instrumentation Services

Laundry Monitoring System

(E. M. Sheen, Instrumentation Section)

Proper operation of the advanced laundry monitoring system, which monitors specific types of protective clothing for alpha, beta, and gamma emitting contamination, continued with approximately 1,500 hours of satisfactory performance to date. Several minor circuitry problems, which did not impair the system effectiveness, have been corrected and no other problems appear to exist at this time. All electronic circuitry line drawings have been completed and the text of the technical report is progressing well.

Meteorological Services

(E. H. Phinney and D. E. Jenne, Atmospheric Sciences Section)

Meteorological services, viz., weather forecasts and observations and climatological services, were provided to plant operations and management on a routine basis.

JULY 1967
Forecasting

<u>Type</u>	<u>No. Made</u>	<u>% Reliability</u>
Production	93	88.6
General	62	89.9
Special	67	95.5

Number of calls processed by Code-A-Phone: 4,915

Temperatures for July averaged 2.6° above normal. Only rain of the month was a trace on the 8th.

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35 J. N. Judy

DATE

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7/21/94

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