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DIVISION OF PRODUCTION AND

HANFORD PLANT ASSISTANCE PROGRAMS

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BNWL-646

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MONTHLY ACTIVITIES REPORT
NOVEMBER 1967

Division of Production
and
Hanford Plant Assistance
Programs

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PACIFIC NORTHWEST LABORATORY

MONTHLY ACTIVITIES REPORT

DIVISION OF PRODUCTION AND HANFORD PLANT ASSISTANCE PROGRAMS

R. S. PAUL

Summary

Columbia River Studies

Calculated temperatures permitted in the Columbia River under various suggested regulations were plotted and reported in support of AEC studies.

Measurements were completed in 362 pupils. Measurements were made at the elementary school on December 5. Lectures were given at the high school to the teaching staff on November 10, and to 13 classrooms on November 27 through December 1. A lecture was also given to the PTA meeting. The evening of November 20 at Robert Frost elementary school in Pasco.

Measurements were made on the equipment and to the mobile whole-body counter van to improve the performance of the facility to further protect the NaI crystal from potential weather damage. Errors found in the computer-calculated environmental doses were being corrected at month's end, and the doses will be recalculated in December.

Two meetings were held with personnel of the State Department of Game to discuss their work under Contract BSA-370 in connection with our study of the influence of game bird consumption on environmental doses.

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BMT-646

DIRECT AEC SPONSORED PROGRAMS

Columbia River Studies

Columbia River Water Temperature Regulations

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

Calculations were made of the impact of several proposed temperature standards for the Columbia River adjacent to the Hanford plant in support of the AEC's efforts toward compatible regulations. Formulas suggested for the Washington State regulations included a limitation on temperature increase as a result of plant operations of fixed value throughout the year, and formulas that adjust the permitted increase according to the natural river temperatures. The effects of these proposed limitations for various selected water years were examined. Investigations included projection of the river conditions following completion of Canadian dams.

Mechanisms of Environmental Exposure

(J. F. Honstead, Environmental Studies Section)

Measurements of radioactivity in school children were completed at the second Pasco elementary school (Emerson) during November. A total of 362 children and 5 teachers were measured. Nearly 75% of the children in grades one through six participated. Lectures on the whole-body counter program were given to the teaching staff at the Mark Twain elementary school on November 20 and to 23 classrooms during the week of November 27 through December 1. Whole-body measurements will begin at this third Pasco elementary school on December 5.

An auxiliary hot-water heater, operated off the truck's cooling system, was installed in the mobile whole-body counter van in late November. The heater can be used in the event of an electrical power failure to prevent damage to the large NaI scintillation crystal during cold weather. While the truck was being serviced, several improvements in the electronics of the 1024-channel analyzer were made at the suggestion of the manufacturer using parts supplied by the factory. Included

ENTER

NOT A DRIVER TO BE USED BY UNITED STATES

During the reporting period 43 Mark IV fuel element components were measured and 57 were weighed.

A two-phase, one-dimensional heated model of the MK I fuel will be used to extend earlier thermal hydraulic data to higher pressures, flow rates and inlet temperatures. The

1. The effect of the boiling turbulent performance of a test section simulating the inner annulus flow channel will be made to study the effect of the "W" support as compared to a solid support. Results will be compared with data produced for a "W" test. Design is complete for the test section and materials are on hand.

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Three failed coproduct drivers continue under study. There are common aspects to these failures and they are somewhat reminiscent of Failure #4, which occurred by coolant entry through an unexplained, highly localized corrosion penetration of the clad in a clad-hardware crevice.

Mission 5

is being produced by merging two previously operating chains. Merging, allocation, and preliminary debugging is complete except for the servicing routines related to burnup.

The computer code, LIBCON, which converts the BNW Master Cross Section Library data into the ENDF/B form is seventy-five percent complete.

may be released and may be used for any purpose without restriction. The reactor is designed for loading and unloading of fuel elements in the central rows of the core. The same design is used for both lead-

Alloys that are to be evaluated by the spray casting process have been made by the water spray technique. Although the water spray technique is not optimum, satisfactory ingots were made of each alloy including the high silicon HDA alloys. Four of the ingots have been extruded into rods and two have been machined into

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Data were observed for the fission product release from a Zircaloy-2 clad Mark II fuel element heated in the laboratory to 1085 C. The percent fission product releases were as follows: Kr^{85} , 39; I^{131} , < 1.8; Cs^{137} , 0.7; Ba^{140} -La, 0.4; and Zr^{95} -Nb, 0.02.

The addition of 0.1 ppm of a polyelectrolyte successfully reduced turbidity breakthrough from columns of N-Area soil while maintaining flow through the columns.

Work is under way to better define radioisotope migration from the 1301-N crib to the Columbia River.

Mission 10

A preliminary report outlining the results of the most recent combined computer-experiment studies in the activation of As^{75} in production reactor coolant was completed. Further

work on Be-Zr brazing alloys was completed. Hardness and low oxygen and low carbon in the cast metal. Spectrographic analyses showed that the major impurity levels were far below the

specification. The casting was 0.2 to 0.3 inches thick. A small amount of zirconium was found in the casting. Further melting was temporarily halted until casting evaluation

A mock-up of a graphite oxidation monitoring channel was fabricated to test the accuracy of the computer simulation of the channel. General agreement is found between the experimental results and the calculated results with the exception

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The polyelectrolyte, Magnifloc 905N, has been found to be as effective as Magnifloc 990N as a filter bed conditioner. Further testing is recommended.

performance. The effect of the number of units on the performance of the total system is shown in Figure 1. The performance of the total system is defined as the average of the performance of the individual units. The performance of the total system is shown to be a function of the number of units. The performance of the total system is shown to be a function of the number of units. The performance of the total system is shown to be a function of the number of units.

Development effort on the portable neutron rem meter progressed with completion of the double-shell polyethylene moderator assembly and with establishment of several design features.

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The outer companion Mark I component with an exposure of 8900 MWd/T (1.03 at.% BU) will be rupture tested as soon as the IRP facility has undergone a required safety inspection.

Emergency Spray Cooling of Discharged Fuel Elements
(D. R. Dickinson, Thermal Hydraulic Analysis Unit)

Additional tests, similar to those reported earlier, were conducted to study the effectiveness of water spray in providing emergency cooling for fuel elements which do not fall into the water basin on being discharged from the reactor. A cylinder of 94-6 Cu-Ni alloy, 1.44 in. diameter and 8 in. long, was heated by an internal cartridge heater and cooled by a water spray of 0.23 in./min from a Rockwood L-11A nozzle placed 11 ft overhead.

The tests showed that the amount of cooling provided by the spray depends strongly on the degree of oxidation of the metal surface. In the previous work, the surface of the test section was only lightly oxidized, and the efficiency of utilization of the spray was near 100% at surface temperatures of 100-140°C and dropped to about 15% at temperatures above 370°C. (The efficiency is the ratio of the rate of heat removal minus the rate with no spray, to the heat required to vaporize all spray falling on the heated target.) In the first of the recent tests, the test section had a somewhat heavier oxide due to extended operation at elevated temperatures; the efficiency at surface temperatures of 360-600°C was found to be 20-23%. The surface was then more heavily oxidized by holding it for several minutes at 700°C. The efficiency of utilization was then found to be about 60% over the entire range from 120-600°C. The efficiency with a cold surface (110°C) was found to be reduced by the oxidation to 65%. All figures cited are approximate, subject to a more detailed analysis of test data.

The increased efficiency at high surface temperatures with the oxidized surface is believed to result from the thermal resistance of the oxide. This reduces the rate of heat transfer to the surface and thereby allows a water drop to quench the local surface to a temperature where it can be wetted.

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will be repeated for each mixer at various total flow rates.

Pressure drop effects of the new mixer design will not be obtained at this time. Should the mixing effectiveness factors for the new design show improvement over the standard design, typical pressure drop data for a complete fuel charge including the new mixers can be obtained easily in the laboratory at a later time.

Boiling Demand Curves for N-Reactor MK I Fuel

(D. E. Fitzsimmons, Experimental Thermal Hydraulics Unit)

The objective of this work is to extend the knowledge of the thermal and hydraulic characteristics of the MK I fuel. A reconditioned electrically heated model of the MK I fuel column will be used to extend earlier experiments to higher pressures, tube powers, flow rates and inlet temperatures. All of the inter-junction flow holes were plugged in both the inner and outer tubes of the models. New thermocouples have been installed in the inner tube. Following the installing of pressure tap lines, the inner tube will be repositioned in the outer tube and the electrical rod ends welded on. The majority of the piping modifications needed to accommodate the test section have been completed with only the field welds remaining. This work will commence when the test section is in place.

Boiling Heat Transfer Characteristics of the N-Reactor MK IV Fuel

(D. E. Fitzsimmons, Experimental Thermal Hydraulics Unit)

The purpose of this study is to experimentally determine the boiling burnout conditions for the N-Reactor MK IV fuel. Particular emphasis will be given to the effect the supports have on the burnout level. The results from these experiments will be utilized to establish process tube operating limits for the future full reactor loading of this fuel.

The hydraulic geometry of the outer annulus and the hole flow channel of the MK IV fuel is similar to the MK I geometry, consequently boiling burnout predictions for these channels will

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vibrational test which excited the support throughout the audio frequency band and treated it as a resonant structure affixed to the clad at each of the four welds. The test was successful in detecting all combinations of defective welds but in some cases the resonant frequency shifts were so minute that a more elaborate test setup would be required to achieve adequate repeatability. The geometry of the support weld area prohibits adequate ultrasonic penetration, thus prohibiting the use of ultrasonics on all but a limited combination of defective welds. Further efforts were not warranted by the quantity of fuels to be examined and a visual inspection was chosen to examine the lot.

UT-16 Test Analysis (Routine Support)

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

An extensive analysis of the difficulties which have been encountered with the UT-16 pulse-echo bond testing system was conducted. Significant impediments were defined and corrective procedures recommended. These were:

1. A change from focussed to flat-faced transducers to alleviate premature focussing of the search beam, which is incident upon a short-radius, concave surface. The suitability of convex-lens transducers for this application is being examined.
2. A narrower axial-direction test area was specified to prevent the search beam from impinging upon an internal can radius.
3. Transducer alignment and a corresponding setup procedure were established which will provide equal sensitivity to both of the unbond orientations which have been encountered.

N-Reactor Simulation

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

Over 100 runs were made with the overall N-Reactor model, simulating turbine trips at full power. This series was a continuation of efforts to match actual plant data. Some were

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barrier characteristics of the plate. In particular, the effect of pH and, to a lesser extent, the effect of agitation on the amount of silicon that was occluded in the nickel plate was studied. The experiments were made using a Watts bromide plating solution at 50°C with a current density of 120 ma/cm² and a silicon concentration of 170-225 g/l (particle size less than 10μ). Brass cylinders, 0.62 cm diameter and 4 cm long, were rotated in a vertical position between 0 and 180 rpm.

The study showed that both agitation and the pH of the nickel plating solution are extremely critical when occluding silicon in the nickel plate. In fact, silicon cannot be occluded in nickel at pH below 3.0. At pH 3 or greater, approximately 10% silicon can be occluded in the plate. Agitation also markedly affects the amount of silicon occluded. When the cathode was rotating at 60 rpm or less, large quantities of silicon could be occluded: increasing the rotation of the cathode to 180 rpm prevented the silicon from occluding in the nickel plate.

More experiments will be done to optimize agitation and current density.

Statistical Assistance

(J. L. Jaech and R. L. Buschbom, Statistics Section)

Statistical analysis to determine the relative bias and precision of the C-Basin profilometer in measuring diameters of K4N fuel elements was completed. Lenses in the profilometer were replaced, so new calibration factors for converting profilometer units to mils were calculated.

Mission 2 - Coproduct Mission

N-Reactor Fuel Failure Analyses

(J. W. Goffard, Metal Fuels Unit)

The radiometallurgical examination and evaluation of N fuel failures #39, 40 and 41 continued. The three failures have features in common, e.g., rupture occurred at the inner

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at high magnification and small patches of white surface oxide were seen. It is not known yet if the clad is pitted at these white patches. The study is being continued.

It is possible that these three failures and the previous failure #4 may be identical and will constitute a third classification of N fuel failures (the first two categories being fretting corrosion and end closure deficiencies). The aspects of driver tube high heat flux, N-Reactor high power demonstrations, locking clip and stop flow perturbation, clad-hardware crevices, retained lubricants from the final assembly step and effect of the new solid type Zr-2 target supports upon clad surface temperatures and consequent clad corrosion are being investigated.

Mission 5 - Other Isotopes

Code Development

(Theoretical Physics Section)

LIBCON - K. B. Stewart

The computer program, LIBCON, which converts the BNW Master Cross Section Library data into the ENDF/B form, is 75% complete. Still to be completed is that portion designed to calculate the floor cross sections in the resonance region and the secondary particle energy distributions for the inelastic scattering and $n-2n$ processes.

LIBCON is being written to allow the data to be punched on cards or written to tape. LIBCON will convert all of the BNW Master Library data into ENDF/B data except for the radioactive decay data and fission product information.

ENDF/B Neutron Cross Section Library - K. B. Stewart

The released version of ENDF/B is available on-site and contains all of the Category 1 (no known errors) isotopes. The released version does not contain U^{233} or the hafnium isotopes. These isotopes have only recently been completed and are available for preliminary testing purposes only.

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boron carbide (B_4C) control rods, with a center-to-center spacing of 32 by 36 inches, the same as the HCR pattern at N-Reactor. The results of these measurements are given in the table following, together with previous dry measurements for comparison.

Two loadings were measured in the assembly. The first was with a 3-1 fuel-to-target/cell ratio of sixty standard tubes of 0.947 wt% enriched metallic uranium, clad with Zircaloy-2, and twenty tubes of bismuth target material. The uranium fuel was 23.3 inch Mark I tube-in-tube NPR geometry loaded in aluminum process tubes.

Bismuth target tubes consisted of fifteen target increments giving a nominal target length of 95.5 inches. Each clad bismuth increment was 6.370 inches long by 1.436 inches in diameter. All targets were positioned centrally within the assembly on the front-to-rear axis.

The second loading contained exactly the same number of fuel and target elements but the target tubes were placed in the two central columns of the assembly and the fuel was placed in all the remaining cells. Control rod patterns were the same. Dry measurements in this loading are now being made.

Material bucklings for the assemblies containing control rods were determined by using the measured extrapolated distances λ_A , λ_B (side-to-side, front-to-rear) from those measurements for the same loading without control rods.

Where applicable, a front-to-rear traverse was taken in row 10 for each control rod measurement. Although only three positions (C , ± 32 in.) had the same flux environment, a cosine fit was made to obtain a rough comparison to the λ_B value where no control rods were present in the assembly. These values λ_B^* are shown in the table, along with previously measured values for the loading where the coolant channels were dry (air-filled).

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Mission 7 - Target Space Enhancement

Aluminum Alloys

(R. R. Studer, Fabrication Metallurgy Unit)

All alloys have been cast, using the commercial flux described previously. The heated receiver enabled the full heat to be cast each time. Water distribution spray rings are still not optimum, but by dropping the emerging billet into a reservoir of agitated water effective cooling is obtained to the extent that at the end of the cast the molten pool of metal is less than one inch deep. Four of the alloys have been primary extruded and returned to the shop for machining preparatory to final extrusion. The remainder of the alloys are in the shop for machining to billets for primary (4-inch to 3-inch diameter) extrusions. The HDA type (high silicon) alloys behave very satisfactorily in direct-chill casting, using the same chilling arrangement that proved satisfactory for leaner alloys. The fear that the less ductile material would be cracked by the drastic chill proved groundless. Pouring temperature for the AlSi type alloys was maintained at approximately 700°C to prevent premature nucleation and growth of AlSi (Fe, Ni) intermetallic compounds. Additions of alloying elements, particularly Mg, Fe, and Ni, were made to those remelt heats which the first analysis showed to be deficient. The re-analysis by DUN Spectrographic Laboratory is under way.

C-Overbore Boiling Demand Curves

(A. M. Sutey, Thermal Hydraulics Analysis Unit)

Run plans were completed for a program to experimentally determine the thermal hydraulic stability characteristics of the C Reactor overbore fuel geometry under both single and two-phase flow conditions. Results of these experiments will demonstrate the relation between pressure drop and flow at various tube power levels and will be utilized to establish process tube operating limits and trip margins.

This study will utilize a full scale prototypical electrically heated model of a C overbore fuel column including actual downstream C Reactor hardware. The C overbore fuel design consists

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Lattice Parameters of Bismuth-Uranium Supercell

<u>Lattice Condition</u>	<u>Thermal Utilization</u>	<u>k_{∞}^* (Air Atm.)</u>	<u>k_{∞}^* (Vacuum Atm.)</u>	<u>Mo^{**} (g-Cu)</u>
Wet Fuel -	0.71187	0.87767	0.87681	1182.7
Wet Target	± 0.00597	± 0.01455	± 0.014	± 154.2
Dry Fuel -	0.76703	0.95282	0.95251	569.4
Dry Target	± 0.00655	± 0.01740	± 0.017	± 155.8
Dry Fuel -	0.78332	0.95726	- - - -	488.0
Air Target	± 0.00650	± 0.01700	- - - -	± 150.0

* Corrections for end effects in the PCTR supercell measurement are still in progress.

** Mo - Mass of copper at the boundary of the fuel cell necessary to achieve unit multiplication in center test cell (i.e., 2 target; 3 fuel).

In this particular experiment the center test cell was a vertical array of fuel and target material which extended from the top of the PCTR test cavity to the bottom and therefore large end effects were experienced in measuring the reactivity of the cell. Relocating a single driver caused significant variations in the cell worth and achieving a proper flux match was a considerable problem. It was discovered that the cell worth was very sensitive to the relative amount of episcadmium neutron spectra so that this value was used as the criterion for a proper spectral match.

Therefore, the flux measurements determined from the experiment are probably of more interest than the k_{∞} measurement. Of particular interest was the enhancement of the flux in the bismuth during the best match condition. The average $1/v$ copper activity in the target material is approximately 2.5 times the activity of copper irradiated with the fuel region.

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this test. The flooded graphite lattice will be simulated with polyethylene wrapped around the process tubes and Lucite strips in the gas vents between the hole bars and filler blocks.

Computer Code Discussions

(A. D. Vaughn, Heavy Moderator Reactor Physics Unit)

The Heavy Moderator Reactor Physics Unit has participated in several meetings with the Reactor Physics Unit of DUN to discuss the use of the HAMMER and EXTERMINATOR computer codes for specific reactor problems being studied by both groups. Goals are to test the feasibility of the code to calculate results similar to experimentally derived data and to develop a code which will be useful for future supercell calculations.

Mission 8 - Nuclear Safety

Release of Fission Gases Under Reactor Accident Conditions

(A. K. Postma, Particulate and Gaseous Waste Research Unit)

A possible means for controlling the release of fission gases from the waste effluent following a reactor incident involves routing the effluent through a sealed quench tank and then to a gravel filled excavation. In the quench tank, steam would be condensed and the fission gases would be partially released to the contained gas volume. From the quench tank, the water would flow into a perforated pipe located at the bottom of a gravel filled crib and then would percolate into the soil. Any fission gases released from water in the crib would be contained within the voids in the gravel filled crib.

Initial study of this concept indicates that it may offer economic advantage compared to other control methods now under consideration. A technical study of this system will be carried out to better determine its technical and economic feasibility.

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installed on Gable Mountain on November 8. It has been functioning satisfactorily to date but the recorder has been randomly actuated by non-seismic events. We suspect that wind deflecting the tall antenna poles next to our facility is the cause. Environmental and Radiological Sciences (E&RS) has consented to temporarily install a portable recording anemometer on Gable Mountain to give data for a correlation between random recordings and wind velocity, direction, etc.

The "A" unit's 10 x amplifier is being assembled.

Six pair of strain gages have been installed on the structural columns of the 105-KE enclosure structure and are ready to collect data during the next period of high wind.

One piece of the background vibrations data taken last summer at 105-KE was coded for computer input and an analysis is being attempted. More pieces of these data will be supplemented, coded, and analyzed depending on the results of the present effort.

The preliminary draft of specifications for a strong-motion accelerograph for the Hanford Project has been circulated for comment. Final purchase specifications for the instrument are planned to be completed next month.

Particulate Migration in N-Area Soils

(B. L. Carlile, Water and Wastewater Research Unit)

Soil column studies to show the effects of polyelectrolyte addition on the breakthrough of strontium and cesium and on particulate migration in N-Area soils are under way. Various concentrations of two polyelectrolytes (Purifloc and Magnifloc) were added to spiked and unspiked water samples and passed through soil columns. Measurements were made on activity breakthrough, turbidity of the effluent, and flowrate through the column.

Preliminary data show that 0.1 ppm of Purifloc added to the water gives best results for reducing turbidity and maintaining flow through the column. Cesium and strontium breakthrough

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Previous tests using zirconium clad fuel and deionized water coolant showed significantly reduced effluent activity, thus prompting this evaluation with process water as the coolant. Neither of these tests has been of sufficient duration to yield interpretable data.

Columbia River Effluent Studies

(J. R. Divine, Reactor Water Chemistry Unit)

The preliminary report, BNWL-CC-1410, was completed. This report outlines the results of the most recent combined computer-experiment studies in the activation of As^{75} in production reactor coolant. Further studies involving theoretical calculations and experiment were planned. The work will include analog computer simulations of absorption-desorption processes in coolant channels and complementary experimental studies of arsenic activation in special reactor test channels.

Process Technology

Be-Zr Braze Alloy Process Development

(R. G. Nelson, Fabrication Metallurgy Unit)

A program was started with the objective of producing high purity outer tube braze rings. This will be accomplished by starting with high purity elemental metals (Zr, Be, Sn, Fe, Ni, Cr) and consolidating and casting these materials using the vacuum consumable arc process.

Heat No. 206 was cut into braze rings and is currently being evaluated. A total of 24 braze rings were parted from selected locations in the cast tube. Five hardness readings were taken on each ring. Ring hardness values varied from R_C 31.7 to 36.8 with an average of R_C 35.0. Chemical analyses were requested on selected rings from two different laboratories. Each laboratory received duplicate samples. The results of one laboratory are shown in the following table.

The relatively low hardness values are a result of the low carbon and oxygen content of the casting. All values are

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within specification except Be which is 0.20 to 0.25% low. This is probably due to loss by vaporization in the arc.

Examination of the electrode used for casting the tube does reveal unmelted metal present; consequently, the prime source of this metal is the electrode. This has tentatively been identified as zirconium. Very little unmelted metal was found in the tube section of Heat No. 206; however, several large pieces were found in the gate area.

Melting has been temporarily halted until the evaluation of Heat No. 206 is completed.

Graphite Oxidation Monitoring Simulation
(R. C. Giberson, Materials Compatibility Unit)

In order to test the computer program for simulating graphite oxidation monitoring, a mock-up of a six-foot-long graphite tube-block channel has been fabricated. The graphite block is about 6 x 6 in. cross section with a 1.75-in. diameter hole down the center. Four graphite boats, 1.25 in. diameter, each containing 8 TSX graphite samples, were placed in the channel. The graphite temperature was established at 855°C in the center of the furnace and 720°C at the ends of the graphite block. A mixture of 50% CO₂-50% He was passed down the center channel at a flow rate of 2.5 ft³/hr.

Weight-loss rates were calculated after a 2-week exposure to the gas mixture. The profile of oxidation was very similar to that observed in the reactor. The peak rate was 160% per thousand operating days (%/KOD) at about 32 in. into the channel.

A simulation of the oxidation test on the computer using the Graphite Oxidation Program (GOP) described in BNWL-331 gave a maximum rate at the same location as was found experimentally, but the magnitude was about one-half. This difference may be attributed to the uncertainty in the diffusion coefficient and the uncertainty in the coefficient of the CO inhibition term. Additional experiments were planned to resolve these differences.

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hydrogen in the base metal beneath the surface layer was varied between 80 and 155 ppm.

A similar examination of process tube 3761 from K West Reactor after 47 months service showed hydrogen concentrations of 3680 ppm at 6 inches from the downstream end, decreasing to 520 ppm at 36 inches. The hydrogen concentration continued decreasing to 14 ppm at 108 inches. Base metal concentrations of 160 ppm at 6 inches decreased to 68 ppm at 96 inches. This tube was removed because it had a ruptured fuel element at 159 to 165 inches. This region of the tube was specially examined by taking four 9/32 inch punchings around the circumference every longitudinal inch between 159 and 165 inches. Analyses of these 28 samples gave 13 to 18 ppm hydrogen. Hydrogen analyses of the front face piece of tubing showed 11 ppm hydrogen.

The maximum total hydrogen and base metal hydrogen were substantially higher in both of these tubes than in any tubes previously examined.

Half Plant Dichromate Test

(R. D. Weed, Corrosion Research Unit)

Sample holders exposed in the downstream end of four process tubes at B Reactor were examined for corrosion after 111 days exposure. Two of the holders were exposed to process water containing 1 ppm $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ and the others to 1/2 ppm $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$. Data obtained from corrosion probes exposed in the rear nozzles of B Reactor were compared for the same time interval. Data are shown in the table following:

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surface of the fuel element during hot-die sizing and promote the pitting corrosion observed in the out-of-reactor loop tests.

Water Filtration Studies

(D. E. Olesen, Water and Wastewater Research Unit)

Manifloc 905N was shown to be as effective as Magnifloc 990N as a filter bed conditioner. Magnifloc 905N should be added to the list of polyelectrolytes recommended for further testing.

A study was started to evaluate the interactions of unit operations in water treatment as they influence total system performance. Initial phases of the study will relate system performance to rapid mixing, flocculation, filter media, pH, and alum concentration. System performance will be measured by effluent turbidity, rate of headloss buildup through the filter, and length of filter run. Electrophoretic mobility measurements will be used to monitor variations in the chemically coagulated water.

100-BC Trench Disposal Study

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

A study to determine the long range effects of ground disposal of reactor effluent to trenches near the Columbia River was started near the 100-BC Area. Discharge to the trench site has been intermittent and varied (10,000 to 30,000 gpm) during the first month of operation. Water samples and measurements (ground water potentials, temperatures and quality) obtained routinely at specified locations will provide the basis for evaluating the radiological and hydrological effects resulting from the disposal.

Infrared-Sensed Water Surface Temperatures

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

The infrared-sensed, water surface temperature data (collected and recorded on the Forest Service flight of about a year ago) pertaining to that stretch of the river in the vicinity of 100-BC Area are being processed to obtain improved definition

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Summary

Mission 1

Additional specimens of extra-low carbon 304L were evaluated re corrosion in simulated IWW with and without fluoride. The rates compare favorably with those obtained with better

total G values for the α -radiolysis of 4M HNO_3 solutions of Pu were only slightly affected by providing an argon gas blanket over the solutions or by having the solutions in contact with polyethylene rings.

A continuous flow system for preparation of the material which accelerates oxidation of Pu(V) was assembled and tests to optimize production of the accelerating material were started.

Based on these

process

Mission 4

product

In connection with proposed experiments that will investigate the effect of boron-containing Raschig rings on criticality of plutonium solutions, the first of several reactor vessels was fabricated, passed inspection at the manufacturer's plant, and was received on site.

Evaporation rates were determined for plutonium nitrate solutions. Release rates from residues were determined for elevated temperatures of 700 and 1000°C. Analytical results are not yet available.

Mission 9

Anaerobic cultures of microorganisms were found to be successful in degrading organic wastes. The effects of

by the use of these bacteria and continuous temperature moni-

with water, leaving supernate and that there was no evidence of capacity loss for 10 load, scrub.

Sr⁹⁰ and Ce¹⁴⁴ were quantitatively leached from irradiated Euxenite solids with DTPA held at 90°C and with EDTA held at 100°C. Leaching with NTA was also successful but not for strontium removal. Also,

of
A control system designed for continuous neutralization was installed in the glass prototype tank test stand. Operability testing is in progress.

Research has shown that filtration with a 5 μ filter was sufficient to obtain 5000 ppm of condensate through the ion exchange column. The condensate exceeded this level when a 50 μ filter was used. This was unsatisfactory due to rapid plugging of the ion exchange column.

An evaluation was made of the inventory of long-lived radionuclides in soil zones within 100 feet of the present water table beneath the 200 Areas due to both accidental and intentional waste discharges. The estimated quantities are on the order of 50, 130 and 70 curies of Co⁶⁰, Sr⁹⁰, and

with esti-
ground water
the overall
disposal

proposed tank
analysis
temperatures to be
waste tanks backfilled with sand were
supplied to ARNCO for analysis

ASSISTANCE TO ATLANTIC RICHFIELD HANFORD COMPANY

Mission 1 - Basic Production Mission

Extra-Low Carbon 304L

(R. F. Maness, Corrosion Research Unit)

Specimens of five additional heats of extra-low carbon 304L (Sandvik 3R12) were obtained and evaluated in boiling solutions of simulated Purex IWW solution with and without fluoride present. The carbon content of the heats ranged from 0.014 to 0.018 wt%. Huey rates ranged from 0.6 to 1.2 mils/mo. Specimens of all heats (evaluated in the sensitized condition) corroded at nearly the same rate in simulated Purex IWW solutions, five to six mils/mo in nonfluoride bearing solution and 1.5 to 2 mils/mo in the waste solution simulating that produced during Zirflex processing. These rates compare favorably with those obtained with better quality heats of 304L stainless steel.

Materials Evaluation

(R. F. Maness, Corrosion Research Unit)

A heat of welded 304L tubing was received by ARHCO for use as heat transfer tube bundles in an alkaline waste concentrator. Welding conditions during production resulted in an unfused area in the center line of the top weld bead. Sections of the tubing showed the crevice to be about one mil wide and from about one to ten mils deep (wall thickness was 0.065 in.). After 240 exposure hours to boiling 65 wt% HNO_3 a small crevice was also noted on the underside of the weld bead. A section of the tube exposed to boiling simulated neutralized waste solution for 250 hr showed no evidence of preferential attack as a result of the crevice.

Powder compacted and sintered 316 stainless steel specimens considered for use as spacers in Purex extraction columns were exposed to boiling solutions of 14.4 and 4M HNO_3 and to 2M HNO_3 + 1.5M UNH solution at 55°C. The specimen exposed to boiling 14.4M HNO_3 dissolved in <20 hr. The corrosion rate in boiling 4M HNO_3 was about 5 mils/mo after two 48-hr

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Catalysis of Np Oxidation in the Purex Process
(J. L. Swanson, Chemical Separations Unit)

The preparation of the material which accelerates the oxidation of neptunium (V) is now being carried out in a flow system rather than in the batch basis previously used. It is expected that the flow system will allow better definition of the optimum conditions for preparation of the accelerating material.

In the arrangement currently employed, two streams, one containing NaOH, NaNO₂ and 1-nitropropane and the other containing HNO₃, are fed to a stirred solution held in a reactor vessel having an over-flow arm for product solution discharge. The product solution is collected in a large volume of water to quench the reaction so that the measured yield will be that prevailing under the conditions at which the reactor is operating. In a typical experiment, the heats of dilution of the HNO₃, of neutralization of the NaOH, and of reaction of the nitropropane raise the temperature about 20°C above ambient; precise temperature control in this range is then achieved by external heating or cooling.

Experiments to date with the flow system have not been extensive enough to provide detailed comparisons of the effects of the variables on the yield of rate-accelerating material. It was found that, under some conditions at least, the yield is decreased by increasing the stirring speed beyond a certain point. Values of the quantity $k_2(X)/(RNO_2)$, a measure of the relative yield of accelerating material, were 0.16×10^4 , 0.16×10^4 , and 0.03×10^4 in the product solution when the stirrer was run at 45, 95, and 140 rpm, respectively--at 42°C with a residence time of 4 min and a solution composition (by make-up) of 0.32M 1-nitropropane, 0.16M NaNO₂ and 3.1M HNO₃.

The yield of accelerating material at the lower stirring speeds is greater than that obtained in batch experiments under similar conditions. The previously reported decrease in concentration of accelerating material on irradiation was

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each channel with the option of displaying a compensated signal on one meter. Main front panel controls include an "over range" lamp, a range switch (10^3 - 10^6 counts/min), several spectrometer circuitry controls, and switches for response time, differential and integral modes, and gain. This instrument will represent a significant advance over the successful single channel model in that it will allow compensation of interference from Zr-Nb, Am^{241} , ruthenium, and other gamma radiation. The instrument should improve the present plutonium measuring range, typically 0.5 to 50 grams, to significantly lower values and should also provide advanced capability for work in new areas that may develop in connection with Pu^{238} , Cm^{244} and Np^{237} .

Mission 3 - Transplutonium Elements

Separation of Americium from Rare Earth Elements

(G. L. Richardson, Process Engineering Unit)

Pilot plant pulse column studies to determine feasible operating conditions for separating americium from rare earths in B-Plant by use of the PAMEX process were completed. The final runs demonstrated that 94 to 96% of the americium could be recovered at the B-Plant rates planned for processing current Purex waste (extractant flow rate ~ 240 gal/hr-ft²) and 86 to 92% at the rates to be used for acidified stored sludge (580 gal/hr-ft²). Approximately 3 to 4% of the Ce and 13 to 18% of the Eu would also report to the Am product stream.

The column used in these studies was a 3-in. ID glass pulse column containing a nozzle plate cartridge with the same geometry to be used in the B-Plant IC column. The ICF (solvent raffinate from the IB column) entered 4 ft from the bottom of the cartridge, thus dividing the column into a stripping section (upper 10 ft) and a scrubbing or re-extraction section (lower 4 ft). The stainless steel nozzle plates had 1/8-in. holes, 10% free area and were spread 2 in. apart in the scrub section and 4 in. apart in the stripping section. The nozzles pointed down.

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Mission 4 - Plutonium-238

Calculations for use in selection of chemical processing schemes were made with program ISOGEN to obtain the fission product distributions in possible irradiations of Am^{241} to produce Pu^{238} . Inventories were calculated for irradiation times of 44, 85, and 150 days and decay times of 5 through 100 days.

Fluoride Volatility Studies

(W. H. Yunker, Nonaqueous Chemistry Unit)

ARHCO has terminated their support of experimental fluoride volatility (FV) work; a study of the feasibility and economics of FV reprocessing of Np^{237} and Am^{241} targets for Pu^{238} recovery will be written.

Vaporization Studies

(J. D. Christian, Physical and Theoretical Chemistry Unit)

This study is to provide basic thermodynamic data and some experimental details necessary to design methods for the elevated temperature separation of actinides, particularly americium from plutonium.

A NaK bubbler was installed in the gas purification line in addition to $\text{Mg}(\text{ClO}_4)_2$, silica gel, and hot U turnings for the transpiration apparatus. The 4A molecular sieve was found to load with Ar and so cannot be effective in purifying the gas; 3A sieve, however, might be useful in removing water and oxygen since the channels are smaller than the dimension of Ar.

A number of transpiration runs were performed on a fresh UCl_3 sample for determining its vapor pressure. The condensates were dissolved and are being stored for analysis, the results of which are required for the computation.

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under way at this time to check the leachability of UO_2 from similarly pressed pellets and this will be followed, if successful, with glove box tests on un-irradiated neptunium oxide-graphite pressed target material.

The pre-formed graphite, neptunium-impregnated fuel rods, on the other hand, are very difficult to disintegrate. Of the several methods investigated, mixed concentrated sulfuric-concentrated nitric acid was found to be the most effective disintegrating agent. However, corrosion problems and the need to remove $SO_4^{=}$ prior to anion exchange processing of the neptunium and plutonium make this particular method less desirable. Other oxidizing solutions (boiling acidic dichromate and basic chromate) were completely ineffective for disintegration. Electrolytic disintegration in 13M nitric acid was somewhat effective although fairly large currents are required and the reaction is fairly slow. Faster electrolysis is obtained by adding sulfuric acid to the nitric acid solution. Addition of dichromate to the solution markedly decreases the rate of reaction.

Electrolytic disintegration will be used for C-Cell processing of the impregnated graphite fuel if a better disintegration method is not found. The problem of mounting the sample in the dissolver for electrolysis must still be worked out.

Neptunium-Plutonium Solvent Extraction Studies

(L. A. Bray and W. W. Schulz, Chemical Separations Unit)

Tracer studies (Bray) with Pu, Np and U were continued during the month and U^{237} (6.75 d) tracer studies were started. The studies will determine the distribution ratios as a function of nitric acid (0.5 - 10M), TBP concentration (1-60%) and valence. Distributions were determined using $K_2Cr_2O_7$, nitrite, and ferrous sulfamate. These tracer studies should provide the basis for full level experiments and for engineering development. The experiments are so designed that the results should be applicable not only to the problems of Np^{237} - Pu^{238} recovery but also to the development of flow-sheets for Purex reprocessing of enriched fuels.

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Mission 8 - Nuclear Safety

Criticality Safety Evaluation of Proposed Shipping Cask for
Irradiated Fuel Elements

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

Neutron multiplication measurements were begun for determining criticality safety of a proposed shipping cask for irradiated fuel elements. The experiments are being performed in the critical assembly room at the CML with tubular fuel elements in a mockup of the proposed transfer cask. The "cask" was water filled and fully loaded with 12 fuel element canisters containing 144 fuel elements of 2.1 wt% U^{235} . The neutron multiplication measurements showed the loaded "cask" to be well subcritical, due largely to the geometrical arrangement of the fuel within the cask and the boron-containing steel insert and boron-containing control rods used to reduce reactivity.

Previous neutron multiplication measurements had indicated that criticality could be achieved with as few as 25 of these fuel elements positioned in an unpoisoned lattice under conditions of optimum water moderation. The fuel element dimensions are: 2.33 in. OD, 1.77 in. ID, and 26 in. length.

The experiments confirm the effectiveness of the control methods used for preventing criticality in the cask.

Further experiments were planned to ascertain criticality safety in the event of an accident involving a broken canister. In this case, the fuel elements will be removed from a canister and positioned at optimum spacing in a lattice arrangement in the cask. Measurements will also be made with 1.25 wt% U^{235} fuel elements in the absence of the boron frit control elements within the cask.

Criticality Safety Evaluation of Plutonium Storage Array

(R. C. Lloyd and F. R. Fisher, Critical Mass Physics Section)

Neutron multiplication measurements were performed in the 234-5 Bldg. to ascertain criticality safety of an existing

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control. The first of the Raschig ring reactor vessels has been fabricated, has successfully passed inspection at the manufacturer's plant, and has been received on-site.

Atmospheric Dispersion of Radioactive Particles

(L. C. Schwendiman and C. A. Radasch, Particulate and Gaseous Waste Research Unit)

Experiments were continued to measure the release rates of plutonium as an aerosol during the evaporation from shallow dishes containing plutonium nitrate solutions. Three runs were completed in which the air velocity over the solution was held constant at 100 cm/sec while temperatures were ambient, 50°C, and 90°C. Dried residue from two previous runs was heated in an induction furnace to determine the plutonium aerosol release at an elevated temperature. The air sweep velocities were 10 cm/sec for the 1000°C temperature and 50 cm/sec for the 700°C temperature. Analytical results are not yet available for these runs.

Results from earlier work show greater Pu loss from solutions evaporated at higher temperatures for a given air velocity over the surface but a somewhat lower loss in the later heating of the residues.

Mission 9 - Waste Management

Biological Degradation of Organic Wastes

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

Saturation quantities of TBP, DBP-MBP, and TBP-NPH (30-70) in a nutrient solution containing NH_4^+ and PO_4^{3-} were seeded with soil from the bottom of well 299 E 24-53. This well is adjacent to the Purex organic disposal crib and the soil contains approximately 3µg of organics, chiefly TBP, per grain of soil.

After incubation at room temperature for two weeks, a microbial growth was evident in all samples except the controls which had no soil present. The growth was more profuse in the anaerobic samples than in those incubated under

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of 20 x 50 mesh Zeolon was used in 10 load, scrub, and elution cycles to determine possible ion exchange capacity losses. Forty column volumes of simulated Purex alkaline supernate were pumped through the Zeolon column at 2 cv/hour. Waste losses were less than 1% in each of the 10 loading cycles. There was no indication of a capacity loss during the runs. The cesium waste losses were actually greater during the initial runs than in the final runs. Further runs with the Zeolon columns are planned with Redox alkaline supernate to determine Zeolon stability in the presence of high NaOH concentration.

Purex Solids

(F. P. Roberts, Chemical Separations Unit)

It was reported previously that 0.1M DTPA will leach strontium and rare earth elements from Purex solids if treated at pH 5 and then the pH raised to 12. Further, more detailed tests have been carried out using synthetic LWW and one full level run was completed in "B" Cell.

In lab scale tests, the solids from 1 liter of synthetic LWW traced with Sr^{85} and Ce^{141} were heated with 100 ml 0.1M DTPA or 0.1M NTA at 90°C at pH 2 for 30 min. The pH was increased in steps and the solution was heated 30 min at each step. The fraction of strontium in solution at each pH was determined. With DTPA, the cerium is essentially completely dissolved at pH 2.8 and the strontium at pH 7.6. With NTA, the cerium was dissolved at pH 3.2 but strontium did not completely dissolve at any pH. At pH above 12 in both systems, reprecipitation of both Sr and Ce occurred.

It is apparent that DTPA is more effective for leaching strontium from the solids than is NTA. The data also present a rare earth-strontium separation; by treating the Sr-rare earth sulfate precipitate with the complexing agent at pH 4, a separation factor of approximately 20 can be obtained.

In the hot cell test, 500 ml of 50 gal/Ton LWW was prepared by concentrating 13,500 ml HAW to 500 ml and denitrating (sugar) to 0.53M H^+ . The precipitate containing 20% of the

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maintain strontium extraction capacity of the cyclically irradiated solvent at or near the flowsheet design basis. This expectation was only partially realized in this experiment.

Radiolytic Destruction of Organic Materials in B-Plant Extraction Column Raffinate

(W. W. Schulz, Separations Chemistry Unit)

To prepare satisfactory B-plant extraction column feedstock from PAW solution, various organic reagents are added to provide proper pH control and/or to suppress extraction of various contaminants. These organic complexants and buffering agents do not extract into the D2EHPA phase but remain in the aqueous raffinate from the extraction column.

In normal B-plant operation, the extraction column raffinate will be neutralized to pH 10 by addition of NaOH and stored at boiling temperature in underground tanks pending eventual ion exchange treatment to remove Cs¹³⁷. In some cases, rework of the raffinate through the extraction column will be required to achieve acceptable recovery of strontium and rare earths. Regardless of the further treatment procedures, knowledge of the rates and effects of radiolytic (and also thermal) destruction of organic complexants and buffering agents in the raffinate is thus desirable and necessary.

Experiments were started to determine the rates and consequences (e.g., formation of solids, pH changes, etc.) of radiolytic destruction of organic materials in unneutralized synthetic raffinate. Initial experiments were concerned with determining suitable procedures for raffinate rework. Longer term experiments are also in progress to study radiolytic and thermal destruction of organic materials in neutralized (pH 10) synthetic raffinates.

Waste Immobilization-Unshrouded Circulators

(J. Dunn, Process Engineering Unit)

Preliminary bench scale demonstration of the unshrouded circulator concentrators has used low-wattage heaters currently on hand. The basic principle has been proven but no meaningful

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system would be required to make 5.5M NH_4F for Zirflex use. Direct scrubbing of ammonia with hydrofluoric acid to produce 5.5M NH_4F , might offer some advantages and should be considered as a third alternate.

Fumeless Dissolving

(G. E. Benedict, Advanced Chemical Engineering Unit)

Preliminary studies on the adaptation of fumeless dissolving to the Purex facility have been made by others. This would involve the substitution of oxygen for air in the dissolver sparge gas, the net effect being that O_2 instead of HNO_3 oxidizes uranium metal to U(VI). Many equipment changes would be necessary in Purex before the full potential of fumeless dissolving could be used. At the present time, NO_x can be reduced in the dissolver off gas, with less upset to normal Purex operation, by improving the operation of the off gas absorbers. One recent flowsheet shows only about 45% acid recovery across the off gas absorbers. A calculation of the best acid recovery to be expected with complete oxygen utilization is only 55%, assuming that the nitrogen oxides leaving the downdraft condenser are all NO and that the air is 15% O_2 at that point.

Reverse Osmosis and Electrodialysis for Low Level Waste Disposal

(G. E. Benedict, Advanced Chemical Engineering Unit)

A literature study was made on the present application of reverse osmosis and electrodialysis pilot plants for conversion of brackish water to potable water. The purpose of this study was to determine if present technology would allow the use of similar equipment for treating Purex low level aqueous wastes.

These pilot plants are not presently operated at a concentration factor high enough to allow recycle of the concentrated stream to the Purex waste concentrators for ultimate disposal of the solids and radioactive materials with the 1WW.

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the fresh demineralized water used in the past. If, as believed, AAD contains 85% of the radionuclides presently being cribbed, this one recycle should reduce the radionuclides released by 1/3. Use of AAD as 1WF-H₂O (sparge water to the waste evaporator) which would eliminate an additional 1/3 of the radionuclides releases is to be tested soon.

Underground Heat Transfer

(W. E. Willingham, Process Engineering Unit)

The computer program that calculated the steady state temperatures in underground waste tanks quoted in BNWL-181 and BNWL-262 has been released for offsite publication as "HOTANK - A Steadystate Heat Transfer Program for Use on the UNIVAC 1107/1108."

Process Technology

Hydrogen-Oxygen Burning in Fission Product Packages

(W. E. Willingham, Process Engineering Unit)

Studies were continued of the ignition, flame propagation and possible detonation of hydrogen-oxygen mixtures (as produced by radiolysis of water) in containers holding fission products on molecular sieves. In the present series of runs, the container (a section of pipe 4 ft long and 4 in. diam) contains a bed of AW-500 molecular sieve 2 ft deep. Ignition of introduced hydrogen-oxygen mixtures is by a hot wire at the unfilled end of the pipe. Results of runs made to date in this configuration are as follows.

No detonation wave sufficient to open the rupture disc has been generated; burning has occurred as shown by ionization probes and the presence of water in the residual gas; burning in the packed section has not been detected by ionization probe detectors.

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bank-tank test stand. Leak testing and preliminary operability testing is in progress; feed make-up is also under way. Initial neutralization of the simulated CAW to produce a W-2 extraction column feed with a pH of 0.75 will be supplemented by further neutralization to produce an end product of pH 2.5 prior to final storage.

B-Plant Assistance, Processing of Pm Inventory
(L. A. Bray, Separations Chemistry Unit)

Work was undertaken to: 1) sample and analyze each of the B-Plant tanks which contains aged Pm and/or Sr⁹⁰ concentrates; 2) determine the volume of solids and the fraction of the fission products associated with the solids; 3) develop appropriate leaching flowsheets, if necessary; 4) determine complexant requirements for each tank of feed; and 5) pilot the plant start-up flowsheets with the samples of crude feed.

Condensate Waste Treatment
(B. W. Mercer, Water and Wastewater Research Unit)

Laboratory experiments with 242-T evaporator condensate indicate that filtration with 5 μ filters may be necessary prior to removal of trace Cs¹³⁷ by ion exchange with AW500 zeolite. Suspended matter was observed in a 1500 gallon batch of 242-T condensate received during the month of October. Filtration with a 50 μ filter was attempted but rapid plugging of the AW500 column occurred. Filtration with a 5 μ filter was sufficient to attain 5500 columns of condensate through the AW500 column before the pressure differential exceeded the limit for the system. Further samples of the 242-T condensate will be obtained to establish an average amount of suspended matter in this waste.

Radionuclides in Soils Beneath 200 Areas
(J. R. Raymond, Geochemical and Geophysical Research Unit)

Results of radioisotopic analyses of soil samples obtained in past waste facility and tank farm exploratory drilling programs, monitoring well scintillation-probing logs and ground

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for inclusion in an evaluation of the tank status.

Structural temperatures were estimated for the proposed AY tank farm design. These temperatures will be used in stress analysis of the tanks. Significant deviations from temperatures in previous tank designs included much lower temperatures at the lower corner where the footing met the wall and much higher temperatures at the haunch. These deviations were due to convective mixing in the air gap provided between the liquid and the concrete wall.

Stress Cracking in Polyethylene Storage Bottles
(J. H. Kleinpeter, Materials Compatibility Unit)

Five of the 10-liter Westlake polyethylene bottles of the type used by ARHCO were tested at 50°C and 25 psig internal pressure with 10% Igepal as the surfactant. The hours-to-break for this group of 5 samples were as follows: 43.7, 22, 51.2, 15.6, and 24.5.

The timer on the sample which broke in <22 hr did not function properly. The average time-to-break for the four bottles remaining was 33.75 ± 14 hr.

Five 3-liter bottles were also tested under the same conditions. The hours-to-break were: 29.3, 27.2, 30.5, 40.5, and 34; the average was 32.3 ± 4.7 hr.

There appeared to be no correlation between thickness at point of break and hours-to-break for the 10-liter bottles. This has not been studied for the 3-liter bottles, but the latter are significantly thinner at all sections than the 10-liter bottles.

Investigation of Silver Reactor Behavior
(H. H. Van Tuyl, Applied Chemical Research Unit)

Work was started on removal of methyl iodide from the Purex vessel vent gas system. Silver nitrate supported on silica gel was found to be quite effective.

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Summary

Samples of fuel oil from the distribution system and of water from the catch basin at 100-N, when analyzed for phenolic

Improvements in Am^{241} detection level will improve the capability for measuring Pu^{239} in human lungs. More human excretion data are needed to properly evaluate Pm^{147} oxide depositions.

Dosimetry Studies

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TECHNICAL ASSISTANCE TO THE HANFORD PLANT

Environmental Evaluations

(J. F. Honstead, Environmental Studies Section)

Oil Contamination in Columbia River at 100-N

Evaluation of problems associated with fuel oil entering the Columbia River at 100-N continued. Samples of fuel oil from the distribution system and of water from the catch basin at 100-N were analyzed for concentration of phenolic compounds. The water sample was analyzed according to ASTM D-1783-62. For the oil analysis 1 ml of oil was placed in 500 ml of H₂O. The oil was removed according to the section in ASTM (D-1783-62) on oil interference; then the sample was run as the previous one. Phenolic compounds in concentrations of < 500 and 4 ppb were detected in the oil and water samples, respectively.

Personnel Dosimetry

(H. V. Larson, Personnel Dosimetry Section)

The study of various lung counting systems continued with the goal of selecting or developing the best possible equipment for "in vivo" evaluation of plutonium and americium lung burdens. Under consideration are the Maushart large volume proportional counter and a multiple thin scintillator crystal counter. The present detection limits attained with the above counters have not approached the goal of measuring 8 nCi of Pu²³⁹. An alternate solution to the problem is to detect the Am²⁴¹ content in inhaled production plutonium and to multiply this quantity by the Pu/Am ratio that can be determined by alpha particle analysis. The detection limit of a 5 in. diameter by 3/8 in. thick NaI crystal was measured using 20 nCi of Am²⁴¹ in a lung. From these data it was estimated that the detection level of four of these detectors would be 0.1 nCi of Am²⁴¹. Using a typical Pu/Am ratio of 20, the Pu²³⁹ detection level would be 2 nCi. As a result of this study, four of the five inch diameter 3/8 inch thick crystals were ordered.

Special external exposure evaluations were performed for 22 Hanford contractor employees; however, no exposure over permissible limits was revealed. One special occupational exposure summary was prepared in response to a request from a new employer of a former Hanford employee, under provision of the Atomic Energy Commission Regulations 10 CFR 20 and AEC Manual Chapter 0524.

Dosimetry Studies

(C. E. Newton, Jr., Biophysical Sciences Section)

Thermoluminescent Personnel Dosimeter

Work to develop a long-term dosimeter for personnel not routinely exposed to radiation continued with further measurements of energy response using a prototype TLD system. The TLD system consists of two Li⁷F Teflon discs; one shielded with stainless steel, the other very lightly shielded. There is an anomalous point in the energy response curve using 0.018 in. thick stainless steel. The response measurements are being repeated using a thicker shield. Data obtained at radium gamma and Co⁶⁰ gamma energies are not consistent with data taken previously. These measurements are also being repeated. All exposures are conducted behind the security credential shielding which is about 0.025 in. thick.

The prototype dosimeters are designed to be compatible with commercial TLD readers for manual readout only. Designs for semiautomatic and/or fully automatic readout are under consideration.

For a dosimeter to be used with personnel normally exposed to radiation, it is important to measure the energy response of the TLD material to electrons of various energies. This study will be done with the electron Van de Graaff accelerator. Special solid-state detectors were ordered for electron flux and energy measurements.

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oxide in animals. These data are being used in the development of a model to be used in radiation protection of workers exposed to promethium oxide. Two forms of the material are considered. One batch of test material was prepared by calcining promethium, followed by neutron irradiation to produce the gamma emitting Pm^{128m} . Another batch of material was obtained from the same material recalcining after irradiation. The urinary excretion rates were vastly different in dogs.

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

Thirty immunized and thirty control rainbow trout were exposed at Bonneville Dam to C. columnaris organisms present naturally in the fish ladder water. A similar test with 18 immunized and 18 control trout was performed in the laboratory, using columnaris released from stock trout as the exposure medium. Average agglutinating titers for both groups of immunized fish remained constant at 1:1280. The unimmunized controls increased from zero to average titers of 1:160 within 2 weeks after exposure to Bonneville ladder water. Unfortunately, the Bonneville fish were lost after a month from blockage of the trough piping. The laboratory control titers continued to increase, reaching a value of 1:400 after 5 weeks of exposure. Titters will probably continue to increase until the water temperature drops to about 50°F. Since the controls did not die from their exposure, it is presumed that the columnaris strains were of low virulence. The laboratory portion of this test will be repeated using a more columnaris-susceptible salmonid and a columnaris strain of known high virulence.

Aerial census of wintering waterfowl was begun. The population utilizing the Hanford section of the Columbia River increased during the month from 25,000 to 147,000 ducks and geese. This is about 50% more than last year and about the same as in 1965. About 24,000 Canada geese were resting within the area at month end, representing the greatest local population observed during 15 years of record.

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NOVEMBER 1967
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