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SPECIAL REVIEW FINAL DETERMINATION
CLASS. U
REVIEWERS/AUTHORS CLASS. DATE
(1) P. S. Baker U 7/20/79
(2) C. D. Gresky U 6/13/80
M. Day 2/25/85

Classification Cancelled
Or Changed To UEC 9.13.71
By Authority Of
By C. Goldberg Date 11.10.71

# OPERATIONS DIVISION MONTHLY REPORT

FOR

MONTH ENDING NOVEMBER 30, 1954



OAK RIDGE NATIONAL LABORATORY
U.S. ATOMIC ENERGY COMMISSION

OAK RIDGE NATIONAL LABORATORY
OPERATED BY
CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
UCC
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OAK RIDGE, TENNESSEE

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COPY NO. 3

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for

Month Ending November 30, 1954

by

A. F. Rupp

DATE ISSUED

JAN 18 1955

OAK RIDGE NATIONAL LABORATORY
Operated by
CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
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## CONTENTS



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# OPERATIONS DIVISION MONTHLY REPORT

## REACTOR OPERATIONS

### ORNL Graphite Reactor

No ruptured slugs were found during November. The slugs discharged along with the two ruptured slugs found in October were measured by the Metallurgy Division; the results are given in Table 1.

It is interesting to note that both channels 2069 and 1674 contained slugs which were not beta transformed; similar measurements made on slugs which have been transformed show little or no increase in length. It appears from this and similar measurements that the untransformed slugs in the reactor may be growing enough that they should be discharged. The large amount of growth of these slugs indicates that the ruptures may have been due to stretching of the jackets instead of to too rapid heating of the uranium; a combination of these effects might also be responsible. However, in some cases of ruptures of beta-transformed slugs, all the undamaged slugs discharged with the ruptured slug, which have also been measured, have been found to be very close to the original length.

TABLE 1. MEASUREMENTS OF RUPTURED SLUGS

| Channel | Number of Slugs | Increase in Length (in.) | Average Increase in Length (in.) |
|---|---|---|---|
| 2069 | 1 | 0.5 | 0.15* |
| | 6 | 0.25 | |
| | 13 | 0.2 | |
| 1674 | 1 | 0.21 | 0.056** |
| | 9 | 0.1 | |

*For 40 slugs.
**For 50 slugs.

Operating data for the ORNL Graphite Reactor and the LITR are given in Table 2.

The automatic controller installed in September has been considerably improved by tightening the gear train on the shim rod which the controller operates. It was also revised so that manual operation is restored whenever the power varies as much as 200 kw from the control point. This was necessary in the event that loss of the signal from the neutron chamber caused the controller to raise the reactor power beyond the control point. The controller is now attached to the neutron chamber in hole 40, which was formerly used for the No. 1 galvanometer. The galvanometer is now attached to a chamber in hole 37.

On November 19, during a plant-wide power failure, shim rod No. 6 did not go in. This is a very unusual occurrence, and it was finally determined that the trouble was due to a piece of metal sticking to the solenoid valve linkage which operates this rod.

TABLE 2. REACTOR DATA

| | ORNL Graphite Reactor | | | LITR | | |
|---|---|---|---|---|---|---|
| | November 1954 | October 1954 | Year to Date | November 1954 | October 1954 | Year to Date |
| Total energy, Mwd | 97.6 | 99.8 | 1100.4 | 76.3 | 52.8 | 801.7 |
| Average power/operating hr, kw | 3500 | 3500 | 3557 | 2993 | 2708 | 2914 |
| Average power/24-hr day, kw | 3254 | 3219 | 3295 | 2543 | 1703 | 2400 |
| Lost time, % | 7.0 | 8.0 | 7.4 | 15.3 | 37.1 | 17.6 |
| Excess reactivity | 97 inhr | 99 inhr | | 3.5% | 2.6% | |
| Fuel pieces charged | 140 | 44 | 1006 | 0 | 2 | 16 |
| Fuel pieces discharged | 58 | 136 | 1214 | 0 | 2 | 16 |
| Research samples | 112 | 109 | 1032 | 18 | 9 | 116 |
| Radioisotope samples | 272 | 221 | 2430 | 39 | 25 | 262 |

[redacted]

The sand filters in the canal demineralizer are still so very radioactive that considerable exposure would be incurred in removing the sand. Further decontamination, with the use of ammonium citrate and Versene solutions, is therefore being done.

A work order has been issued for installing capacitors and lightning arresters on the two 900-hp fan motors; the estimated cost is $1700.

Data on the operation of the reactor exit air filters are shown in Table 3.

The usage of experimental facilities in the ORNL Graphite Reactor is given in Table 4.

TABLE 3. PRESSURE-DROP DATA

| | Pressure Drop (in. water gage) | | |
|---|---|---|---|
| | Glass Wool | CWS No. 6 | Total Across House |
| 11-30-54 | 1.5 | 1.3 | 4.2 |
| 10-31-54 | 1.4 | 1.3 | 4.1 |
| Clean filters | 1.1 | 1.3 | 3.3 |

### Low-Intensity Test Reactor

Operation of the LITR during November was normal except that the shutdowns for research continued to be rather high. A comparison of the shutdowns in October and in November is given below.

| | November | October |
|---|---|---|
| Unscheduled shutdowns for operational reasons, hr | 0.834 | 1.133 |
| Regular operations shutdowns, hr | 38.716 | 27.200 |
| Special shutdowns for research, hr | 68.714 | 247.849 |

The usage of experimental facilities in the LITR is shown in Table 5.

Measurements of the specific activity of $Na^{24}$ samples irradiated before and after the lattice change made in October (elements were moved from lattice positions 11, 21, 31 to 45, 55, and 56) show that the removal of fuel elements from the position adjacent to the pneumatic tube and substitution of beryllium reduced the thermal-neutron flux only about 12%.

Corrosion coupons of aluminum and carbon steel were exposed in the upper tank, where they were not subjected to any appreciable flux, and in the lattice in a neutron flux of about $2 \times 10^{13}$ neutrons/cm$^2$/sec for about six months. Both aluminum and steel showed about twice the corrosion rate in the lattice as in the upper tank. One explanation for this is that the samples in the lattice were probably at a slightly higher temperature as a result of gamma heating; another probable explanation is that radiation effects were responsible for the higher corrosion rate. Data on the samples are shown in Table 6.

The demineralizer installed in September gave six weeks of service before it had to be regenerated on November 1; it was put back into operation on November 6 but required regeneration again on November 23. Some trouble has been experienced in regenerating the anion resin, and efforts are being made to determine the cause. The demineralizer has continued to give very good service; the radioactivity in the water during operation is generally below 50,000 counts/min/ml. A second cation column holding 2 ft$^3$ of IR-120 resin was added, giving two such columns in front of the mixed-bed column. These columns reduce the radioactivity in the water by about 90% before the water reaches the mixed-bed column and thereby protect the radiation-sensitive anion resin.

The magnet found to be damaged in October has been repaired by completely disassembling the core and reassembling the core pieces by use of some spare coils.

## RADIOISOTOPE PRODUCTION AND SALES

Data on the production of processed and unprocessed radioisotopes are given in Tables 7 and 8; special-preparations data are given in Table 9, and a summary of radioisotope shipments is given in Table 10.

Twenty-six sources of $Cs^{137}Cl$ were made in pelleted form and sealed in double stainless steel jackets for radiographic work. The source strengths ranged from 5 to 15 curies for each piece, totaling 195 curies for the entire batch.

Eighteen radium-type needles were loaded with a total of 26 mc of $Cs^{137}$. They will be the first $Cs^{137}$ needles used for radiation of tumors by implantation; this work is being done at M. D. Anderson Hospital in Texas.

A W irradiation can containing 575 pieces of $\frac{1}{8} \times \frac{1}{8}$ in. cobalt was opened and the activity measured. The individual pieces were found to contain approximately 0.8 curie of $Co^{60}$, a specific activity of 3.6 curies/g.

**TABLE 4. USAGE OF EXPERIMENTAL FACILITIES – ORNL GRAPHITE REACTOR**

| Hole Number and Orientation | Dimensions (in.) | Division in Charge of Facility | Person in Charge | Type of Experiment or Usage |
|---|---|---|---|---|
| 1, 2, north and south | 4 × 4 | | | Regulating rods |
| 3, north and south | 4 × 4 | Operations | J. A. Cox | Sulfur exposure for radiophosphorus production |
| 4, north and south | 4 × 4 | Operations | J. A. Cox | Miscellaneous exposures of special samples |
| 5, 6, north and south | 4 × 4 | | | Shim rods |
| 7, 8, 9, vertical | 4 × 4 | | | Safety rods |
| 10, vertical | 4 × 4 | Solid State | J. H. Crawford, Jr. | Low-temperature sample-exposure facility (no samples during month) |
| 11, vertical | 4 × 4 | Operations and Chemical Technology | J. P. McBride | Boron shot safety tube and HRP fuel studies |
| 12, vertical | 4 × 4 | Operations | J. A. Cox | General exposures of samples in water-cooled facility |
| 13, 14, north and south | 4 × 4 | Operations | J. A. Cox | Target exposures for radioisotopes and research |
| 15, south | 4 × 4 | Operations | J. A. Cox | Miscellaneous large-sample exposures |
| 15, north | 4 × 4 | Solid State (G.E.) | L. E. Stanford (G.E.) | Miscellaneous large-sample exposures* |
| 16, north and south | 4 × 4 | Operations | J. A. Cox | Sulfur exposure for radiophosphorus production |
| 17, north | 4 × 4 | Unassigned | | Empty |
| 17, south | 4 × 4 | Physics | E. O. Wollan | Neutron polarization* |
| 18, north and south | 4 × 4 | Operations | J. A. Cox | Miscellaneous large-sample exposures |
| 19, north and south | 4 × 4 | Solid State | O. Sisman | Water-cooled exposure facility |
| 20, north | 4 × 4 | | | Graphite temperature thermocouples |
| 20, south | 4 × 4 | Solid State | J. C. Wilson | Creep of metals (no samples during month) |
| 21, north and south | 4 × 4 | Operations | J. A. Cox | Sulfur exposure for radiophosphorus production |
| 22, north | 4 × 4 | Solid State (G.E.) | | Ionization-chamber tests* |
| 22, south | 4 × 4 | Operations | J. A. Cox | Two pneumatic tubes for general usage |
| 30 | 9 × 9 | Solid State (G.E.) | L. E. Stanford (G.E.) | Life tests of equipment in radiation (no tests during month) |
| 31 | 9 × 9 | | | Blocked by one end of air seal H-beam across top of graphite |
| 32, 33 | 9 × 9 | | | Contain chamber for high-power-level trip circuit |

*None during month.

TABLE 4. (continued)

| Hole Number and Orientation | Dimensions (in.) | Division in Charge of Facility | Person in Charge | Type of Experiment or Usage |
|---|---|---|---|---|
| 34 | 9 × 9 | | | Contains chamber for No. 2 power-level galvanometer |
| 35 | 9 × 9 | | | Blocked by one end of air seal H-beam across top of graphite |
| 36 | 9 × 9 | | | Contains chamber for high-power-level trip circuit |
| 37 | 9 × 9 | | | Test facility for ionization chambers |
| 40 | 9 × 9 | | | Contains chamber for No. 1 power-level galvanometer |
| 41 | 6-in. dia | | | Rear wall suction-pressure tap; hole into discharge manifold |
| 42 | 6-in. dia | | | Unit pressure differential tap; hole into discharge manifold |
| 43 | 6-in. dia | | | Unused (inaccessible); hole into discharge manifold |
| 44 | 6-in. dia | | | Unused; hole into discharge manifold |
| 45 | 6-in. dia | | | Gas discharge from hole 22 pneumatic tubes; hole into discharge manifold |
| 46, 47 | 6-in. dia | | | Used for viewing west end of graphite with periscope; vertical holes into discharge manifold |
| 50, north | 4 × 4 | Solid State | J. H. Crawford, Jr. | General sample-exposure facility |
| 50, south | 4 × 4 | Physics | E. O. Wollan | Neutron spectrometer |
| 51, north | 4 × 4 | Solid State | J. H. Crawford, Jr. | Water-cooled $U^{235}$ neutron converter |
| 51, south | 4 × 4 | Physics | C. G. Shull | Neutron spectrometer |
| 52, north | 4 × 4 | Solid State | J. H. Crawford, Jr. | Facility for exposing samples at liquid-nitrogen temperatures |
| 52, south | 4 × 4 | Physics | L. D. Roberts | Low-temperature work |
| 53, 54, 55 | 4 × 4 | Solid State (G.E.) | L. E. Stanford (G.E.) | Half-holes for miscellaneous large-sample exposures* |
| 56, north | 4 × 4 | Physics | E. C. Campbell | Fast pneumatic tube |
| 56, south | 4 × 4 | Physics | H. S. Pomerance | Oscillator for measuring neutron absorption cross sections |
| 57, north | 4 × 4 | Training School | H. S. Pomerance | General-purpose neutron collimator |
| 57, south | 4 × 4 | Physics | S. Bernstein | Neutron polarization* |
| 58, north | 4 × 4 | Unassigned | | Empty |
| 58, south | 4 × 4 | Chemistry | H. Levy | Neutron spectrometer |

*None during month.

**TABLE 4. (continued)**

| Hole Number and Orientation | Dimensions (in.) | Division in Charge of Facility | Person in Charge | Type of Experiment or Usage |
|---|---|---|---|---|
| 59 | 4 × 4 | Unassigned | | Half-hole; blocked by work at hole 17, south |
| 60 | 4 × 4 | Solid State | J. C. Wilson | Half-hole for creep of metals (no samples during month) |
| 61 | 4 × 4 | Operations | J. A. Cox | Half-hole for miscellaneous large-sample exposures |
| East and west animal tunnels | | | | General exposures of large samples to low flux |
| Thermal column | | Physics | | Used by several groups for low-level neutron flux work |
| Inclined animal tunnel in thermal column | | | | Exposures of biological specimens |
| West core hole | | Physics | | Lid tank for shielding studies |
| A | 1.68-in. dia | Operations | E. E. Beauchamp | Charging-face hole containing 20 small cans of $CaCO_3$ |
| B | 1.68-in. dia | Unassigned | | Charging-face hole; empty |
| C | 1.68-in. dia | Solid State | J. C. Pigg | Charging-face hole; insulation test |
| D | 1.68-in. dia | Solid State | C. E. Schilling | Charging-face hole; uranium samples |
| 1069 | 1.5-in. dia | Unassigned | | Charging hole containing an aluminum liner used for general exposure of suitable samples |
| 1768, 1968 | 1.75 in. square | Solid State | R. H. Kernohan | Charging holes containing neutron converter donut; used for general exposures of samples to fast-neutron flux |
| 1867 | 1.75 in. square | Unassigned | | Charging hole containing neutron converter donut; used for general exposures of samples to fast-neutron flux |
| 2079 | 1.5-in. dia | Operations | J. A. Cox | Charging hole containing pneumatic tube; used for exposure of research and radioisotope samples |
| 0857, 0880, 1484, 1853, 2857, 2880 | | | | Charging-face holes containing boron-coated thermopiles for reactor instrumentation |
| Others | | | | Seven uncharged peripheral holes contain $CaCO_3$ for radioisotope production; 409 uncharged peripheral holes remain unused |

TABLE 5. USAGE OF EXPERIMENTAL FACILITIES – LITR

| Facility Number | Type of Facility | Division in Charge of Facility | Person in Charge | Type of Experiment or Usage |
|---|---|---|---|---|
| HB-1 | 6-in.-ID beam hole | Physics | E. C. Smith | Chopper-type neutron velocity selector |
| HB-2 | 6-in.-ID beam hole | Solid State and G.E. | D. S. Billington | General exposures of large samples and loops; loop being prepared |
| HB-3 | 6-in.-ID beam hole | Solid State | J. C. Wilson | Creep of metals |
| HB-4 | 6-in.-ID beam hole | Chemistry | G. H. Jenks | HRP loop test |
| HB-5 | 6-in.-ID beam hole | Chemistry | G. H. Jenks | HRP fuel stability and corrosion tests (no tests during month) |
| HB-6 | 6-in.-ID beam hole | Chemistry | G. H. Jenks | HRP fuel stability and corrosion tests |
| HR-1, 2 | Pneumatic tubes | Operations | J. A. Cox | General short exposures of research and radioisotope samples |
| C-28 | Hollow fuel element in core | Solid State | T. H. Blewitt | Exposure of metal crystals to high, fast flux |
| C-38 | Hollow fuel element in core | Solid State | J. B. Trice | Exposure of specimens for flux determination methods |
| C-42 | Hollow Be core piece with access tube from top plug | Solid State (G. E.) | L. E. Stanford (G. E.) | Exposure of miscellaneous small specimens |
| C-44 | Hollow Be core piece with access tube from top plug | Chemical Technology | J. P. McBride | Blanket stability and corrosion tests |
| C-46, 48 | Hollow Be core piece with access tube from top plug | Solid State | G. W. Keilholtz | ANP fuel tests (no tests during month) |
| C-29, 49 | Mg tray in core space | Operations | J. A. Cox | Exposures of research and radioisotope samples |
| C-39 | Be core piece with four vertical holes | Operations | J. A. Cox | Exposures of research and radioisotope samples |
| V-1 | Inclined low-flux hole | | | Contains boron-coated thermopile for reactor instrumentation |
| V-2 | Inclined low-flux hole | General Electric | L. E. Stanford | General exposure facility |
| V-3, 4 | Inclined low-flux hole | Unassigned | | Empty |

Seven hot $Ir^{192}$ samples were canned for reirradiation. It is expected that more of this type of work will be required as the use of $Ir^{192}$ for radiography increases.

## RADIOISOTOPE DEVELOPMENT

### $Cs^{137}$ Purification, Building 3029

Equipment installation and testing for $Cs^{137}$ purification have been completed. A larger tantalum coil was installed in the crystallizer to reduce the time required for heating and cooling.

Two cold runs were made, with special emphasis being given to the alum crystallizations and aluminum precipitation. It was found that the final amount of alum crystals should be approximately 250 g. If the concentration of crystals is greater than 125 g per liter of solution, the precipitate forms slowly and is very hard to filter.

Three tracer runs were made, with the following results: run No. 1, in which a poor sample of the starting solution made a material balance impossible – incomplete precipitation of the aluminum resulted in a poor yield from the column; run No. 2, in which the precipitation was very good, approxi-

**TABLE 6. CORROSION DATA FOR SAMPLES EXPOSED IN THE CORE AND IN THE UPPER TANK**

| Sample No. | Material | Days in Reactor | Corrosion Rate (mpy) | |
|---|---|---|---|---|
| | | | In Core | In Upper Tank |
| 420-61 | 2S aluminum | 182 | 0.22 | |
| 420-64 | 2S aluminum | 182 | | 0.09 |
| 420-53 | Carbon steel | 175 | 8.67 | |
| 420-38 | Carbon steel | 182 | | 3.70 |

**TABLE 8. UNPROCESSED RADIOISOTOPE PRODUCTION DURING NOVEMBER**

| Product | Units |
|---|---|
| Service irradiations | 62 |
| Bromine-82 | 3 |
| Calcium-45 | 1 |
| Chromium-51 | 2 |
| Copper-64 | 2 |
| Gallium-72 | 1 |
| Gold-198 | 68 |
| Gold-199 | 1 |
| Iodine-131 | 6 |
| Iridium-192 | 2 |
| Iron-55,59 | 2 |
| Mercury-203 | 3 |
| Phosphorus-32 | 2 |
| Potassium-42 | 24 |
| Rubidium-86 | 5 |
| Silver-111 | 8 |
| Sodium-24 | 20 |
| Zinc-65 | 1 |
| Total | 213 |

**TABLE 7. PROCESSED RADIOISOTOPE PRODUCTION DURING NOVEMBER**

| Product | Source | Amount (mc) | Specific Activity (mc/g) |
|---|---|---|---|
| Chromium-51 | LITR irradiation | 2,744 | 3,118 |
| Iodine-131 | Graphite Reactor metal | 38,694 | No carrier added |
| Iron-55 | W irradiation | 1,104 | 86.14 |
| Iron-59 | W irradiation | 315 | 24.56 |
| Iron-59 | LITR irradiation | 26.5 | 3,600 |
| Niobium-95 | W metal | 6 | No carrier added |
| Phosphorus-32 | Graphite Reactor irradiation | 12,425 | 40,000 |
| Prometheum-147 | Scrup waste | 6,075 | No carrier added |
| Sodium-24 | LITR irradiation | 229 | 2,156 |
| Sulfur-35 | W irradiation | 6,320 | No carrier added |

mately 85% recovery; and run No. 3, in which the precipitation was very good, approximately 95% recovery.

A hot run is scheduled to be started December 6, 1954.

### Short-Lived-Fission-Products Plant, Building 3028

A study was made of a proposed process for separating short-lived fission products by utilization of the continuous pulse column principle. It was decided that the cost of this installation would be excessive and that a process for continuous operation was not necessary.

A process flowsheet has been started for a batch extraction method of separating the short-lived fission products. This method has been used successfully, and very little experimental work will be necessary.

**TABLE 9. SPECIAL RADIOISOTOPE PREPARATIONS DURING NOVEMBER**

| | Number | Amount (curies) |
|---|---|---|
| $Co^{60}$ sources | 7 | 2701 |
| $Cs^{137}$ sources | 26 | 195 |
| $Ir^{192}$ sources | 4 | 14.5 |
| $Sr^{90}$ source | 1 | 0.1 |
| $H^3$ ampoules | 11 | 8.8 |
| $He^3$ ampoule (3.5–4.0%) | 1 | 900* |
| $He^3$ ampoules (>95%) | 2 | 2* |
| $H^2$ targets | 5 | ** |

*Cubic centimeters.

**Too small to be measured.

### Fission-Product Pilot Plant

The directive authorizing funds for the design of the Fission-Product Pilot Plant has been received.

Formulation of design data for the architect-engineer who is to design the building is in progress. In order to establish the external dimensions of the cell block, a preliminary equipment layout was made, shielding calculations were rechecked, and the operational features of the finishing and loading cells were detailed. The architectural section of the Engineering Department is preparing sketches for the architect-engineer.

Preparation of criteria for service requirements in the plant building is in progress.

Experiments are being run on the process slurries in a 14-in. solid-bowl centrifuge to determine centrifuge size and speed and permissible feed rates.

### Shielded Transfer Vessel

The hemispherical shells required for the shielded transfer vessel are being fabricated by Lukens Steel Company. Stainless-clad steel was substituted for solid stainless steel on the outer shell because of the lower cost.

### Iodine-125

Tellurium(IV) oxide (0.48 g) enriched electromagnetically to 87.9% $Te^{125}$ was bombarded in the 86-in. cyclotron for a period of 8.3 hr (1506 $\mu$a·hr) and processed for $I^{125}$.

**TABLE 10. RADIOISOTOPE SHIPMENTS**

| | November 1954 | October 1954 | November 1953 | August 1946 Through November 1954 |
|---|---|---|---|---|
| Separated material | 884 | 789 | 807 | 50,138 |
| Unseparated material | 211 | 209 | 237 | 13,201 |
| Total | 1095 | 998 | 1044 | 63,339 |
| Nonproject | 1004 | 895 | 943 | |
| Project | 80 | 74 | 79 | |
| Foreign | 11 | 29 | 22 | |
| Total | 1095 | 998 | 1044 | |

To prevent possible loss of iodine that could have volatilized and/or united with the aluminum capsule during the high-temperature period of bombardment, the entire 6.5-g aluminum capsule containing the $TeO_2$ was dissolved in a mixture of NaOH and $NaNO_3$. A slight excess of nitric acid was added to the solution in a closed system to dissolve the $TeO_2$, and then the iodine was distilled from the nitrates, after an oxidation ($KMnO_4$) reduction ($H_3PO_3$) process, and collected in 0.1 *N* NaOH solution. The yield as calculated by personnel using the 86-in. cyclotron was 1 mc of $I^{125}$; the actual yield was 15 mc. The enriched $Te^{125}$ was returned to the Stable Isotope Research and Production Division for re-use.

### $Sr^{90}$ Sources

The radiation from an $Sr^{90}$ source prepared in a "K" monel container was investigated by means of gamma-ray spectroscopy and beta absorption measurements. The 0.002-in.-thick "K" monel source window (~43 mg/cm$^2$) absorbed approximately 88% of the 0.537-Mev $Sr^{90}$ betas. The half-thickness of the 2.18-Mev $Y^{90}$ beta measured through the 2-mil window was 154 mg/cm$^2$. The half-thickness of $Y^{90}$ on a glass backing was 160 to 170 mg/cm$^2$ and 225 to 235 mg/cm$^2$ on polystyrene. Scintillation spectrometer studies of the source revealed that the $Sr^{90}$ beta source as now fabricated, with a platinum backing, emits not only the 2.18-Mev $Y^{90}$ beta but also the 0.068-Mev platinum x ray. To eliminate the x ray, the use of a carbon backing to replace the platinum is being investigated.

An 800-mc $Sr^{90}$ source which was fabricated on March 8, 1954, with a platinum backing and a 2-mil-thick "K" monel window, was recalled from the UT-AEC Agricultural Research Station for inspection. The source was leak-tested and studied under the microscope; no radiation damage to the 2-mil window could be observed. The source is being held for further observations.

### Separation of $Zn^{65}$ from Copper

An ion-exchange method which is considered to be an improvement over the dithizone extraction method for the isolation of carrier-free $Zn^{65}$ from cyclotron target material (Cu) has been worked out. Zinc is adsorbed on Dowex 2 anion-exchange resin from 5 *N* HCl. The elements Cu, Cr, Ni, Co, Fe, Ag, and Al are not adsorbed on Dowex 2 from 5 *N* HCl and pass into the effluent. The $Zn^{65}$ is eluted from the column with 2 *N* HCl.

### Technetium Processing

A $\phi_4AsNO_3$ (tetraphenyl arsonium nitrate) or $\phi_4AsMnO_4$ (tetraphenyl arsonium permanganate) precipitation was found to give a decontamination factor of between 100 and 1000 for both ruthenium and cesium.

The solubility of $\phi_4AsNO_3$ was determined in water and in various $NaNO_3$ solutions, as shown in the following data:

| $NaNO_3$ (*M*) | $\phi_4AsNO_3$ (g/100 ml) |
|---|---|
| 0 | 2.97 |
| 1.0 | 0.1650 |
| 2.0 | 0.0743 |
| 3.0 | 0.0320 |
| 4.0 | 0.0029 |

Technetium carries on $\phi_4AsNO_3$ precipitates in greater than 98% yield. From the above solubility determinations, it may be seen that $\phi_4AsNO_3$ and technetium both may be recovered in excellent yield and may be separated from all contaminating activities and metallic cations. Technetium may even be recovered from the main stream on a $\phi_4AsNO_3$ precipitate as the following data show.

| | |
|---|---|
| $NaNO_3$ | 3 *N* |
| $HNO_3$ | 0.5 *N* |
| $\phi_4AsCl$ | 2.0 g/liter |
| $Re^{188}$ tracer | (substitute for Tc) |
| Re carried | 99.6% |

By using a $\phi_4AsCl$ concentration of 1.0 g/liter, only 75% of the rhenium tracer was carried. The $\phi_4AsNO_3$ may be leached from $\phi_4AsTcO_4$ and returned to the main stream so that very little organic reagent is consumed. The $\phi_4AsTcO_4$ product is dissolved in an ethyl alcohol solution. The ethyl alcohol is evaporated off, and technetium is precipitated as the sulfide, by the use of thioacetamide, from 2 to 3 *M* HCl. If it is necessary to further remove traces of ruthenium and cesium, $Tc_2S_7$ is dissolved in $NH_4OH$-$H_2O_2$ and reprecipitated with $\phi_4AsCl$ reagent.

### Boron Evaporator

Equipment has been designed and fabricated for the evaporation of thin films of elemental boron onto metallic backings, which are required for Physics Division work. Temperatures as high as 3500°C have been obtained with this equipment in which heating is done by bombardment of a small graphite crucible with an electron beam. Good control of the temperature is easily attained. The equipment can be completely disassembled and cleaned in 1 hr.

The equipment and procedure will be more fully described in a later report.

## RADIOACTIVE-WASTE DISPOSAL

A total of 10.8 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond (see Table 11); this discharge is 55% of that of last month and 30% of the average per month of 1953. Some of the activity contributed was the result of an operating accident in the Solvent Column Pilot Plant, Building 3503, the flushing of the Metal Recovery Building canal, and operations in the manipulator cell of Building 3029.

A total of 49,650 gal of wastes containing 2036 curies was transferred to chemical-waste storage pit No. 2 this month. Of the total, 450 gal was not active and was moved by truck from Unit Operations Building 3503. The remaining wastes were pumped from chemical-waste tank W-6. This is the first time that waste has been pumped successfully from this tank. The total of all wastes discharged to the waste storage pit No. 2 to date is 1,145,358 gal containing 15,697 curies.

The chemical-waste system received 73,200 gal of waste during the month.

Another chemical-waste storage pit located adjacent to chemical-waste storage pit No. 2 is under construction. The capacity of this new pit will be 1,000,000 gal, the same as that of pit No. 2. Construction should be completed during December.

Metal-waste collection tank WC-8 servicing Building 3503 has been taken out of service temporarily and converted to thorium-waste storage. The tank has been disconnected from its pump so that the contents cannot accidentally be pumped into the metal-waste system. This tank will be returned to metal-waste service next year, at which time the Chemical Technology Division will remove the thorium.

New samplers have been installed at tanks W-5, -6, and -8 for the express purpose of taking pH samples of future, very highly radioactive waste. These samplers are designed so that quantitative amounts of sample can be obtained.

Manhole No. 25 sampler and flowmeter was out of service temporarily because of a large leak around the weir; this leak has been repaired.

New 10-belt sheaves were installed on the motor and fan of the exhaust system servicing Buildings 4501 and 4505. These sheaves replaced underpowered 6-belt sheaves, which put great strain on the driving V-belts.

A set of 11 matched V-belts was installed on the 125-hp motor and fan exhausting the hoods and cells of Building 3026. The old belts were completely worn out.

The coupling connecting the 30-hp electric motor to the hot off-gas fan sheared; no reason was found for the failure. This coupling has been replaced.

## MISCELLANEOUS OPERATIONS

### Water Demineralization

The production of demineralized water was 390,990 gal in November, compared with 399,300 gal last month.

Considerable trouble has been encountered recently with the anion resin beds because they failed to give proper capacity. Efforts are being made to determine whether the additional 5 $ft^3$ of resin added to each of the anion beds in September has prevented sufficient backwashing so that the beds cannot be regenerated properly. Considerable maintenance was required on the multiport valve on unit No. 2. Unit No. 1 now has bypass diaphragm

**TABLE 11. ACTIVITY DISCHARGED TO WHITE OAK CREEK**

| Source | November 1954 | | Average Per Month, Year to Date | | Average Per Month, 1953 | |
|---|---|---|---|---|---|---|
| | Gallons | Beta Curies | Gallons | Beta Curies | Gallons | Beta Curies |
| Settling basin | 8,340,000 | 10.0 | 13,100,000 | 16.3 | 19,450,000 | 24.1 |
| Retention pond | 440,000 | 0.8 | 500,000 | 1.5 | 500,000 | 11.7 |
| Total | 8,780,000 | 10.8 | 13,600,000 | 17.8 | 19,950,000 | 35.8 |

valves around the multiport valves.

Operating data on the demineralizers are given in Table 12.

### Hydrogen Liquefaction

The new hydrogen liquefier was installed, and it failed when tested with nitrogen under pressure; one of the inner jackets was ruptured. The unit is now being rebuilt with rupture disks on each jacket so that the unit will be protected. The trouble appeared to be caused by a leak into one of the vacuum jackets, which resulted in failure of the jacket under pressure. No liquid hydrogen was made during the month.

### Activation Analyses

A total of 186 requests for information concerning activation analyses has been received; 85 have developed into requests for analyses, 69 of which have been completed.

### Off-Shift Services

A total of 433 man-hours was expended in performing various services requested by other divisions. The work included the filling of cold traps, maintaining furnace operations, checking test-loop operations, maintaining bottled oxygen supply, and generally ensuring continued operations of equipment and experiments on evening shifts and week ends.

### Decontamination Services

Approximately 260 man-hours was spent on the plant equipment decontamination service.

TABLE 12. AVERAGE AMOUNTS OF WATER PASSED THROUGH REGENERATION UNITS DURING OCTOBER AND NOVEMBER

| | Number of Regenerations | | Amount of Water Through Each Unit (gal) | |
|---|---|---|---|---|
| | November | October | November | October |
| No. 1 cation | 6 | 2 | 44,400 | 60,750 |
| No. 2 cation | 5 | 3 | 42,750 | 52,767 |
| No. 1 anion | 11 | 2 | 27,127 | 52,350 |
| No. 2 anion | 14 | 4 | 15,500 | 54,350 |