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LABORATORY RECORDS
1954

OPERATIONS DIVISION MONTHLY REPORT

FOR

MONTH ENDING MARCH 31, 1954

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OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending March 31, 1954

by

A. F. Rupp

DATE ISSUED

MAY 19 1954

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OPERATIONS DIVISION MONTHLY REPORT

SUMMARY

The activities of the Operations Division for the month ending March 31, 1954 are summarized and indexed below:

1. The Graphite Reactor (3684 kw) and the LITR (3000 kw) operated satisfactorily. Approximately six months have now passed since there were any slug ruptures in the Graphite Reactor (p 2).
2. Oven tests of irradiation cans containing elemental sulfur have been started because of the leakage of sulfur from these containers in the reactor (p 2).
3. The 200-g fuel element tested in the LITR is more economical to use than the 168-g element (p 6).
4. Initial tests on the new iodine plant are in progress. Oxygen sparging is effective in reducing the nitrite content of the scrub liquor (p 6).
5. A large (1540-curie) Cs^{137} source for use in cancer research at ORINS was completed (p 9).
6. A new inorganic ion-exchange medium is being tested (p 10).

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REACTOR OPERATIONS

ORNL Graphite Reactor

No slug ruptures were found during March; the approximately six months which have elapsed since the last rupture (October 12, 1953) is the longest period without any ruptures since 1946-47, when there was a period of about eight months free of ruptures. Operating data are given in Table 1. The absence of ruptures may be due to elimination of the practices of starting up the reactor quickly and of "heating up" immediately after startup by running the reactor at a high power until the metal temperature had risen to the operating value. These two changes were initiated last fall and coincide approximately with the absence of ruptures. Although no recent measurements have been made of slug growth, a new crop of ruptures may be expected if growth continues.

Design work on additions to the canal demineralizer is in progress, and it is expected that installation can be started next month.

The slug cutter has just been removed from the canal for repairs; approximately five orders for sliced slugs are outstanding. After the slug cutter was removed from the canal, it was found that the leaks in the motor box had been due to the screws rusting completely apart in the box cover.

Hole 12 is becoming a very popular facility, both for radioisotope and research use. Work is under way on some sort of shielded storage facility so that samples can be removed and placed in the shield without exposing personnel to radiation.

An inlet filter change was completed on March 22, causing the Pitot-static pressure to decrease from approximately 28 mm Hg to 15.

Several leaks have developed in cans containing sulfur for P^{32} production. As a result, it has been decided to have all sulfur cans tested in an oven at about 150°C before they are irradiated.

Bearings on the No. 3 fan were inspected on March 29 and no evidence of excessive wear was found. The 900-hp motor removed from the No. 2 fan in February was repaired, and the trouble was found to have been due to a nut which had come loose inside the motor and had dropped down inside the motor housing where it rubbed against the cooling fan. The nut was supposed to have been spot-welded to the frame but apparently this had not been done.

The usage of experimental facilities in the ORNL Graphite Reactor is shown in Table 2.

Work is proceeding on the preparation of glass-wool filters for cell 4. It is expected that filters in this cell will be changed in late April or early May. Work has also begun on preparing 200 paper filters for changing the entire filter house No. 2 filters.

Table 3 shows a comparison of the pressure drop across the exit air filters last month with that experienced this month and with clean filters.

TABLE 1. REACTOR DATA

	ORNL GRAPHITE REACTOR			LITR		
	March 1954	February 1954	Year to Date	March 1954	February 1954	Year to Date
Total energy, Mwd	104.7	93.8	308.7	77.8	76.5	241.3
Average power/operating hr, kw	3684	3583	3693	3000	2992	2997
Average power/24-hr day, kw	3376	3352	3430	2510	2733	2681
Lost time, %	8.4	6.4	7.1	16.3	8.7	10.5
Excess reactivity	81 inhr	71 inhr		3.3%	3.3%	
Fuel pieces charged	119	128	293	1	2	4
Fuel pieces discharged	124	184	452	1	2	4
Research samples	95	86	251	6	4	14
Radioisotope samples	243	235	663	27	19	70

TABLE 2. USAGE OF EXPERIMENTAL FACILITIES – ORNL GRAPHITE REACTOR

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	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	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 (no samples during month)
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 reseorch
15, north	4 × 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Miscellaneous large-sample exposures
15, south	4 × 4	Operations	J. A. Cox	Miscellaneous lorge-sample exposures
16, north and south	4 × 4	Operations	J. A. Cox	Target exposures for radioisotopes and reseorch
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-somple 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 far 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
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

TABLE 2. (continued)

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
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 hales into discharge manifold
50, north	4 × 4	Solid State	J. H. Crawford	General sample-exposure facility
50, south	4 × 4	Physics	E. O. Wollan	Neutron spectrometer
51, north	4 × 4	Solid State	J. H. Crawford	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	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
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 af metals (no samples during month)
61	4 × 4	Operations	J. A. Cax	Half-hole for miscellaneous large-sample exposures
East and west animal tunnels				General exposures af large samples to low flux

TABLE 2. (continued)

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
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	E. P. Blizard	Lid tonk for shielding studies
A	1.68-in. dio	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, D	1.68-in. dia	Solid State	J. C. Pigg	Charging-face holes; insulation test
1069	1.5-in. dia	Unassigned		Charging hole containing an aluminum liner; used for general exposure of suitable samples
1768, 1867, 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
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 peripherol holes contain $CaCO_3$ for radioisotope production; 409 uncharged peripheral holes remain unused

TABLE 3. PRESSURE-DROP DATA

	PRESSURE DROP (in. water gage)		
	Glass Wool	CWS No. 6	Total Across Hause
3/31/54	2.9	3.2	7.4
2/28/54	2.8	3.0	7.0
Clean filters	1.1	1.3	3.3

Low-Intensity Test Reactor

The down time was exceptionally high because of shutdowns required for some of the experiments. Almost half (8.1%) the 16.3% lost time was due to the following shutdowns:

	March	February
Unscheduled shutdowns for operational reasons, hr	2.60	5.36
Regular operational shutdowns, hr	58.93	35.70
Special shutdowns for research, hr	59.90	17.13

The 200-g fuel element added in February provided sufficient reactivity for the LITR to be operated for four weeks, or twice the life provided by the 168-g elements. It appears that 200-g elements will be considerably cheaper to use because of the fewer shipments of spent fuel elements and the smaller amount of processing required. Operating data are given in Table 1.

Ion-exchange equipment for treatment of the LITR cooling water has been ordered from the Pennfield Company and delivery is expected about April 12. Design is almost completed for the piping necessary for installation of this equipment.

Work is still proceeding on installation of circulating fuel loops in holes HB-2 and HB-4. A lead shield has been installed in front of HB-2, along with considerable electrical and piping work. A stainless steel line has been installed in HB-4, with some of the steel shelves containing high-pressure piping outside the hole. Also during the month a semicircle about $1\frac{1}{4}$ in. in diameter was cut from the bottom skirt of the upper grid just above C-58 to provide room for hydraulic lines from a spent beryllium piece to be installed as part of the circulating fuel loop in HB-4. The upper grid was very radioactive and the reactor was left down overnight so that some of the radioactivity would decay.

The usage of experimental facilities in the LITR is indicated in Table 4.

RADIOISOTOPE PRODUCTION

Separation of fission products from tank-farm waste continued. About 900 curies of Cs^{137} was removed in highly concentrated form and stored pending final purification. Cesium production rates were reduced in order to separate the alkaline earth and rare earths; these fractions are being accumulated in the cell and will be recycled until about 1000 curies of Ce^{144} is collected.

Radioisotope production for the month is shown in Tables 5 and 6.

Fifty pounds of beryllium nitride pellets was received from Brush Beryllium Company, and preliminary arrangements have been made with Hanford to supply the cans into which the pellets are to be placed for irradiation at Hanford.

Hanford has indicated a desire to provide a special "through hole" facility in one of the reactors which would be used exclusively by ORNL for the irradiation of cobalt or other materials. They will be requested to make a rough estimate of the cost of this facility to ORNL.

RADIOISOTOPE DEVELOPMENT

Iodine-131 Plant Tests

Five dissolvings of unirradiated slugs were made in the new iodine plant during the month. Conditions for these runs were the same as those for regular I^{131} runs in existing equipment so as to afford a sound basis for comparison and to determine what changes are needed.

Test runs 1, 2, and 3 were made without I^{131} tracer; the main purpose was to follow the course of nitrite and nitrate compounds through the process and to learn how to operate the new equipment. Oxygen was sparged into the catch tank at a rate of 0.1 cfm during dissolving and sparging of run 2. The distribution of nitrates with O_2 sparging was 75% in the catch tank and 25% in the caustic scrubber; without O_2 sparging the distribution was 55% in the catch tank and 45% in the caustic scrubber. The nitrite content of the catch-tank liquor was not reduced by O_2 sparging in run 2, as compared with the amounts observed in runs 1 and 3. However, in run 4, with O_2 sparging, the nitrites were a factor of 3 less than the amount found in run 3.

The amount of nitrate carried over to the distillate receiver from the still varied from 25 to 75 g and was roughly proportional to the total nitrite content of the catch-tank liquor.

The rectifying column of the still was tested by distilling water from 5.3 *N* HNO_3; no nitrate was detected in the distillate. The chemistry involved in the distillation step is being investigated to determine what steps are required to reduce the distillation of nitric or nitrous acid.

To each of runs 4 and 5, about 100 mc of I^{131}

TABLE 4. USAGE OF EXPERIMENTAL FACILITIES – LITR

FACILITY NUMBER	TYPE OF FACILITY	DIVISION ASSIGNED TO	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 (G.E.)	D. S. Billington	General exposures of large samples and loops
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	Experiment being prepared
HB-5	6-in.-ID beam hole	Chemistry	C. H. Secoy	HRP fuel stability and corrosion tests (no tests during month)
HB-6	6-in.-ID beam hole	Chemistry	C. H. Secoy	HRP fuel stability and corrosion tests
HR-1, 2	Pneumatic tube	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	Chemistry	C. H. Secoy	Uranium exposures by J. Halperin
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-49	Be core piece with four vertical holes	Operations	J. A. Cox	Exposures of research and radioisotope samples
C-53, 56	Mg tray in core space	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	Analytical Chemistry	G. W. Leddicotte	Exposure facility for activation analyses
V-3, 4	Inclined low-flux hole	Unassigned		Empty

tracer was added during the dissolving. Inactive iodine was added to bring the total weight of iodine up to that expected in a 20-slug run. In run 4, 63% of the I^{131} was sparged from the dissolver; all the iodine was caught in the catch tank and the water scrubber. Sixty-three per cent of the I^{131} in the still solution was distilled and collected in the receiver; 0.8% was found in the caustic scrubber.

Glassware for the final purification cell has been designed and is being fabricated.

Multikilocurie Loading Cell, Building 3029

Approval for expenditure of funds for the multikilocurie loading cell was received during the month. Construction drawings of the cell are being made by the K-25 Engineering Department.

TABLE 5. PROCESSED RADIOISOTOPE PRODUCTION DURING MARCH

PRODUCT	SOURCE	AMOUNT (mc)	SPECIFIC ACTIVITY (mc/g)
Cerium-141	Hanford metal	262	c.f.*
Cerium-144	Hanford metal	1,395	c.f.
Cerium-144	Scrup waste	576	c.f.
Iodine-131	Graphite Reactor metal	52,717	c.f.
Iron-59	MTR irradiation	90	10,000
Phosphorus-32	Graphite Reactor irradiation	16,604	40,000
Sodium-24	LITR irradiation	17,416	2,903
Yttrium-91	Hanford metal	465	c.f.

*No added carrier.

TABLE 6. UNPROCESSED RADIOISOTOPE PRODUCTION DURING MONTH

PRODUCT	UNITS
Service irradiations	70
Barium-131	2
Bromine-82	5
Calcium-45	1
Chlorine-36	1
Copper-64	2
Europium-152, 154	1
Gallium-72	4
Gold-198	51
Gold-199	1
Hafnium-181	1
Iodine-131	4
Lanthanum-140	1
Mercury-197	2
Molybdenum-99	1
Osmium-191	3
Phosphorus-32	26
Potassium-42	19
Rubidium-86	4
Samarium-153	1
Selenium-75	1
Silver-111	3
Sodium-24	20
Total	224

The target date for completion of the engineering phase is April 30. A contractor will be engaged on a lump-sum basis to build the cell.

Orders have been placed for the cerium glass window and the pneumatic hoist, and delivery is expected within three months. Placement of an order for two model 8 manipulators is being delayed pending receipt of complete specifications from the manufacturer. Assurance has been given by the manufacturer that delivery on two manipulators can be made in July.

Fission-Product Equipment, Building 3028

Design criteria have been given to the Chemical Technology Division for the design of TBP extraction equipment for the plant that will produce short-lived fission products. Equipment to be designed and fabricated includes two pulse columns, pumps, associated tanks, and instrumentation. No completion date has been established.

Shielded Fission-Products Shipping Tank

The preliminary design and estimate of a very large shielded container to be used in shipping large amounts of fission-product solutions from Hanford, Arco, or Savannah were completed. If this carrier is constructed, it should be very useful for transporting other hot solutions, as well.

Multicurie Fission-Products Plant

Drawings and a cost estimate for the submission of a preliminary proposal for the multicurie fission-products plant are now being prepared by the Engineering Department.

Cesium-137 Source

The preparation of large gamma sources from fission-product $Cs^{137}Cl$ was successfully demonstrated by the completion of a 1540-curie unit on March 12.

A preliminary concentration and purification of the cesium was made in the small, south tank-farm plant. The product at this point was in a volume of 7.3 liters as cesium sulfate, containing corrosion products from stainless steel and other impurities. A purification of this material was made in all-glass equipment. The chemical steps involved were: three or more fractional crystallizations of cesium ammonium alum, precipitation of aluminum hydroxide by air-ammonia gas mixture, removal of sulfate ion by anion-exchange resin column, and evaporation and conversion of the product to cesium chloride.

A total of 2042 ± 50 curies of Cs^{137} was processed in 400-curie batches. The cesium chloride product totaled 1903 ± 50 curies in 1135 ml of solution, giving an over-all yield of about 93%.

The cesium chloride pelletizing and source assembly operations were made in the hot chemistry cell to take advantage of the versatility of the master-slave manipulators. For convenience in operation, the gamma source was made in the form of two pellets, each containing an equal quantity of Cs^{137}. In the following description of the pelletizing procedure, all curie values given have a probable error of ±2.5%.

Five hundred twenty milliliters of cesium chloride solution containing 773 curies of Cs^{137} was transferred by vacuum lift to a head vessel and dropped by gravity to an evaporator assembly. The evaporator consisted of a 400-ml capacity Vycor beaker heated by a flat resistance-wire furnace element and a heat lamp. Hot off-gas vacuum was connected to an inverted pyrex funnel over the beaker. The solution was evaporated to about 25 ml and then stirred with a glass rod until the crystals appeared to be dry. The salt was baked at approximately 400°C for 2 hr to remove any remaining water. That portion of the cesium chloride adhering to the beaker was scraped with a stainless steel blade. The salt was next transferred to a die made of Carpenter No. 484 tool steel and pressed at 20,000 psi. The cylindrical pellet was easily handled by tongs for measuring and loading in the source holder. An estimated 760 curies of Cs^{137} was contained in the pellet.

The same procedure was used to make the second pellet, which was estimated to contain 780 curies of Cs^{137}. The physical data for the two pellets are listed in Table 7.

The two pellets were stacked in a type 316 stainless steel cylinder with a 2-mm wall thickness and a 0.5-mm bottom window. A plug of the same metal was inserted and the closure was completed with Easy-Flo silver brazing alloy. An inspection of the braze seal gave some doubt as to its completeness; therefore, a layer of All-State No. 430 silver-

TABLE 7. PHYSICAL DATA FOR Cs^{137} PELLETS

	PELLET NO. 1	PELLET NO. 2	VALUES FOR STACKED PELLETS
Weight, g	33.07	27.86	60.93
Curies	760	780	1540
Specific activity, curies/g	22.98	27.997	25.27
Dimensions, cm			
Diameter	3.1826	3.1826	3.1826
Height	1.350	1.280	2.630
Volume, cc	10.739	10.182	20.922
Density, g/cc	3.079	2.736	2.912
Curies/cc	70.77	76.61	73.61

bearing stainless steel solder was run over the silver brazing alloy. This unit was placed in another type 316 stainless steel cylinder having a 0.5-mm bottom window and a type 410 magnetic stainless steel threaded plug. The closure was completed with the All-State solder to seal the threads.

The gamma window of the completed source was 1 mm of stainless steel, which has an attenuation of about 6%. The radiation intensity through this window was measured at a distance of 3 m with a hard-shell gamma-probe instrument. The value was 50 r/hr at 3 m, or 83.6 r/min at 30 cm.

Experiments with Inorganic Ion-Exchange Material

Studies are being made on an inorganic ion-exchange medium manufactured by the Minnesota Mining and Manufacturing Company. Since this medium is inorganic, it is believed that it will suffer much less radiation damage than the usual organic resin type. Radiation-damage studies are now in progress. One very good application for an ion exchanger of this type would be in the finishing stages of the cesium production process; accordingly, initial experiments are being made to study its characteristics in handling cesium. The capacity was determined to be 0.4 meq of cesium per milliliter of ion exchanger when the input liquor is at a pH of 7. The equilibration time was measured for cesium and it was found that approximately 75% of the cesium was taken up in 2 min. Further experiments indicated that cesium could be removed from an ammonium alum solution with good efficiency. If this step can be used on a large scale, it will reduce the time required for the purification cycle by a factor of 2.

Additional experiments were made by using mixed fission products from tanks which contained Purex 1AW waste. After removal of excess acid and dilution, the activity was taken up almost quantitatively on the ion exchanger. Elution was carried out first with 0.1 *N* HCl, and a small amount of cesium was removed. Further peaks of activity were removed with 1 *N* HCl. No complexing agents were tried; however, it is apparent that some chromatographic-type separation occurs even when diluted HCl is used as an elutriant.

Ruthenium Chemistry

The behavior of ruthenium in various processes used for the separation and purification of fission products has always imposed a difficulty. Experiments were made to learn more about the forms in which ruthenium exists in fission-product waste. Purex 1AW was evaporated to remove excess acid, adjusted to 3 *N* HNO_3, and passed through a column of Dowex-1 anion-exchange resin. Roughly one-half the ruthenium was taken up. The effluent was diluted to 1.5 *N* HNO_3 and again passed through a similar column, which removed very little of the remaining ruthenium. Apparently some separation of different forms of ruthenium was achieved; tests are continuing to determine the extractability of the nonabsorbed ruthenium in Varsol and TBP. The ruthenium taken up on the anion-exchange resin was only partially eluted with oxalic acid or HCl; it is probable that much of the absorbed ruthenium was reduced to the metal or a lower oxide.

Purification of Rubidium Target Material

The target material that has been used for the standard irradiation units of rubidium contains approximately 0.6% cesium, which is very troublesome in that it produces fairly large amounts of two-year Cs^{134}. Because of the very similar chemistry of cesium and rubidium, Cs^{134} greatly interferes with the experiments that many users of Rb^{86} have in progress. Amberlite 100 ion-exchange resin was used for the purification of 15 g of rubidium target material. The rubidium and cesium were selectively eluted with HCl, and a rubidium product containing only 0.08% cesium was obtained. Some sodium contamination was picked up from the ion-exchange material and the glassware used during the purification but is considered relatively unimportant as compared with the original cesium contamination.

RADIOISOTOPE SALES

In the past, all shipments of radioisotopes have been made on the basis of premium transportation costs to cover the total valuation of the radioactive material being shipped. In most instances the transportation costs have been greatly in excess of what they would have been if the shipment had been made at the maximum free valuation. As of March 29, 1954, all shipments are being made at the maximum free valuation unless requested otherwise by the consignee.

During the month, prices were established for several new items and are as follows:

Co^{57}	$ 25/mc
Co^{58}	20/mc
Eu^{155} (fission product)	10/mc
I^{129}	100/mg
Kr^{85}	50/curie

In addition, the krypton will be packaged in standard size packages of 100 mc, 500 mc, 1 curie, and 5 curies. An additional $15 package charge will be placed on all 100- and 500-mc packages.

A new shipping container that has been designed and approved by the Bureau of Explosives for shipment of radioactive gases such as A^{37}, Kr^{85}, and tritium has been put into use.

Radioisotope shipments made during March 1954 are compared in Table 8 with those made during February 1954 and March 1953. A breakdown according to separated and unseparated material (including totals for August 1946 through March 1954) and for project, nonproject, and foreign shipments is also shown.

RADIOACTIVE-WASTE DISPOSAL

A total of 11.0 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond (see Table 9). This discharge is 71% of that of last month and 31% of the average per month in 1953.

The volume of hot wastes received this month was relatively low. The waste evaporator was shut down intermittently to utilize the manpower on other jobs.

The evaporator was decontaminated for the repair of the automatic feed-control valve and some steam leaks on both the inlet and outlet side of the coils.

An unusual number of bearing failures occurred at the stack area this month. The bearings on both the electric, hot off-gas blower fan and motor

TABLE 8. RADIOISOTOPE SHIPMENTS

	MARCH 1954	FEBRUARY 1954	MARCH 1953	AUGUST 1946 THROUGH MARCH 1954
Separated material	933	850	840	43,411
Unseparated material	248	198	275	11,493
Total	1181	1048	1115	54,904
Nonproject	1071	937	1022	
Project	96	85	72	
Foreign	14	26	21	
Total	1181	1048	1115	

TABLE 9. ACTIVITY DISCHARGED TO WHITE OAK CREEK

DISCHARGED FROM	MARCH 1954		AVERAGE PER MONTH YEAR TO DATE		AVERAGE PER MONTH 1953	
	Gallons	Beta Curies	Gallons	Beta Curies	Gallons	Beta Curies
Settling basin	14,960,000	9.4	14,400,000	14.6	19,450,000	24.1
Retention pond	630,000	1.6	660,000	2.2	500,000	11.7
Total	15,590,000	11.0	15,060,000	16.8	19,950,000	35.8

had to be replaced because of excessive wear; the motor bearings on the 125-hp motor powering the cell and hood exhaust fan for Building 3026 were replaced, and the shaft bearings on the Radioisotope Area cell and hood exhaust fan were scraped and realigned.

The CWS filters in the cell and hood exhaust system serving Building 3026 were changed.

A total of 11,800 gal of nonradioactive concentrated chemical waste was transferred to chemical-waste storage pit No. 2. Of this amount, 5000 gal was $Al(NO_3)_3$ waste from Unit Operations, Building 4505, and 6800 gal was NH_4NO_3 from metal recovery operations, Building 3505.

The installation of the 4000-gal monitoring tank for the hot Pilot Plant, which will replace the two old concrete tanks W-1 and W-2, has been started.

Analytical tests of the corrosion coupons, removed from all the stainless steel monitoring tanks on February 10, indicated that very little corrosion has taken place over a six-month period. The coupons will be reinserted into the tanks and allowed to remain there for a one-year period before the next inspection.

Significant operating data for the waste evaporator are given in Table 10.

MISCELLANEOUS OPERATIONS

Water Demineralization

The demineralized-water plant operated without difficulty in March; however, the acid system is badly corroded and requires extensive repairs. Multiport valves are also giving trouble and will require some repair. Table 11 shows a comparison of the number of regenerations and the average amounts of water passed through each unit during February and March.

The production of demineralized water was 392,460 gal, compared with 318,660 gal in February.

Hydrogen Liquefaction

Twenty-two and one-half liters of liquid hydrogen was produced in five runs in March; however, much of this amount was lost during transfer operations

TABLE 10. WASTE-EVAPORATOR OPERATION

	SOLUTION FED TO EVAPORATOR (gal)	CONCENTRATE PRODUCED (gal)	VOLUME REDUCTION	BETA CURIES IN FEED	BETA CURIES IN CONDENSATE
March 1954	133,700	9,400	14.3:1	10,700	0.18
Average per month year to date	162,900	10,900	14.9:1	13,600	0.40
Average per month 1953	188,300	18,100	10.4:1	12,300	1.62

TABLE 11. AVERAGE AMOUNTS OF WATER PASSED THROUGH REGENERATION UNITS DURING FEBRUARY AND MARCH

UNIT	NUMBER OF REGENERATIONS		AMOUNT OF WATER THROUGH EACH UNIT (gal)	
	March	February	March	February
No. 1 cation	5	3	50,440	64,666
No. 2 cation	4	2	71,125	62,650
No. 1 anion	6	5	31,292	45,640
No. 2 anion	7	6	34,971	36,783

because of a defective transfer line. The transfer line is being repaired and a silica-gel cold trap is also being fabricated so that a special batch of unconverted liquid hydrogen can be prepared. As soon as this has been done, it is planned to keep a 15-liter storage flask filled with liquid hydrogen so that users can obtain it as needed. A second liquefier obtained from K-25 in February has been sent back for repair.

Activation Analyses

A total of 158 requests for information concerning activation analyses has been received; of the 59 which have developed into requests for analyses, 42 have been completed.

RALA

The repair of spare Rala equipment has been started. Some of the work performed to date includes:

1. the removal of the defective product evaporator tank which will be replaced with a new tank of different design and greater capacity,
2. the replacement of corroded universal joints on valve extension handles,
3. the repacking of all valves,
4. the replacement of Teflon liners in the sampler valves,
5. the replacement of the defective product-line ionization chamber.

The "clam-shell" heater which failed during the last run was replaced. This equipment was tested under operating conditions and was found to be satisfactory.

The next run is now scheduled to start in about one month. The exact starting date will depend on the completion of the cubicle repairs and the Hanford shutdown schedule.

SF MATERIAL CONTROL

Twenty enriched U-Al alloy fuel rods were shipped to Phillips Petroleum Company, Scoville, Idaho. This makes a total of 626 fuel rods and 59 control rods shipped to date.

During the month 77.62 kg of 93% enriched uranium in the form of U-Al alloy billets was received from Y-12 for extrusion by the Metallurgy Division in connection with the fabrication of Hanford "J" slugs; 60.83 kg of this material was returned to Y-12 following completion of extruding work. Some difficulty has been experienced in handling this material; namely: (1) there has been a net weight difference between Y-12 and X-10 weights on about 25% of the billets; (2) on March 15, the temperature controller on one of the preheat furnaces failed and allowed the furnace to overheat, resulting in a meltdown of eight billets into an irregular-shaped solid mass. No loss is believed to have been experienced because of this failure.

On March 18, 30 kg of 93% enriched uranium metal was received from Y-12 for use in fabricating metal foil for ANP critical experiments. However, owing to the excessive amount of work now being handled in the metallurgical shops, it was decided to request assistance from another AEC facility in rolling the foil. A letter has been sent to the AEC requesting that they arrange to have General Plate Company perform the rolling work. The material was returned to Y-12 on March 26 for storage until authorization is given to ship the material to General Plate Company.

Recovery operations were started on the Hanford metallurgical-waste program. The final results on the first three dissolver batches averaged only 57% as much material as was estimated by Hanford. One product batch, containing 587 g of plutonium, was completed and sent to the SF Office for storage. It was planned to ship this container to Rocky Flats March 30; however, the AEC Washington Office requested that the material be held as a possible source of low G/T plutonium.

The SF Office prepared a special report for inclusion in a four-plant report covering the estimated cost of measuring SF materials for process control and accountability purposes, cost of keeping records, and the cost of SF materials compared with the cost of measuring for accountability purposes. The report was prepared in response to a request made by the AEC.

Other special work during the month was the preparation of the ORNL Special Reactor Material cost budget for FY 1955 and FY 1956 and preparation of the ORNL quarterly radium inventory report for the period ending March 31, 1954.

Fissionable material receipts and shipments for March 1954 slightly exceeded the entire amount received and shipped during the calendar year 1953. The detail work involved in inspecting material and preparing documents increased very sharply. Temporary storage also presented a problem. It has been proposed that a new vault be constructed in order to solve the storage problem.

SF surveys consisted in visiting three persons possessing SF material and checking and weighing the material when feasible. No apparent discrepancies were encountered. In addition, the records of five analytical laboratories were audited, and the results disclosed that all records were in good order and that proper accounting had been made for all samples.

During March there were 27 receipts and 40 outgoing shipments, compared with 33 receipts and 32 shipments last month. Tables 12 and 13 are summaries of receipts and shipments for March.

TABLE 12. SF MATERIALS RECEIVED

FROM	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Carbide and Carbon Chemicals Co., K-25, CCC	Depleted uranium oxide	2	37,544.22
	U^{234} and U^{236} sources	1	0.02
Carbide and Carbon Chemicals Co., Y-12, CYT	93% U^{235}-Al alloy billets	8	77,617.23
	93% U^{235} (fluoride mixture)	2	1.52
	93% U^{235} metal	1	29,997.25
	PuO_2 sample	2	Negligible
	Depleted uranium metal billet	3	798,717.00
	Normal uranium (UO_2F_2)	1	1,589.00
	Normal uranium compounds	3	1,279.00
General Electric Co., AGT	Enriched uranium specimen	2	16.02
North American Aviation, Inc., DNA	Normal uranium (9 samples)	1	153.00
Phillips Petroleum Co., MTI	93% U^{235} (UF_4)	1	0.27
Total shipments received		27	

TABLE 13. SF MATERIALS SHIPPED

TO	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Argonne National Laboratory, ANL	Depleted uranium sliced slugs	1	1,724.00
	Plutonium in slug		0.10
	93% U^{235} samples	1	0.04
Carbide and Carbon Chemicals Co., Y-12, CYT	Normal uranium compounds	3	7,374.17
	93% U^{235}-Al alloy rods	13	60,827.78
	PuO_2 residue	2	0.07
	U^{233} as $UO_2(NO_3)_2$	1	0.03
	Thorium compounds	3	47,409.00
	93% U^{235} metal	1	29,997.25
	93% U^{235} solution	1	0.72
	Depleted uranium metal turnings	1	3.00
Dow Chemical Co., SFJ	Plutonium nitrate solution	1	13.59
E. I. du Pont de Nemours & Co., SDA	Normal U-Al alloy slugs	1	138.00
Phillips Petroleum Co., CPI	Spent LITR elements	1	817.59
	Normal U-Al alloy "J" slugs	1	70,941.00
Phillips Petroleum Co., MTI	93% U^{235} (UF_3)	2	0.03
	93% U^{235}-Al assemblies	4	4,189.03
Sylvania Electric Products, Inc., SYL	Depleted U-Al alloy slugs	1	9,019.00
USAEC, Oak Ridge Operations Office, CPA	Normal U_3O_8, irradiated	1	0.83
Westinghouse Electric Corp., WEM	93% U^{235}-Al alloy foil	1	1.36
Total shipments		40	