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OPERATIONS DIVISION MONTHLY REPORT

FOR

MONTH ENDING DECEMBER 31, 1953

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OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending December 31, 1953

by

A. F. Rupp

DATE ISSUED

FEB 11 1954

OAK RIDGE NATIONAL LABORATORY
Operated by
CARBIDE AND CARBON CHEMICALS COMPANY
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OPERATIONS DIVISION MONTHLY REPORT

SUMMARY

The activities of the Operations Division for the month ending December 31, 1953 are summarized and indexed below:

1. Both the Graphite Reactor and LITR operations were satisfactory and uneventful during the month (p. 2).
2. New shim rods had to be straightened before they could be inserted in the LITR (p. 7).
3. Record amounts of Sr^{90} and Ru^{106} were produced this month (p. 7).
4. Encouraging results were obtained on the new silver deposition method of I^{131} purification (p. 8).
5. Holdup of construction of the multikilocurie loading cell will seriously affect the Co^{60} utilization program (p. 9).
6. Plans were made for producing large Zr^{95}-Nb^{95} sources for radiation tests at the UT-AEC farm (p. 9).
7. A test pellet of pure fission-product $Cs^{137}Cl$ was fabricated and tested (p. 9).
8. Strontium-90 may be fabricated into light-metal alloys for future sources (p. 10).
9. Rala equipment was thoroughly tested. The use of a filter aid was found to be a factor in recent poor process performance (p. 12).

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REACTOR OPERATIONS

Operating Data

	DECEMBER 1953	NOVEMBER 1953	YEAR TO DATE 1953
ORNL Graphite Reactor			
Reactor power			
Total accumulated (kwhr)	2,592,043	2,471,236	30,351,453
Average kw/operating hr	3,711	3,700	3,749
Average kw/24-hr day	3,484	3,432	3,465
Lost time (%)	5.97	7.65	7.57
Excess reactivity (inhr)	150	131	
Slugs discharged	131	92	1,308
Slugs charged	85	70	1,165
Product made (g)	94.60	90.19	1,107.72
Product discharged (g)	7.63	4.26	42.89
Low-Intensity Test Reactor			
Reactor power			
Total accumulated (kwhr)	2,023,049	1,923,600	15,198,891
Average kw/operating hr	2,994	2,988	1,997
Average kw/24-hr day	2,719	2,672	1,735
Lost time (%)	9.2	10.57	13.1
Position of No. 2 shim rod (in. out)	19.685*	20.111	

*This corresponds to approximately 3.1% excess reactivity.

ORNL Graphite Reactor

There were no slug ruptures during the month. The power was increased from 3700 to 3800 kw on December 28, and this has increased the maximum metal temperature from 245 to 255°C. If no ruptures occur at the higher temperature, the power will be raised again in about a month.

On December 28, the length of the slug row in each of several fuel channels was measured and compared with the results of measurements made about six months ago. All these rows, composed of slugs which were not beta transformed, were found to have increased in length. The minimum increase was approximately 3 in., and the maximum increase was about 6 in., or a maximum of about 0.143 in. per slug. This increase correlates with results obtained by the Metallurgy Division in measuring slugs discharged from the reactor from channels containing a ruptured slug. Slugs which have not been beta transformed have increased in length as much as 0.187 in. after 464 days of irradiation; the average increase in length for 23 slugs irradiated for 569 days was 0.084 in. per slug. The reactor contains a considerable number of such slugs which were charged before it was learned that they were improperly heat-treated, and it may be necessary eventually to replace some of them.

Ocasionally, the reactor power was unsteady during the month and is believed to have resulted from the entrapment of air bubbles in the top of the tube on the hole 19 equipment. The air was trapped because the water outlet was located on the side instead of on the top of the tube. The outlet will be rotated so that the trouble will be eliminated.

Operation of the reactor exhaust fans was normal except that some of the duct work on the No. 1 fan cracked because of years of vibration and had to be repaired by welding.

The usage of experimental facilities in the ORNL Graphite Reactor is shown in Table 1.

TABLE 1. 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, north and south	4 × 4			Regulating rod
2, north and south	4 × 4			Regulating rod
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, north and south	4 × 4			Shim rod
6, north and south	4 × 4			Shim rod
7, vertical	4 × 4			Safety rod
8, vertical	4 × 4			Safety rod
9, vertical	4 × 4			Safety rod
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, north and south	4 × 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
14, north and south	4 × 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
15, north and south	4 × 4	Operations	J. A. Cox	Miscellaneous large-sample exposures
16, north and south	4 × 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
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	Unassigned		Empty
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	9 × 9			Contains chamber for high-power-level trip circuit
33	9 × 9			Contains 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 1 (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	Training School	H. S. Pomerance	Contains chamber for reactor kinetics study
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 dischorge 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 dischorge from hole 22 pneumatic tubes; hole into discharge manifold
46	6-in. dia			Used for viewing west end of graphite with periscope; vertical hole into discharge manifold
47	6-in. dia			Used for viewing west end of graphite with periscope; vertical hole 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 the temperature of liquid nitrogen
53	4 × 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Half-hole for miscellaneous large-sample exposures
54	4 × 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Half-hole for miscellaneous large-sample exposures
55	4 × 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Half-hole for miscelloneous 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 callimator
57, south	4 × 4	Physics	S. Bernstein	Neutron polarization
58, north	4 × 4	Solid State	O. Sisman	Circulating loops for Na and NaK
58, south	4 × 4	Chemistry	H. Levy	Neutron spectrometer
59	4 × 4	Unassigned		Holf-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 animal tunnel				General exposures of large samples to low flux

TABLE 1 (continued)

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
West animal tunnel				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	E. P. Blizard	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	Solid State		Charging-face hole; coaxial cable exposure
C	1.68-in. dia	Chemical Technology		Charging-face hole; thorium exposures
D	1.68-in. dia	Chemical Technology		Charging-face hole; uranium exposures
1069	1.5-in. dia	Unassigned		Charging hole containing an aluminum liner; used for general exposure of suitable samples
1768	1.75 in. square	Solid State	R. H. Kernohan	Charging hole containing neutron converter donut; used for general exposures of samples to fast-neutron flux
1867	1.75 in. square	Solid State	R. H. Kernohan	Charging hole containing neutron converter donut; used for general exposures of samples to fast-neutron flux
1968	1.75 in. square	Solid State	R. H. Kernohan	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

The change in pressure drop (inches of H_2O) across the exhaust-air filtration system during the month was as follows: glass wool filters, 2.6 to 2.7 in.; CWS-6 filters, 2.8 to 2.7 in.; total across the system, 6.6 to 6.8 inches. With new, clean filters these values are 1.1, 1.3, and 3.3 in., respectively.

Low-Intensity Test Reactor

The LITR operated very satisfactorily during the month.

By scheduling work in the core, the removal of the top plug has been limited to about once every

TABLE 2. 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. D. 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	H. F. McDuffie	HRP fuel stability and corrosion tests
HB-6	6-in.-ID beam hole	Chemistry	H. F. McDuffie	HRP fuel stability and corrosion tests
HR-1	Pneumatic tube	Operations	J. A. Cox	General short exposures of reseorch and radio-isotope samples
HR-2	Pneumatic tube	Operations	J. A. Cox	General short exposures of research and radio-isotope 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	H. F. McDuffie	Empty
C-46	Hollow Be core piece with access tube from top plug	Solid State	G. W. Keilholtz	ANP fuel tests (no tests during month)
C-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	Mg tray in core space	Operations	J. A. Cox	Exposures of research and radioisotope samples
C-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	Inclined low-flux hole	Unassigned		Empty
V-4	Inclined low-flux hole	Unassigned		Empty

two weeks. This materially reduces the work during alternate shutdowns. In December, for example, the shutdowns for Operations work accounted for only 5.9% down time, while shutdowns for research accounted for an additional 3.3%.

No bid has yet been received on the revised specifications for a mixed-bed resin column of 20-gpm capacity.

On December 8, an attempt was made to replace the No. 2 shim rod. The replacement rod did not move freely in the bearings, and a second rod that was tried gave no better results. The old rod was then reinserted, and the reactor operated with this rod until December 29. The two rods which had given trouble were straightened (one was found to be bowed about $\frac{1}{16}$ in.), and when they were inserted in the reactor they moved freely.

The usage of experimental facilities in the LITR is indicated in Table 2.

Irradiation Services

Stringers 13, 14, and 15 contained 4 research and 130 radioisotope production targets at the end of December, compared with 13 research and 180 radioisotope targets at the end of November. Pneumatic tubes in hole 22 were charged with 39 research but with no radioisotope samples during December, compared with 13 research and 29 radioisotope targets charged in November. A total of 209 targets was present in all positions, compared with 304 in November.

RADIOISOTOPE PRODUCTION

Radioisotope production for the month is given in Tables 3, 4, and 5. One iodine run was lost because of an operating error. Production of Ru^{106} and Sr^{90} this month was the largest attained so far in the radioisotope program. These radioisotopes are being recovered from tank-farm wastes.

RADIOISOTOPE SALES

Radioisotope shipments made during December 1953 are compared in Table 6 with those made during November 1953 and December 1952. A breakdown according to separated and unseparated material (including totals for August 1946 through December 1953) and for project, nonproject, and foreign shipments is also shown.

TABLE 3. PROCESSED RADIOISOTOPE PRODUCTION DURING DECEMBER

PRODUCT	SOURCE	AMOUNT (mc)	SPECIFIC ACTIVITY (mc/g)
Barium-140	Hanford metal	260	c.f.*
Calcium-45	Hanford irradiation	218	10,750**
Calcium-45	Hanford irradiation	2,295	38
Cerium-144	Hanford metal	220	c.f.
Chromium-51	LITR irradiation	1,399	3,170
Iodine-131	Graphite Reactor metal	68,880	c.f.
Iron-55	Hanford irradiation	70	1,550
Phosphorus-32	Graphite Reactor irradiation	16,263	40,000
Ruthenium-106	Scrup waste	22,982	16,100
Sodium-24	LITR irradiation	14,411	4,200
Strontium-89	Hanford metal	392	c.f.
Strontium-90	Scrup waste	36,700	c.f.
Sulfur-35	Hanford irradiation	10,492	c.f.

*No added carrier.

**Made from target enriched in Ca^{44}.

TABLE 4. UNPROCESSED RADIOISOTOPE PRODUCTION DURING DECEMBER

PRODUCT	UNITS
Service irradiations	51
Antimony-beryllium	1
Antimony-122	1
Antimony-125	1
Arsenic-77	1
Bromine-82	5
Cerium-141	1
Chromium-51	1
Cobalt-60	1
Copper-64	3
Europium-152,154	1
Gold-198	42
Hafnium-181	1
Indium-114	1
Iodine-131	3
Molybdenum-99	1
Nickel-63	6
Phosphorus-32	1
Potassium-42	18
Rhenium-186	1
Rubidium-86	3
Silver-111	2
Sodium-24	15
Strontium-89	1
Zinc-65	1
Total	163

TABLE 5. SPECIAL RADIOISOTOPE PREPARATIONS DURING DECEMBER

	NUMBER	TOTAL AMOUNT (mc)
Ir^{192} sources	2	
Cs^{137} source	1	3,000
Co^{56} source	1	1,300
Sn^{116} source	1	
Sr^{90} sources	5	
A^{37} ampoules	5	5
H^3 ampoules	2	4,200
H^3-Zr targets	12	10,405
He^3 ampoules	6	15 cc

RADIOISOTOPE DEVELOPMENT WORK

New Iodine-131 Processing Unit, Building 3028

Installation of instruments for the new I^{131} processing unit is 90% complete; electrical work is 95% complete. Testing and calibration of equipment was started; construction work is now scheduled for completion by February 1.

Purification of Iodine-131

Thirty experiments were run during the month to determine the effect of several variables on the plating of I^{131} on silver metal surfaces. The experiments were made by using 2 × 2 cm silver sheets in solutions containing I^{131} tracer and iodide ions in concentrations equivalent to a 10-curie I^{131} run. The 1 liter of test solution was made up to contain 10 g of Na_2SO_4, 1 g of $NaHSO_3$, and 104 μg of iodine as KI; the pH was adjusted to between 3 and 4 with H_2SO_4. The results of these experiments are listed below.

1. The rate of reaction of I^- with silver surfaces varies directly with the I^- concentration, inversely with the amount of I^- already deposited on the silver surface, and directly with the solution temperature. No studies were made to determine the relative influence of each variable; however, the relationship is apparently nonlinear.

2. The maximum amount of I^- taken up under the given test conditions by the use of silver sheet pretreated with dilute HNO_3 was 80% of the total iodine in the test solution. Approximately 25% was taken up in 1 hr at 25°C.

3. By electroplating a very thin coating of silver onto the base metal of rolled silver sheet, the uptake of I^- was increased to 90% in 1 hr at 25°C.

4. The maximum amount of I^- taken up at 25°C on unplated silver surfaces is approximately 16 $\mu g/cm^2$.

TABLE 6. RADIOISOTOPE SHIPMENTS

	DECEMBER 1953	NOVEMBER 1953	DECEMBER 1952	AUGUST 1946 THROUGH DECEMBER 1953
Separated material	859	807	749	40,782
Unseparated material	169	237	176	10,863
Total	1028	1044	925	51,645
Nonproject	932	943	824	
Project	73	79	89	
Foreign	23	22	12	
Total	1028	1044	925	

5. The optimum pH range for I^- uptake is 3 to 4.

6. Electrical coupling with a platinum anode increased I^- uptake rate on the unplated silver surface to 40%/hr at 25°C. Couples of Ag,Au and Ag,C gave about the same results; however, the maximum total uptake was not increased.

7. Regeneration of the plated silver surface with H_2S and with thiourea solutions did not decrease the uptake rate or total iodine capacity of the silver surface.

Further experiments with flat electrodes and with columns packed with silver Raschig rings are planned.

Shielded Analytical Hood for Iodine-131

The budget request for a shielded analytical hood was approved, and a work order was written for its construction. Design drawings are 90% complete. Detailed drawings are being submitted to the Mechanical Department for fabrication as they are completed. All hot sampling and analytical control work for the new iodine unit will be done in this hood; consequently, it will not be necessary to transport hot samples to the analytical laboratory.

Multikilocurie Loading Cell, Building 3029

The construction request for the multikilocurie loading cell has not yet been approved by the AEC. Completion of specifications for the shielding window glass, manipulators, and hoist is expected by January 8, 1954. The completion of this cell is necessary for the handling of large sources of Co^{60} and other isotopes in the teletherapy source-fabrication program.

Separation of Short-lived Fission Products, Building 3028

Design and process development work continued on the unit which will be associated with the new iodine plant and which will be used to separate other short-lived fission products from the I^{131} plant UNH waste. Nineteen large Zr^{95}-Nb^{95} sources, totaling 2500 curies, will be required by the UT-AEC farm for animal radiation tests next summer. It is planned to prepare these sources in the new unit. Piping changes were made so that UNH solution from dissolver B could be passed through a silica-gel column located in utility cubicle C.

A preliminary, chemical flow sheet for separation of short-lived fission products has been completed. An important part of the process is the removal of uranium by TBP solvent extraction, and arrangements are being made with the Chemical Technology Division to design and build the small pulse columns required. Other developmental work was done on a rapid method for coprecipitating Sr^{89}, Ba^{140}, and $Pb(NO_3)_2$ carrier with fuming HNO_3 from the concentrated TBP process effluent. A Sr^{89} yield of about 80% was obtained, and this is satisfactory for fast radioisotope-separation processes.

Cesium-137 Source

Detailed testing continued on various phases of the Cs^{137} fabrication problem. Most important are the corrosion tests on the source container and the solution evaporator and the radiation stability tests on the compressed CsCl pellet.

Test strips of brass, of silver-plated brass, and of type 304 stainless steel were immersed to a depth of 1.5 cm in dry $Cs^{137}Cl$ powder. The type 304 stainless steel showed no evidence of corrosion after exposure for 30 days. Both the brass and the silver-plated brass showed a slight corrosion on that portion under the powder and heavy corrosion on the area exposed to air above the powder.

A solution containing approximately 40 curies of $Cs^{137}Cl$ in 20 ml of water was allowed to stand in types 304 and 309 stainless steel cups. In both cases, the $Cs^{137}Cl$ was evaporated to dryness to remove excess HCl before making the test. In a period of three days, both cups developed approximately the same degree of corrosion, which was evidenced by an orange-red deposit over the surface of the metal covered by the liquid. This deposit, presumably hydrated Fe_2O_3, was easily removed by washing.

A similar test with Hastelloy C, in which a green solution was formed, showed that this alloy also was corroded by $Cs^{137}Cl$.

A solution containing 65 curies of purified $Cs^{137}Cl$ was evaporated to dryness, after which the salt was powdered. The powder was transferred to a 1-cm-dia die and pressed at approximately 38,000 psi. The resulting pellet was weighed and measured, and it was estimated that about 60 curies of powder had been transferred to the die. The following observations on the pellet were made:

Appearance	Surfaces glazed and edges sharp
Weight	2.95 g
Diameter	0.9992 cm
Height	1.117 cm
Density	3.37
Specific activity	~20 curies/g
Radiation intensity	52 r/hr at 32 in.

Thulium Source

A 100-mg pellet containing more than 99.9% Tm_2O_3 was sealed in 2S aluminum for irradiation in the LITR at a flux of 2.6×10^{13}. The irradiation will be started on January 12, 1954.

Strontium-90 Sources

A possible method for preparing very large Sr^{90} beta sources is by alloying strontium with light metals, such as aluminum and magnesium, and rolling the alloys into thin sheets. The sheets could then be cut, shaped, and encased in a suitable holder. Another method is by electrodeposition, which is difficult but not impossible to carry out. Some preliminary tests and literature searches are reported below.

Nowotny and Wesenberg[1] report that alloys containing 15% strontium can be rolled and drawn and that they do not react with air or water to any appreciable extent; the strontium-aluminum phase diagram is also given.

Another report indicated that aluminum will reduce strontium salts to the metal. Attempts to prepare an alloy in the laboratory by the $Sr(NO_3)_2$-Al or SrO-Al method were unsuccessful because of the high temperatures required. A 2% strontium alloy was prepared by using the SrF_2-Al method. In this case, the mixture is self-fluxing.

A strontium-aluminum alloy containing 10 to 15% strontium was prepared by heating SrF_2 and an equivalent amount of lithium metal plus the required excess of aluminum. The mixture was heated by means of an induction heater in an argon atmosphere; the reduction occurs at moderate temperature with very little vaporization of metal. The alloy contained some lithium metal, but it was only slightly reactive with the atmosphere.

Several references were found on the preparation of magnesium-strontium alloys. A British patent (575061) describes the preparation of one of these alloys by heating the mixture Na + 20% NaF + $SrCl_2$ + Mg at 700 to 900°C.

Strontium may be electrolytically deposited from fused salts (German patent 738870), from liquid ammonia (French patent 949844), and from acetone.[2] An Austrian patent (170266) describes a method of plating strontium from an aqueous solution into a liquid-gallium-metal cathode. The plating bath may then be changed to ethylenediamine, and the gallium metal is converted into an anode which makes it possible to plate the strontium on a suitable, solid, metallic cathode.

Brief tests were made in plating strontium from acetone solution, and they were successful enough to warrant further work. A cell is being made in which plating can be done from a $SrBr_2$-acetone

[1] H. Nowotny and H. Wesenberg, *Z. Metallkunde* 31, 363 (1939).

[2] H. E. Patten and W. R. Mott, *Trans. Am. Electrochem. Soc.* 15, 529 (1909).

bath, under an inert atmosphere, and onto a copper cathode. A $CuBr_2$-acetone bath will then be substituted so that the strontium will be covered with metallic copper. Strontium-89 will be used as a tracer in these experiments.

Radiation Stability of Bakelite Cement

Bakelite varnish cement is frequently used as a sealing agent in the fabrication of radiation sources, and irradiation tests were made for determining its radiation stability, which has already been shown to be very good by presumptive tests. Air-dried bakelite cement (1.2 g) was exposed to a total dose of 10^8 r in the cobalt irradiator. The pressure developed in a 25-cc free volume was 0.25 atm, and no damage could be detected by visual examination. These results indicate that dried bakelite cement is quite stable under radiation.

Assay Methods for Argon-37

Work continued on the calibration of an ion chamber for A^{37} assay. The x ray emitted from A^{37} has an energy of 2.63 kev and a fluorescence yield of 0.108. The mass absorption coefficient for propane is about 2000. If the ion yield for A^{37} is assumed to be the same as that for tritium (about 100% in each case), as is claimed by several authorities, the calibration of a chamber for tritium is valid for A^{37}. The ion current in a Borkowski chamber filled with propane to a pressure of 1 atm is then calculated to be 1×10^{-6} amp for 1.67 curies of A^{37}.

RADIOACTIVE-WASTE DISPOSAL

A total of 18.87 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond (see Table 7); this discharge is 53% of the average for the year to date. The leaks in the metal-waste and the chemical-waste lines from Building 3026-D which accounted for most of the discharge last month have been repaired.

The chemical-waste evaporator was shut down for 94 hr this month to repair the valve to the drain line from the bottom of the evaporator tank to the concentrate storage tank and to repair some steam leaks; the released manpower was used for other scheduled work. Significant operating data for the evaporator are shown in Table 8.

TABLE 7. ACTIVITY DISCHARGED TO WHITE OAK CREEK

DISCHARGED FROM	DECEMBER 1953		AVERAGE PER MONTH 1953		AVERAGE PER MONTH 1952	
	Gallons	Beta Curies	Gallons	Beta Curies	Gallons	Beta Curies
Settling basin	16,225,000	17.75	19,446,000	24.06	21,963,000	34.25
Retention pond	529,000	1.12	501,000	11.69	385,000	7.25
Total	16,754,000	18.87	19,947,000	35.75	22,348,000	41.50

TABLE 8. WASTE-EVAPORATOR OPERATION

	SOLUTION FED TO EVAPORATOR (gal)	CONCENTRATE PRODUCED (gal)	VOLUME REDUCTION	BETA CURIES IN FEED	BETA CURIES IN CONDENSATE
December 1953	179,129	19,128	9.37:1	10,517	0.12
Average per month 1953	188,293	18,108	10.40:1	12,316	1.62
Average per month 1952	188,180	13,010	14.46:1	18,123	1.98

Construction of the pump pit in the south tank farm has been started. This pit is for the waste line from the tank farm to the chemical-waste storage pit No. 2.

The Cottrell precipitator was shut down for 4 hr to remove defective wet- and dry-bulb thermometers and to replace a broken valve-handle extension.

MISCELLANEOUS OPERATIONS

Water Demineralization

The production of demineralized water was 379,140 gal, compared with 339,600 gal in November.

Hanford Irradiations

The following radioisotope samples were received from Hanford on December 8:

Sample Number	Material	Number of Targets
ORNL-147	Fe_2O_3	1
ORNL-152	$AgNO_3$	1
ORNL-156	Cadmium	2
ORNL-160	Cs_2CO_3	1
ORNL-165	$CaCO_3$	2

Cyclotron Radioisotopes

No cyclotron targets were received during the month of December.

Activation Analyses

A total of 141 requests for information concerning activation analyses has been received; 53 have developed into requests for analyses, 42 of which have been completed.

RALA

Decontamination, repair, and testing work on Rala equipment was continued and is expected to be completed during the first week in January. A small test run will then be made in preparation for a large-scale run tentatively scheduled to begin on January 16, 1954.

The UNH "crud" filters were replaced with new units which were checked for leaks and flow rates and which were found to be satisfactory. The process filters, after being repaired, were tested and found to be passing a precipitate of lead and barium carbonates through the filter media. New process filters are being fabricated as replacements for the leaking units. A leak in the product line to the resin-column cubicle was found and repaired.

The Teflon gaskets on all valves and filters have been replaced with gaskets made of polyethylene, which is more stable in high radiation fields.

Several tanks in cell A, in which a filter aid had been used, have been washed with 5% ammonium bifluoride solution to dissolve any filter aid which may have been left in the system. Filtration tests following these washes seem to indicate that the removal of this material has been completed.

SF MATERIAL CONTROL

Three shipments consisting of 99 drums of UNH solution containing 8457 kg of depleted uranium were made to Carbide and Carbon Chemicals Company, Y-12, during the month. These shipments, numbered 35 through 37, were of uranium recovered under the Metal Recovery Program and make a total of 85,423 kg shipped to date.

One fuel assembly and one shim safety-control rod were shipped to Phillips Petroleum Company, Scoville, Idaho. This makes a total of 561 fuel assemblies and 59 control rods shipped to date.

Twelve kilograms of contained U^{235} in the form of metal to be used in fabricating MTR assemblies was received from Y-12.

Difficulty has been experienced at the Metal Recovery Plant in the recovery of approximately 6636 kg of depleted uranium which was received from Harshaw Chemical Plant during November and December. The material, supposedly in the form of sodium diuranate, was found to be largely "crud," which requires a major leaching operation prior to processing. Since the Laboratory lacks adequate facilities for this type of operation, the SF group has recommended that the material be shipped to Y-12 for recovery. This proposal is receiving serious consideration. K-25 is interested in having this material processed at the earliest possible date, and they believe also that Y-12 can accomplish the recovery better than any other site. Unless a decision is reached soon, the material will probably have to be stored for several years in the burial-ground area. The present containers are corroding very fast; so it will be necessary to obtain better drums to store the material. Many of the drums were already severely damaged by corrosion when they were shipped from Harshaw; some of them

even had holes which were covered with masking tape.

In the interest of simplifying SF accountability for personnel possessing small quantities of material, the SF Accountability Office started a campaign to encourage personnel who are qualified, because of the small quantity of material held, to change their accountability from a status based on routine procedure to one based on research issuance. Official Bulletin AR – No. 268 was issued in this connection, and SF office personnel contacted 25 persons to further explain the research-issuance procedure. Of this number, two persons applied for a research issuance, three persons rejected the plan, and the balance decided to study the matter further. Those rejecting the plan stated that the records required under the standard SF accounting procedure actually aided them in keeping a tabulation of their material.

Five persons holding SF material were visited during the month; the material in their possession was checked and weighed when feasible and no apparent discrepancies were encountered. The records of six analytical laboratories also were audited, and the results disclosed that all records were in good order and that proper accounting had been made for all samples.

During December, there were 25 receipts and 23 outgoing shipments, compared with 25 receipts and 27 shipments last month. Tables 9 and 10 are summaries of receipts and shipments for December.

TABLE 9. SF MATERIALS RECEIVED

FROM	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Brookhaven National Laboratory, BNL	Depleted uranium	3	2,156,000.00
	Plutonium		197.00
Carbide and Carbon Chemicals Co., Y-12, CYT	Enriched uranium	5	12,933.01
	Normal uranium	8	9,490.96
	Plutonium	1	Negligible
	U^{236}	1	0.015
General Electric Co., AGT	Enriched uranium	1	0.83
	Normal uranium	1	30.00
General Electric Co., SGE	Enriched uranium	1	0.08
Harshaw Chemical Co., MHR	Depleted uranium	1	969,000.00
Iowa State College, ISC	Normal uranium	1	412.00
Phillips Petroleum Co., MTI	Enriched uranium	2	7.05

[redacted]

TABLE 10. SF MATERIALS SHIPPED

TO	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Carbide and Carbon Chemicals Co., K-25, CCC	Depleted uranium	2	357.00
	U^{233}	1	0.59
Carbide and Carbon Chemicals Co., Y-12, CYT	Enriched uranium	6	690.99
	Depleted uranium	4	8,457,382.18
	Normal uranium	3	4,460.90
	U^{233}	1	Negligible
	Plutonium	1	Negligible
	Thorium	1	34,428.00
General Electric Co., SGE	Enriched uranium	1	53.46
Phillips Petroleum Co., MTI	Enriched uranium	1	300.00
USAEC, Oak Ridge Operations Office, CPA	Normal uranium	1	0.10
Westinghouse Electric Co., WEM	Normal uranium	1	369.00

[redacted]