[redacted]

CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0349497 5

ORNL-1564
Progress

AEC RESEARCH AND DEVELOPMENT REPORT

LABORATORY RECORDS
1954

OPERATIONS DIVISION MONTHLY REPORT

FOR

MONTH ENDING MAY 31, 1953

DECLASSIFIED
Classification Changed To:
By Authority Of: AEC 9.21.70
By: G. Goldberg 2.10.71

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this document, send in name with document and the library will arrange a loan.
UCN-7969
(3 3-67)

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

[redacted]

[redacted]

ORNL-1564

This document consists of 22 pages.

Copy 3 of 49 copies. Series A.

Contract No. W-7405-eng-26

OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending May 31, 1953

by

M. E. Ramsey

DATE ISSUED

JUL 15 1953

OAK RIDGE NATIONAL LABORATORY
Operated by
CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
Post Office Box P
Oak Ridge, Tennessee

[redacted]

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES

3 4456 0349497 5

[redacted]

ORNL-1564
Progress

INTERNAL DISTRIBUTION

1. C. E. Center
2. Biology Library
3-4. Central Research Library
5-7. Central Files
8. Central Files, ORNL R.C.
9. C. E. Larson
10. P. C. Aebersold
11. E. A. Bagley
12. G. E. Boyd
13. R. B. Briggs
14. D. W. Cardwell
15. G. H. Clewett
16. D. D. Cowen
17. J. A. Cox
18. J. S. Felton
19. K. A. Fowler
20. G. H. Gillette
21. C. S. Harrill
22. A. Hollaender
23. H. K. Jackson
24. C. P. Keim
25. M. T. Kelley
26. R. S. Livingston
27. S. A. Lough
28. K. Z. Morgan
29. E. J. Murphy
30. M. E. Ramsey
31. P. M. Reyling
32. L. P. Riordan
33. A. F. Rupp
34. E. D. Shipley
35. A. H. Snell
36. F. L. Culler
37. H. F. Stringfield
38. C. D. Susano
39. J. A. Swartout
40. A. M. Weinberg
41. C. E. Winters
42. E. J. Witkowski

EXTERNAL DISTRIBUTION

43-46. AEC, Washington
47. Technical Information Service, Oak Ridge
48-49. Hanford Operations Office

[redacted]

[redacted]

CONTENTS

	Page
SUMMARY	1
REACTOR OPERATIONS DEPARTMENT	3
Operating Data	3
Reactor Operations	3
ORNL graphite reactor	3
Low-intensity test reactor	7
Filter House	9
Fan House	9
Radioisotopes	9
Water-Demineralization Plant	10
CHEMICAL SEPARATIONS AND RADIOISOTOPE DEVELOPMENT DEPARTMENTS	10
Radioisotopes	10
Iodine (I^{131} – 8 d)	10
Iodine development work, Building 3028	10
Phosphorus (P^{32} – 14.3 d)	10
Phosphorus development work	10
Precipitation process, Building 3515	10
Purification of Cs^{137}	10
Purification of Sr^{90}	11
Purification of Pm^{147}	11
Manganese (Mn^{54} – 310 d) from the 86-in. cyclotron	11
Tests on chemical resistance of Tygothene tubing	11
Processed radioisotope production	11
Special preparations	11
Radioactive-Waste Disposal	11
Waste discharged to White Oak Creek	12
Chemical-waste evaporator	12
Waste-tank inventory	13
RaLa (Ba^{140} – 12.5 d)	14
RADIOISOTOPE SALES DEPARTMENT	15
Hanford Irradiations	15
Cyclotron Radioisotopes	15
Activation Analyses	15
SF Material Control	16

[redacted]

OPERATIONS DIVISION MONTHLY REPORT

SUMMARY

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

1. Lost graphite reactor operating time averaged 7.1%, compared with 10.4% for April (p. 3).
2. Two ruptured slugs were detected and discharged without difficulty (p. 3).
3. The hydrogen liquefier is again in operation (p. 3).
4. A table indicating the use of the experimental facilities in the ORNL graphite reactor is included (p. 4).
5. The LITR down time was 9.2%, compared with 10.0% for April (p. 3).
6. A 400-gpm filter is being installed in the LITR water system for the purpose of more quickly clarifying the turbidity caused by silt which is sometimes disturbed during maintenance of the system (p. 7).
7. A table showing usage of LITR experimental facilities is included (p. 8).
8. It was necessary to remove an iron hydroxide deposit on the anion column of the water-demineralization plant (p. 10).
9. Better yields of I^{131} have been obtained by lowering the dissolving temperatures and by adding hydroxylamine sulfate to the dissolver solution (p. 10).
10. Evaluation of sulfur produced from H_2S for P^{32} production is being made (p. 10).
11. Decontamination of the fission-product precipitation process equipment in Building 3515 has been started so that repair work can be initiated next month (p. 10).
12. Purification methods for Cs^{137}, Sr^{90}, and Pm^{147} are being developed (p. 10).
13. A total of 20.3 curies of beta activity was discharged to White Oak Creek, compared with 34.7 curies last month (p. 12).
14. RaLa run No. 52 was started on May 23, and a partial shipment of approximately 7000 and possibly as much as 13,000 curies was made on May 29. A recovery run is being performed, and it is expected that a supplemental shipment can be made. The limited success of the run was due to major filtration difficulties encountered in the use of the product filter (p. 14).
15. There were 989 radioisotope shipments made this month, compared with 1022 during April (p. 15).

REACTOR OPERATIONS DEPARTMENT

OPERATING DATA

	MAY 1953	APRIL 1953	YEAR TO DATE 1953
ORNL Graphite Reactor			
Reactor power			
Total accumulated (kwhr)	2,623,225	2,344,455	12,621,198
Average kw/operating hr	3796.54	3635.47	3808.62
Average kw/24-hr day	3525.84	3256.19	3482.67
Lost time (%)	7.13	10.43	8.56
Excess reactivity (inhr)	43	30	
Slugs discharged	85	96	447
Slugs charged	109	72	391
Product made (g)	95.74	85.56	460.63
Product discharged (g)	2.13	2.25	9.86
Low-Intensity Test Reactor			
Reactor power			
Total accumulated (kwhr)	1,013,578	968,694	4,521,327
Average kw/operating hr	1,500	1,495	1,453
Average kw/24-hr day	1,362	1,345	1,248
Lost time (%)	9.2	10.0	14.1
Position of No. 2 shim rod (in. out)	24.750	23.550	

REACTOR OPERATIONS

ORNL Graphite Reactor

There were two slug ruptures during the month. Rupture No. 112, which was discovered on May 18, occurred in channel 1964 after the slug had been in the reactor for 55 days at a temperature of about 240°C. This unbonded slug was being irradiated for the production of radioiodine and was the second from the west end of a 24-slug row. Rupture No. 113, which was discovered on May 25, occurred in channel 2070 after the slug had been in the reactor for 419 days at a temperature of about 240°C. This bonded slug was from lot 110 which was not beta transformed, and it was the fifteenth from the west end of the row. The slug was covered with blisters and both ends were off, but the uranium was not badly oxidized.

The excess reactivity of the reactor has generally been above 35 inhr, with the maximum metal temperature at about 290°C. In view of the number of ruptures, it does not seem to be desirable to increase the maximum metal temperature above 300°C at present.

Estimates are being obtained on the cost of inserting approximately 400 plugs in the peripheral channels of the reactor to seal the slots in the bridge tubes. If the cost is not too great, it may be worth-while to limit the air flow in the outside channels so that more air flows through the hotter central channels.

X-ray measurements of graphite samples made by the Solid State Division indicate that stored energy in cooler sections of the reactor is not much different from that in the central zone.

The pneumatic tube facility in hole 2079 is being adapted so that short irradiations may be made for research or radioisotope production.

The hydrogen liquefier is again in operation, and four successful runs were made which produced 7 liters of liquid hydrogen.

Table 1 indicates the usage of experimental facilities in the ORNL graphite reactor.

TABLE 1. USAGE OF EXPERIMENTAL FACILITIES – ORNL GRAPHITE REACTOR

HOLE NO. AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
1, north and south	4 by 4			Regulating rod
2, north and south	4 by 4			Regulating rod
3, north and south	4 by 4	Operations	J. A. Cox	Sulfur exposure for radiophosphorus production
4, north and south	4 by 4	Operations	J. A. Cox	Miscellaneous exposures of special samples
5, north and south	4 by 4			Shim rod
6, north and south	4 by 4			Shim rod
7, vertical	4 by 4			Safety rod
8, vertical	4 by 4			Safety rod
9, vertical	4 by 4			Safety rod
10, vertical	4 by 4	Solid State	J. H. Crawford	Low-temperature sample-exposure facility
11, vertical	4 by 4	Operations and Chemical Technology	J. P. McBride	Boron shot safety tube and HRP fuel studies
12, vertical	4 by 4	Chemistry	H. F. McDuffie	HRP fuel studies and general exposures
13, north and south	4 by 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
14, north and south	4 by 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
15, north	4 by 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Miscellaneous large-sample exposures
15, south	4 by 4	Solid State	J. C. Wilson	Creep of metals
16, north and south	4 by 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
17, north	4 by 4	Unassigned		Empty
17, south	4 by 4	Physics	E. O. Wollan	Neutron polarization
18, north and south	4 by 4	Analytical Chemistry	G. W. Leddicotte	Empty
19, north and south	4 by 4	Solid State	O. Sisman	Water-cooled exposure facility
20, north	4 by 4			Graphite temperature thermocouples
20, south	4 by 4	Solid State	J. C. Wilson	Creep of metals
21, north and south	4 by 4	Operations	J. A. Cox	Sulfur exposure for radiophosphorus production
22, north	4 by 4	Unassigned		Empty

TABLE 1. (continued)

HOLE NO. AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
22, south	4 by 4	Operations	J. A. Cox	Two pneumatic tubes for general usage
30	9 by 9	Solid State (G.E.)	L. E. Stanford (G.E.)	Life tests of equipment in radiation
31	9 by 9			Blocked by one end of air seal H beam across top of graphite
32	9 by 9			Contains chamber for high-power-level trip circuit
33	9 by 9			Contains chamber for high-power-level trip circuit
34	9 by 9			Contains chamber for No. 2 power-level galvanometer
35	9 by 9			Blocked by one end of air seal H beam across top of graphite
36	9 by 9			Contains chamber for high-power-level trip circuit
37	9 by 9	Training School	H. S. Pomerance	Contains chamber for reactor kinetics study
40	9 by 9			Contains chamber for No. 1 power-level galvanometer
41	6-in. dia			Rear wall suction pressure tap
42	6-in. dia			Unit pressure differential tap
43	6-in. dia			Unused (inaccessible)
44	6-in. dia			Unused
45	6-in. dia			Gas discharge from hole 22 pneumatic tubes
46, vertical	6-in. dia			Used for viewing west end of graphite with periscope
47, vertical	6-in. dia			Used for viewing west end of graphite with periscope
50, north	4 by 4	Solid State	J. H. Crawford	Empty
50, south	4 by 4	Physics	E. O. Wollan	Neutron spectrometer
51, north	4 by 4	Solid State	J. H. Crawford	Water-cooled U^{235} neutron converter
51, south	4 by 4	Physics	C. G. Shull	Neutron spectrometer
52, north	4 by 4	Solid State	J. H. Crawford	Facility for exposing samples at the temperature of liquid nitrogen
53	4 by 4 half hole	Solid State (G.E.)	L. E. Stanford (G.E.)	Miscellaneous large-sample exposures

TABLE 1. (continued)

HOLE NO. AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
54	4 by 4 half hole	Solid State (G.E.)	L. E. Stanford (G.E.)	Miscellaneous large-sample exposures
55	4 by 4 half hole	Solid State (G.E.)	L. E. Stanford (G.E.)	Miscellaneous large-sample exposures
56, north	4 by 4	Physics	E. C. Campbell	Fast pneumatic tube
56, south	4 by 4	Physics	H. S. Pomerance	Oscillator for measuring neutron absorption cross sections
57, north	4 by 4	Training School	H. S. Pomerance	General purpose neutron collimator
57, south	4 by 4	Physics	S. Bernstein	Neutron polarization
58, north	4 by 4	Solid State	O. Sisman	Circulating loops for Na and NaK
58, south	4 by 4	Chemistry	H. Levy	Neutron spectrometer
59	4 by 4 half hole	Unassigned		Blocked by work at hole 17, south
60	4 by 4 half hole	Chemistry	H. F. McDuffie	Empty
61	4 by 4 half hole	Biology and Operations		Activation of phosphorus sources and general large-sample exposures
East animal tunnel				General exposures of large samples to low flux
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		Biology		Infrequent 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; 20 small cans of $CaCO_3$
B	1.68-in. dia	Unassigned		Charging-face hole; empty
C	1.68-in. dia	Unassigned		Charging-face hole; empty
D	1.68-in. dia	Unassigned		Charging-face hole; empty
1768		Solid State	R. H. Kernohan	Charging hole containing neutron converter donut; general exposures of samples to fast neutron flux
1867		Solid State	R. H. Kernohan	Charging hole containing neutron converter donut; general exposures of samples to fast neutron flux

TABLE 1. (continued)

HOLE NO. AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
1968		Solid State	R. H. Kernohan	Charging hole containing neutron converter donut; general exposures of samples to fast neutron flux
1069		Unassigned		Charging hole containing an aluminum liner; general exposure of suitable samples
2069		Transferred from Solid State to Operations during May 1953	J. A. Cox	Charging hole containing pneumatic tube; exposure of research and radioisotope samples
0857, 0880, 1484, 1853, 2857, 2880				Charging-face holes containing boron-coated thermopiles for reactor instrumentation
Others				Thirty-four uncharged peripheral holes contain tantalum slugs for the Army; seven uncharged peripheral holes contain $CaCO_3$ for radioisotope production; 375 uncharged peripheral holes remain unused

Low-Intensity Test Reactor

On May 5, a new shim rod was inserted, because the No. 1 shim rod appeared to be slightly bent. After the rod has decayed sufficiently, it will be inspected more closely.

A filter capable of handling 400 gpm has been obtained from surplus and will be installed in the water system so that the water can be clarified more readily. It has been observed that any maintenance work on the water system disturbs the silt and introduces dirt that causes turbidity which persists for several days.

The instrument scrams that result from the period safety system increased in frequency and appeared to be due to the period amplifier.

An inspection procedure is being set up for the spray system and includes the use of a port in the top of the spray tank to permit a regular examination of the tank. This is necessary because of silt in the water system which might plug the lines to the spray nozzle.

The first shipment of seven spent fuel elements was sent to the Chemical Processing Plant at Arco on May 13 and arrived there on May 15. At least two more loads of elements will be shipped as soon as possible.

Considerable amounts of iron hydroxide in the LITR demineralizer columns make it necessary to rinse the anion exchanger with acid prior to caustic regeneration. It is believed that the hydroxide results mainly from the use of caustic in regenerating the anion-exchange resin. A large variety of activities is found on the resin columns, and a study is now in process to identify these activities.

Table 2 indicates the usage of experimental facilities in the LITR.

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. 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	H. F. McDuffie	Empty
HB-5	6-in.-ID beam hole	Chemistry	H. F. McDuffie	HRP fuel stability and corrosion tests
HB-6	6-in.-ID beam hole	Transferred from Solid State to Chemistry in May 1953	H. F. McDuffie	Empty
HR-1	Pneumatic tube	Operations	J. A. Cox	General short exposures of research 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	Empty
C-48	Hollow Be core piece with access tube from top plug	Solid State	G. W. Keilholtz	Empty
C-53	Mg tray in core space	Operations	J. A. Cox	Exposures of research and radioisotope samples
C-57	Mg tray in core space	Operations	J. A. Cox	Exposures of research and radioisotope samples
C-59	Be core piece with four vertical holes	Operations	J. A. Cox	Exposures of research and radioisotope samples

TABLE 2. (continued)

FACILITY NUMBER	TYPE OF FACILITY	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
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

FILTER HOUSE

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

FAN HOUSE

Both fans functioned normally throughout the month.

RADIOISOTOPES

Stringers 13, 14, and 16 contained 289 cans of target material at the end of May, as compared with 373 cans of target material at the end of April.

Table 4 shows a comparison of the radioisotope and research samples charged into the ORNL graphite reactor during May with those handled in April.

TABLE 3. PRESSURE-DROP DATA

DATE	PRESSURE DROP (in. water gage)		
	Glass Wool	CWS No. 6	Total Across House
5/31/53	2.4	2.7	6.3
4/30/53	2.3	2.6	6.1
Clean filters	1.1	1.3	3.3

TABLE 4. RADIOISOTOPE AND RESEARCH SAMPLES

	MAY 1953		APRIL 1953	
	Research	Radioisotopes	Research	Radioisotopes
Stringers 13, 14, 16	8	133	12	220
Hole 22	2	60	54	3
All other holes	2	35	4	23
Total by groups	12	228	70	246
Total for month	240		316	

WATER-DEMINERALIZATION PLANT

During the month, the anion column began to show a lowered capacity and to produce water with low resistance. An examination revealed that considerable iron hydroxide had collected in the resin. After an acid rinse which was followed by caustic regeneration, the capacity of the column and the resistance of the water returned to normal.

A comparison of the amount of water demineralized during May and April is given below:

	May 1953	April 1953
Water demineralized (gal)	379,020	311,760

CHEMICAL SEPARATIONS AND RADIOISOTOPE DEVELOPMENT DEPARTMENTS

RADIOISOTOPES

Iodine (I^{131} – 8 d)

Eighty ORNL slugs were processed in 10 runs and 39,447 mc of I^{131} was shipped.

Low yields were experienced in the first three runs as a result of crude products from the stills being acidic rather than basic. The product from one of these runs contained a manganese dioxide precipitate which had to be filtered out.

In an attempt to improve the product yields, the uranium dissolving procedure was altered in all but the three runs previously mentioned. The temperature at the height of the reaction was not permitted to rise above 105°C and was slowly decreased to as low as 95°C at the end of the 18- to 20-hr dissolving time. Another change, incorporated in all but the first four runs, was the addition of a 5% hydroxylamine sulfate solution, in three 75-ml portions, to the dissolver solution in the second distillation step.

These changes appeared to restore normal yields to the iodine process. It is believed that the dissolving temperature, which recently had been running higher than normal, was causing the oxidation of the iodine to the iodate. In this valence state, the iodine could not distill out of the solution. On the other hand, the hydroxylamine sulfate reduces, even at the lowered dissolving temperature, some of the iodine which is oxidized.

Iodine Development Work, Building 3028

Although delivery was made of the two main dissolver condensers, no further construction work was done. Design drawings of the sampling-analysis cubicle and related equipment were started; this equipment was not included in the original project.

Phosphorus (P^{32} – 14.3 d)

Eighteen 2500-g cans of sulfur were processed and 11,394 mc of P^{32} was shipped; processing presented only minor difficulties.

Phosphorus Development Work

Pressure extraction tests with 0.2 *N* HNO_3 were made on a sample of commercial sulfur prepared from H_2S. No evidence of organic matter was found, and the purity of the extract was better than that obtained with any other sample of sulfur tested thus far. Experiments were started on the use of activated alumina as a substitute adsorption agent in the purification of molten sulfur; MgO is used at present. The objective is to eliminate magnesium in the purified sulfur.

Precipitation Process, Building 3515

Decontamination of the precipitation process equipment and cells is in progress; the radiation level has been reduced from approximately 50 r to 500 mr/hr. It is expected that repair work will begin about June 8 after further decontamination.

A tantalum agitator was fabricated from available parts for use in precipitator No. 2; the bearing assembly was modified to take the new shaft.

Selas microporous porcelain filters of porosities No. 10 and No. 01 and a micrometallic porosity G stainless steel filter were tested for filtering the iron precipitate formed under slightly acid conditions by hydrolysis of urea; the performance of all the filters was satisfactory.

Purification of Cs^{137}

Final chemical purification of Cs^{137} is necessary to remove corrosion products, excess sulfate, ammonium ion, and organic matter. An experimental run on 18 curies of Cs^{137} was made as follows: The ammonium ion was destroyed by boiling the sample with aqua regia. The sulfate,

Fe, Cr, Ni, and SiO_2 were precipitated by the addition of $Ba(OH)_2$. Excess Ba^{++} was removed as $BaCO_3$ by precipitation with $(NH_4)_2CO_3$. After the final removal of NH_4^+ with aqua regia, the product was evaporated to dryness and then taken up in dilute HCl. Satisfactory products were obtained, but the yields were low because of adsorption of Cs^{137} on $BaSO_4$, and the mechanical operations in handling large amounts of $BaSO_4$ were found to be too difficult for routine use of this procedure. In the next series of experiments, the carrying of Cs^{137} on ferrous sulfide in the presence of the above-mentioned impurities will be studied.

Purification of Sr^{90}

Experiments were made in removing heavy-metal contamination from the Sr^{90} preparation by electrolysis into mercury. A regular-run product containing 2.4 curies of Sr^{90} and 500 ppm of heavy metals in dilute HCl was electrolyzed for 2 hr at a potential of 4 volts; the heavy-metal contamination was reduced to <10 ppm, which is well within specifications.

Although previous work with ion-exchange processes was largely unsuccessful because of radiation damage to the resin, experiments are again being made on the purification of Sr^{90} by using a phenolic-base ion-exchange resin (Duolite C-3). Radiation damage of phenolic-base resins is thought to be much less than that of vinyl-base types, for example, Dowex-50.

Purification of Pm^{147}

Experimental work was done on the separation of Pm^{147} from amercium and curium and adjacent lanthanide rare earths by chromatographic ion-exchange separation in which 13.5 *N* HCl was used as the eluting agent. The 13.5 *N* HCl was produced by absorption of HCl gas in 12 *N* HCl. Some minor operating difficulties were encountered, but promising results were obtained; the best decontamination factor,

$$\frac{\text{alpha/beta ratio starting}}{\text{alpha/beta ratio of fraction}},$$

was 62. Improvement of this general method could lead to a satisfactory production process for Pm^{147} purification.

Manganese (Mn^{54} – 310 d) from the 86-in. Cyclotron

A test target of chromium was irradiated with 22-Mev protons in the 86-in. cyclotron for the production of Mn^{54}. The target received 1315 μa·hr of bombardment and yielded 0.23 mc of Mn^{54}.

Tests on Chemical Resistance of Tygothene Tubing

Samples of new plastic tubing, Tygothene, in two formulations, type A (medium flexibility) and type B (maximum flexibility), were tested for resistance to various reagents in comparison with type S22-1 Tygon, which is now in general use at the Laboratory. The test reagents used were concentrated solutions of HNO_3, HCl, H_2SO_4, NaOH, and carbon tetrachloride. Samples were immersed for 36 hr at room temperature. Tygon S22-1 hardened, changed color, or suffered some noticeable damage in all reagents, but Tygothene A showed no visible change in any of the reagents. Tygothene B was almost as good but became slightly tacky in concentrated H_2SO_4 and NaOH. Samples of Tygothene are now being exposed in the Co^{60} irradiator for the determination of radiation damage. If radiation resistance is good, this type of tubing will be very useful in radiochemical equipment.

Processed Radioisotope Production

Table 5 is a list of radioisotope product solutions that were prepared during May.

Special Preparations

The following special preparations were made: 46 Co^{60} sources were loaded with a total of 27.16 curies; a 25-mc Cs^{137} source in a standard capsule; a 50-mc Ba^{140} source in a standard capsule; 30 units of KH_2PO_4 processed for the U.S. Department of Agriculture – this completes the work on this project; a special solution of Sr^{90} to have a concentration greater than 50 mc/ml; 8 ampoules of tritium, assay showed a total of 305 mc; 3 ampoules of A^{37}, assay showed a total of 22.5 mc.

RADIOACTIVE-WASTE DISPOSAL

Thirteen pots and ten drums were received from Argonne National Laboratory. The contents of ten pots and eight drums were jetted to chemical-waste tank W-5, and the contents of two drums and three pots were jetted to metal-waste tank W-7.

TABLE 5. RADIOISOTOPES PRODUCED DURING MAY

PRODUCT SOLUTION	SOURCE	AMOUNT (mc)	SPECIFIC ACTIVITY (mc/g)
Barium (Ba^{140} – 12.8 d)	Fission products, ORNL graphite reactor	38.2	Carrier-free
Carbon (C^{14} – 5720 y)	Hanford reactors	703.3 769.8	71.7 105
Cerium (Ce^{144} – 275 d)	Fission products, ORNL graphite reactor	542	Carrier-free
Cesium (Cs^{137} – 37 y)	Fission products, ORNL graphite reactor	19,930	Carrier-free
Chromium (Cr^{51} – 26.5 d)	LITR	1,190	1,687
Iron (Fe^{55} – 2.91 y)	Hanford reactors	253	253
Iron (Fe^{59} – 46.3 d)	Hanford reactors	48.75	5.0
Nickel (Ni^{63} – 85 y)	Hanford reactors	57.6	4.8
Sodium (Na^{22} – 2.6 y)	Pittsburgh cyclotron	27	750
Strontium (Sr^{90} – 25 y)	ORNL graphite reactor	7,060	Carrier-free
Strontium (Sr^{89} – 53 d)	ORNL graphite reactor	50	Carrier-free
BaS^{35} (S^{35} – 87.1 d)	Hanford reactors	1,363	16,200

There was 28,800 gal of chemical-waste concentrate containing 1377 curies of beta activity discharged to chemical-waste storage pit No. 2 from tank W-8. The total transferred to date from the concentrate tank to the pit is 143,400 gal bearing 5255 curies.

The Cottrell precipitator was shut down for 10½ hr to repair the alarm system, to inspect the hot off-gas system filters, to perform regular inspection of the power pack, and to install two bypass slide valves in the off-gas system to allow isolation of the precipitator or filters without loss of off-gas service to the many users.

The hot off-gas system was shut down for 7 hr to allow installation of the bypass valves mentioned previously. The hot off-gas filters were inspected and found to be in good condition.

Tank WC-2, the metal receiving tank from the new iodine cell, was found to be filling up with water from an unknown source; investigation is under way to determine the source of the leak.

The west bearing on the fan shaft of the electrically powered, off-gas fan failed and was replaced with a different type of bearing which should operate more satisfactorily.

Because the bearings on the fan shaft of the Radioisotope Area hood-exhaust system had overheated, they were removed and scraped and were found to be heavily scored.

The Building 3026 cell ventillation was shut down for ½ hr to allow the tie-in of special sampling facilities so that the Health Physics Division could sample the exhaust streams during the RaLa runs.

Waste Discharged to White Oak Creek

A total of 20.33 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond (see Table 6). This discharge was only 58.6% of that of last month.

Chemical-Waste Evaporator

The chemical-waste evaporator was shut down for 40 hr this month in an effort to make necessary repairs to a leaking valve and flanges under the evaporator tank. Several repairs were made, but the work for which the decontamination was originally intended could not be done because the radiation levels in the cell could not be lowered enough to give adequate working time. Evaporator operation is shown in Table 7; waste-tank inventory is shown in Table 8.

TABLE 6. ACTIVITY DISCHARGED TO WHITE OAK CREEK

DISCHARGED FROM	MAY 1953		APRIL 1953	
	Gallons	Beta Curies	Gallons	Beta Curies
Settling Basin	20,733,000	15.80*	19,312,000	25.01
Retention Pond	502,000	4.53	471,000	9.67
Total	21,235,000	20.33	19,783,000	34.68

*0.49 curie contributed by the evaporator.

TABLE 7. WASTE-EVAPORATOR OPERATION

MONTH	SOLUTION FED TO EVAPORATOR (gal)	CONCENTRATE TO W-6 (gal)	VOLUME REDUCTION	BETA CURIES TO EVAPORATOR	BETA CURIES TO SETTLING BASIN
May 1953	170,245	12,844	13.25:1	8707	0.49
April 1953	186,202	18,238	10.2:1	4447	0.56

Waste-Tank Inventory

TABLE 8. WASTE-TANK INVENTORY

TANKS	CAPACITY (gal)	FREE SPACE (gal)	
		May 1953	April 1953
Hot-Pilot-Plant Storage			
W-3, 13, 14, 15	48,500	32,340	32,100
Chemical-Waste Storage			
W-5	170,000	72,000	98,000
Evaporator-Concentrate Storage			
W-6, 8	340,000	113,500	123,000
Metal-Waste Storage			
W-4, 7, 9, 10	543,000	237,000	218,500

RaLa (Ba^{140} – 12.5 d)

RaLa run No. 52 was started on May 23, and a partial shipment was made on May 29. The exact amount of product in the shipment is not known because of a discrepancy in the readings of the two-product measuring instruments. It is known, however, that the shipment contained at least 7000 curies and possibly as much as 13,000 curies. The product appeared to be very clean and well distributed in the cone.

The relatively small quantity of product produced was a result of difficulties experienced in the operation of a new large-area process filter. Although the new filter appeared to work very satisfactorily when used in the extractions and the first metathesis operations, it was discovered after the run progressed through the resin-column operation that approximately half the product was held up on this filter and that it could not be washed off or dissolved by any ordinary means.

At the end of the month, a recovery run was in progress, and it is hoped that another small shipment can be made. No attempt was made to combine the two portions of product, because at the time the lost product was located, the first portion of the run was nearing completion and could not be held for several days without incurring decay losses, as well as possible losses through the off-gas system. Also, the success of the recovery run could not be assured.

The possibility of losing the product on the large-area filter was suspected before the run was started. Consequently, the operating procedure was set up for use of the large filter for the filtration of sulfate extractions and for the large metathesis, because these operations required the use of large volumes of liquid and large volumes of backwash. The last two metatheses and water washes, in which small volumes were used, were scheduled to be filtered through the old small-area filter. Unfortunately, the small filter plugged almost completely, and it was necessary to filter the metathesis water washes through the large filter.

In attempting to remove the product from the filter for the recovery run, approximately 40 gal of 3 M HNO_3 in 5-, 10-, and 20-liter portions was used to backwash the large filter. Each backwash recovered a small portion of the total product, but only 50% of the total lost product was recovered. In view of this difficulty in removing the product from the filter, it is doubtful that the product was completely removed in any of the extraction or metathesis operations.

Minor difficulties experienced in this run included failure of the dissolver contact microphone during slug loading, failure of the specific-gravity instrument during the slug-heel dissolving, false readings on the closely calibrated liquid-level oil manometer on the extraction tank, failure of the radiation chamber on the resin column, and failure of a steam trap (in closed position) on the upper jacket of the product evaporator. The analytical summary of the complete run will be included in the June report.

More equipment was removed from cell B. Lines which formerly connected cell A vessels to cell B vessels were capped off in cell B to eliminate the possibility of any process leakage of radioactive solutions into cell B during the run.

RADIOISOTOPE SALES DEPARTMENT

Radioisotope shipments made during May 1953 are compared in Table 9 with those made during April 1953 and May 1952. A breakdown according to separated and unseparated material (including totals for August 1946 through May 1953), and for project, nonproject, and foreign shipments is also shown.

HANFORD IRRADIATIONS

The radioisotope samples listed in Table 10 were received from Hanford during the month.

CYCLOTRON RADIOISOTOPES

No cyclotron targets were received during the month of May.

ACTIVATION ANALYSES

A total of 104 requests has been received for information concerning activation analyses; 36 have developed into requests for analyses, 25 of which have been completed.

TABLE 9. RADIOISOTOPE SHIPMENTS

	MAY 1953	APRIL 1953	MAY 1952	AUGUST 1946 TO MAY 1953, INCLUSIVE
Separated material	809	815	708	35,083
Unseparated material	180	207	161	9,478
Total	989	1022	869	44,561
Nonproject	885	910	761	
Project	78	89	92	
Foreign	26	23	16	
Total	989	1022	869	

TABLE 10. RADIOISOTOPES RECEIVED FROM HANFORD

SAMPLE NUMBER	MATERIAL	NUMBER OF PIECES	DATE DISCHARGED	DATE RECEIVED
ORNL-147	Normal iron oxide	1	3/17/53	5/7/53
ORNL-165	Calcium carbonate	2	3/17/53	5/7/53
ORNL-160	Cesium carbonate	2	4/5/53	5/7/53
ORNL-162	Iridium	1	4/5/53	5/7/53
ORNL-158	Antimony	1	4/5/53	5/7/53
ORNL-146	Cobalt	8	3/13/53	5/7/53
ORNL-13	Beryllium nitride	64	3/26/53	5/7/53
		49	3/13/53	5/7/53
ORNL-159	Potassium chloride	16	4/23/53	5/23/53
ORNL-146	Cobalt	7	3/13/53	5/23/53

SF MATERIAL CONTROL

Two shipments consisting of 56 drums containing UNH solutions of depleted uranium with a total uranium content of 4598 kg were shipped to Mallinckrodt Chemical Works, St. Louis, Missouri, during May. These were the eighth and ninth shipments of uranium recovered under the Metal Recovery Program and make a total of 18,918 kg shipped to date.

During May, ten MTR fuel assemblies were shipped to Phillips Petroleum Company, Scoville, Idaho. This makes the total number shipped to date 395 fuel assemblies and 48 control rods.

A total of 28 ANL fuel assemblies containing 4.40 kg of U^{235} was shipped to Argonne National Laboratory, Scoville, Idaho.

A 10.75-kg quantity of contained U^{235} in the form of uranium-aluminum alloy billets was received from Y-12 during May and extruded into rods. The rods and resulting scrap were returned to Y-12.

The first shipment of spent LITR radioactive fuel elements was made during May to American Cyanamid Company, Scoville, Idaho, for recovery. The shipment consisted of four LITR fuel assemblies and three LITR shim safety rods containing 0.78 kg of U^{235}.

On May 23, a carload-lot shipment was received from Hanford and consisted of 72 irradiated uranium slugs for the RaLa process and two casks containing miscellaneous radioisotopes.

On May 14, 15 drums containing UNH solutions of depleted uranium with a total uranium content of 1019 kg were shipped to Harshaw Chemical Company for denitration.

All outlining work has been completed in connection with the new SF accounting manual. A survey is under way to determine the distribution of the manual in order to secure data relative to placing a purchase order for the required number of binders. It is anticipated that the general section will be published in June 1953; other sections will be issued as soon as they are completed.

SF surveys during the month consisted in visiting 17 persons possessing SF material. The material in their possession was inspected and weighed when feasible, and no apparent discrepancies were encountered. In addition, the records of three analytical laboratories were audited; this disclosed that all records were in good order and that proper accounting had been made for all samples.

There were 21 receipts and 30 outgoing shipments of SF material during May, compared with 29 receipts and 47 outgoing shipments during April. Tables 11 and 12 are summaries of receipts and shipments for May.

TABLE 11. SF MATERIALS RECEIVED

FROM	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Argonne National Laboratory, ANL	Depleted uranium	1	3,800.00
	Plutonium	1	3.24
Battelle Memorial Institute, BMI	Thorium	1	2,050.00
Carbide and Carbon Chemicals Co., Y-12, CYT	Enriched uranium	5	10,810.40
	Normal uranium	8	1,276,634.44
	Depleted uranium	1	15.00
General Electric Co., HGE	Thorium	1	2,135,729.00
	Depleted uranium	1	258,982.00
	Plutonium		65.00
Phillips Petroleum Co., MTI	Enriched uranium	2	0.46

TABLE 12. SF MATERIALS SHIPPED

TO	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
American Cyanamid Co., CPI	Enriched uranium	1	779.31
Argonne National Laboratory, ANL	Enriched uranium	5	4,400.51
Carbide and Carbon Chemicals Co., Y-12, CYT	Enriched uranium (net)	2	153,682.15
	Enriched uranium	8	468.24
	Normal uranium	4	8,941.01
	U^{233}	1	0.11
	Depleted uranium	1	18.00
Harshaw Chemical Co., MHR	Depleted uranium	1	1,019,111.00
Mallinckrodt Chemical Works, MCW	Depleted uranium	2	4,598,262.00
Phillips Petroleum Co., MTI	Enriched uranium	3	1,683.67
USAEC, Oak Ridge Operations Office, CPA	Normal uranium	1	11.60
	U^{233}	1	0.002