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OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending May 31, 1952

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OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending May 31, 1952

by

M. E. Ramsey

DATE ISSUED

JUL 23 1952

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TABLE OF CONTENTS

	Page
SUMMARY	1
PILE DEPARTMENT	3
Operating Data	3
Pile Operations	3
Graphite pile	3
Low-intensity test reactor	4
Filter House	4
Fan House	4
Radioisotopes	4
Water-Demineralization Building	5
CHEMICAL SEPARATIONS AND RADIOISOTOPE DEVELOPMENT DEPARTMENTS	6
Radioisotopes	6
Iodine (I^{131} – 8 d)	6
Iodine development work	6
Phosphorus (P^{32} – 14.3 d)	6
Phosphorus development work	6
Carbon (C^{14} – 5740 y)	6
Fission products	6
Hot chemistry cell (Building 3029)	7
Europium target material	7
Extraction of rare earths with tributyl phosphate	8
Tritium	8
Processed radioisotopes	8
Cyclotron radioisotopes	8
Special preparations	9
Miscellaneous work	9
Waste Disposal	9
Wastes discharged to White Oak Creek	10
Chemical-waste evaporator	11

[redacted]

[redacted]

[redacted]

RaLa 12

RADIOISOTOPE CONTROL DEPARTMENT 14

Hanford Irradiations 14

Cyclotron Radioisotopes 14

Activation Analyses 17

SF Material Control 17

[redacted]

OPERATIONS DIVISION MONTHLY REPORT

SUMMARY

The activities of the Operations Division for the month ending May 31, 1952 are summarized and indexed in the following:

1. Lost X-10 graphite pile operating time was 11.6% compared with 14.9% for April and 12.1% for the year to date (p. 3).

2. Approximately 16,000 aluminum–silicon bonded slugs have been charged into the X-10 graphite pile (p. 3).

3. The LITR down time was 16.6%. Much of the down time resulted from two water-drop tests and a training period (p. 4).

4. All horizontal beam holes of the LITR will be in use by the first week of June (p. 4).

5. It has been found that the deaerator in the Water-Demineralization Building operates equally as well as a degasifier (p. 5).

6. Since I^{131} yields have been low during the month, the equipment will be repaired during June (p. 6).

7. No trouble was encountered in separating the P^{32} from the purified target material (p. 6).

8. Installation of precipitation process equipment in Building 3515 is expected to be completed during June (p. 6).

9. A study of tributyl phosphate extraction of rare earths is in progress (p. 7).

10. A total of 46.5 curies of beta activity was discharged to White Oak Creek compared with 19.4 curies last month. Two errors were responsible for approximately 30 curies of the discharge (p. 10).

11. Testing of RaLa equipment continued with the purpose of determining the nature of needed minor process changes (p. 12).

12. There were 869 radioisotope shipments compared with 939 during the previous month (p. 14).

PILE DEPARTMENT

OPERATING DATA

	May 1952	April 1952	Year to Date 1952
Graphite Pile			
Total accumulated kwhr	2,474,896	2,203,648	11,871,525
Average kw/operating hr	3761.06	3596.52	3700.64
Average kw/24-hr day	3326.47	3060.62	3254.26
Per cent lost time	11.6	14.9	12.1
Excess pile reactivity (inhr)	20	50	
Slugs discharged	6927	270	16,809
Slugs charged	6969	266	16,839
Product made (g)	90.32	88.47	433.27
Product discharged (g)	1304.22	24.54	3,145.55
Low-Intensity Test Reactor			
Total accumulated kwhr	822,359	697,609	2,839,756
Average kw/operating hr	1326	1091	980
Average kw/24-hr day	1105	969	778
Per cent lost time	16.6	11.2	20.6
Position of No. 2 shim rod (in. out)	22.578	22.773	

PILE OPERATIONS

Graphite Pile

No slug ruptures occurred during May.

Approximately 14,000 bonded slugs have been charged into the central part of the pile, and the maximum metal temperature has been increased to 275°C, which permitted considerably higher operating power during May 1952 of 3761 kw per operating hr compared with 3518 kw for Moy 1951.

Bonded-slug production at Y-12 continued. Oven testing of 8910 slugs at 400°C for one week gave a total of 107 mechanical rejects (mostly because of handling), 7 blisters, and 2 ruptures. Slug lots showing blisters or ruptures are held aside for loading in the outer zones of the pile. A total of 6887 bonded slugs were charged during the month, bringing the total bonded slugs in the pile to 15,940.

On May 12, six slugs containing tantalum were discharged after having been irradiated for one week. These were loaded into a cask and shipped on May 14.

Excess reactivity was about 20 inhr at the end of the month. It is believed that hole 19 is leaking water into the graphite because of the loss of reactivity and because of the unstable power that has existed since the hole was last filled. The cause of the loss of reactivity is expected to be established during the coming month.

The steel beams to support shields around holes 10, 11, and 12 on top of the pile have been received.

Six runs were made to produce a total of 11.3 liters of liquid hydrogen. The storage container that will permit stockpiling liquid hydrogen has not been received.

The canal water showed a large increase in activity during the month. This was analyzed and found to be mostly Co^{60}. To reduce the contamination of the canal water, a wooden dam was inserted near the west end of the canal and all exposed cobalt placed on the west side of the dam. A lock in the dam permits transfer of samples from one side to the other without exchange of a large amount of water. A higher water level (from 1 to 4 in.) can be maintained on the east side of the dam. Four days after the dam was installed, the water activity in the canal had dropped from over 2000 to less than 100 counts/min/ml. All of the water being purged from the canal is now passed through an ion-exchange column that removes the radioactive cobalt. This is sent to the hot storage tanks W-1 and W-2 when the ion-exchange resin is regenerated.

Low-Intensity Test Reactor

The LITR operated satisfactorily during the month. The rather high down time of 16.6% resulted from two water-drop tests made at the request of the Reactor Safeguard Committee and two days of training when 66 students of ORSORT were instructed in pile operation. Since the major part of the training was at very low power, this was regarded as down time.

The two water-drop tests were made to determine the maximum temperature reached by the fuel elements following loss of water. At 1250 kw, the highest temperature obtained was 254°C with a thermocouple inserted between plates of the fuel elements in position C-25. A thermocouple inserted in the fuel element in C-28 showed a considerably lower temperature. Although operation at 1500 kw appears to be quite safe even if the water should be lost suddenly, it has been decided to install an auxiliary water tank that would permit water to be sprayed over the core for several hours following any loss of water from the reactor. With such a device, it seems that the reactor could be operated well above 1500 kw without any possibility of damage to the fuel elements should the water be lost from the reactor tank.

The new water system permits circulation of as much as 1500 gal of water per minute. However, this circulation rate is not necessary at present power and a rate of about 1100 gal/min has been adopted for 1500-kw operation.

The reactivity of the LITR has held up remarkably well since the last addition of a fuel element on April 15. Removal of experiments that absorbed appreciable reactivity accounts for part of this condition.

Within the first week of June, all of the horizontal beam holes will be filled. One of the vertical holes (V-2), which terminates outside the reactor tank, is being made into a useful facility. Previously, it had been thought that the neutron flux in these holes would be too low for most purposes. However, after the increase of power to 1500 kw, it was decided that one could be used for activitation analyses, especially for irradiation of solutions where a vertical hole is desirable. Provision of a liner and a sliding-door catcher arrangement permits samples to be inserted while the reactor is operating.

FILTER HOUSE

Table 1 is a comparison of the pressure drop across the exit air filters last month with the pressure drop this month and that experienced when all filters are clean.

FAN HOUSE

The fan house operation was normal throughout the month.

RADIOISOTOPES

Stringers 13, 14, and 16 contained 385 cans of target material at the end of May as compared with 389 cans of target material in these stringers at the end of April.

Table 2 shows a comparison of the radioisotope and research samples charged into the pile during May with those handled in April.

TABLE 1

Pressure-Drop Data

Date	Pressure Drop (in. water gage)		
	Glass Wool	CWS No. 6	Total Across House
5/31/52	3.9	2.0	6.2
4/30/52	2.8	1.8	5.9
Clean filters	1.1	1.3	3.3

TABLE 2

Radioisotope and Research Samples

	May 1952		April 1952	
	Research	Radioisotopes	Research	Radioisotopes
Stringers 13, 14, and 16	7	145	8	142
Hole 22	50	6	66	1
All other holes	5	17	9	22
Total by groups	62	168	83	165
Total for month	230		248	

WATER-DEMINERALIZATION BUILDING

It has been found that operation of the deaerator can be improved considerably by changing it to a degasifier. Instead of using a vacuum on the deaerator to remove CO_2, a small fan was installed to blow air countercurrent to the water flowing down through the packing. With this arrangement, water of satisfactory pH and resistance can be produced somewhat more economically than by the deaerator type of operation where more labor and steam are required.

Table 3 presents data for May compared with that of April.

TABLE 3

Water Demineralized and Deaerated

	Gallons Produced		
	May 1952	April 1952	Year to Date 1952
Demineralized	363,138	405,000	2,221,688
Deaerated	31,020	56,940	221,960

OPERATIONS DIVISION MONTHLY REPORT

CHEMICAL SEPARATIONS AND RADIOISOTOPE DEVELOPMENT DEPARTMENTS

RADIOISOTOPES

Iodine (I^{131} – 8 d)

Seventy-two ORNL slugs were processed and 42,109 mc was shipped. The yields were consistently low throughout the month. It is suspected that this is caused by a partial failure of equipment that may not become apparent without complete decontamination and inspection.

A Hanford-slug run is scheduled to be made early in June. An adequate stockpile of product is expected to be produced that will permit a shutdown of equipment for decontamination and repairs, if it appears advisable at that time.

Iodine Development Work

No further work was done on the new iodine plant this month. Permission has not been received to start construction.

Phosphorus (P^{32} – 14.3 d)

Thirteen 2500-g cans of irradiated sulfur were processed and 10,571 mc was shipped. All products were within specifications. A small, 480-mc carrier-free run of ORNL-irradiated material was made.

A special 2500-g can of sulfur, bombarded at Brookhaven, was processed and produced 4800 mc of P^{32}. This product was made in the carrier-free equipment and the entire batch shipped back to Brookhaven.

Phosphorus Development Work

The first batches of purified target material that have passed through the pile were processed during the month. Insufficient purified material was withdrawn to make up an entire batch for the normal production extraction. However, even though only 50% of the new material was used, it was determined that at least no new unknown factors are going to be introduced because of the magnesium oxide purification. The precipitation test in the product P^{32} was negative. Essentially all of the material that will be withdrawn from the pile within the next several weeks for regular production should be purified target material.

Carbon (C^{14} – 5740 y)

C^{14} production during the month was 1201 mc as barium carbonate.

A separation of C^{14} from a special experimental sample of beryllium nitride that was irradiated in the LITR was made for the Physics Division in connection with a study that is being done to determine the neutron spectrum in the LITR.

Work continued on the final report on the beryllium nitride–C^{14} process. It is now about 50% complete.

Fission Products

Building 3026 Processing. Operations were continued on the processing of old "W" slugs for Sr^{90} production; approximately 2100 mc was separated. The system was thoroughly decontaminated and several runs of short-lived fission products were made by utilizing UNH solution from the iodine dissolver. Three curies of short-lived mixed fission products was prepared to be stored for future orders.

Precipitation Process (Building 3515). Construction work of approximately three weeks duration remains to be done on the installation of equipment. Piping is about 60% complete, with most of the remaining work consisting of installation of tubing and extension handles. Electrical work is about 50% complete. The revised expected completion date is June 30.

The two pieces of periscope shielding glass were received and were found to have imperfections that caused a distorted image in the field of view. These were returned to the Penberthy Company for refinishing.

Two micrometallic filter vessels were received. These vessels were found to leak because of poor machining around the flanges. The filters will be returned and a substitute vessel will be made in the ORNL shops.

The Vycor process vessels have not been received.

Cs^{137} Source Assembly Station (Building 3013). Fifty drawings covering the design of equipment have been completed on this project. About 80 drawings will be required for the entire job.

All surplus equipment and piping in Building 3013 were salvaged or removed to the burial ground. Installation of the new equipment should start within approximately two months.

Purification of Rare Earths. The heated ion-exchange column is operated on a two-shift basis to separate the individual rare earths. As previously reported, this unit has been quite effective in producing relatively pure Pm^{147} and Eu^{155}. The samarium fractions contain inactive samarium in sufficient quantity to be precipitated and easily detected by spectrographic analysis. The europium can also be detected by spectrographic analysis.

Because of the relatively weak energy of the samarium beta, no carrier was added in an effort to separate the last traces of promethium and europium so that a sample of sufficiently low self-absorption could be obtained for an accurate assay. The samarium was purified by two sodium amalgam separations. This procedure removed the promethium from the samarium and the europium. A portion of the separated samarium-europium was fractionated on the steam-heated ion-exchange column. The enrichment of the samarium fraction was followed by means of beta proportional counter absorption curves. The enrichment of the samarium obtained in one pass through the column was 57%. It is planned to test procedures for separating europium and samarium by selective reduction in a Jones reductor, followed by coprecipitation of europium with barium sulfate.

Purified Fission Products. The following fission products were produced:

Mixed Fission Products	176 mc
Yttrium (Y^{91} – 57 d)	330 mc
Zirconium-Niobium (Zr^{95}, Nb^{95} – 65 d, 35 d)	
Zr^{95}	1160 mc
Nb^{95}	1860 mc

Hot Chemistry Cell (Building 3029)

The Hot Chemistry Cell has been referred to in previous reports as the "Argonne–Type Cell." Work on this project continued through the month. The access roadway and floor of the cell (standard concrete) were poured and the forms for the barytes concrete walls are complete. The steel-lead door frame was installed. Considerable piping, placing of sleeves, and installation of access port must be done before the pouring of concrete walls is started. The master-slave manipulator is now scheduled to arrive from the manufacturer by June 30.

Europium Target Material

A qualitative spectrographic analysis was made on each of three fractions from a rare-earth mixture purchased from Rare Earths, Inc. The three fractions were obtained as follows: the carbonate crude was dissolved in HCl; an insoluble portion, representing 45% of the total weight, was filtered off and the soluble rare earths were recovered as oxide; the mixed oxides were treated with excess HCl, the solution filtered, and samples of the filtrate (fraction No. 1) and the residue (fraction No. 2) were taken; the filtrate was extracted with sodium amalgam and the rare earths recovered from the mercury by acid leaching (fraction No. 3). The analyses showed the following elements present:

Element	Fraction No. 1	Fraction No. 2	Fraction No. 3
Ce	M	S	M
Dy	T	FT	
Er			
Eu	T	FT	FT
Gd	VW	T	
Hf			

Ho			
La	S	S	S
Lu			
Nd	M	W	M
Pr	W		W
Sc			
Sm	M	S	M
Tb			
Tm			
Y	M	M	
Yb	T	FT	FT
Zr			

M = Moderate
S = Strong
T = Trace
FT = Faint trace
VW = Very weak
W = Weak

An estimate of the europium content was found to be well below the 0.5% reported by Rare Earths, Inc.

Extraction of Rare Earths with Tributyl Phosphate

A study of the tributyl phosphate (TBP) extraction of the rare earths is in progress. A series of extractions was performed on a 12.5 *N* HNO_3 solution of the rare-earth concentrate obtained in europium fractionations. A 60% TBP–40% Varsol mixture was used from which the rare earths were recovered by extraction with 4 *N* HNO_3.

One extraction sequence was performed with six fresh portions of TBP. The rare earths were recovered and converted to oxides. The color of the oxides changed from tan in the first fraction to brick red in the sixth fraction. A sample from the first and sixth extract was dissolved in 5% HCl and analyzed spectrophotometrically over the spectral range 350 to 1000 mμ. A model DU Beckman spectrophotometer was used. Both samples had a high absorption background in the 350 to 400 mμ range, which prevented a determination of europium and samarium. An estimate of the other elements found is as follows:

Element	Fraction No. 1	Fraction No. 2
Nd	60%	20%
Pr	10%	3%
Er		2%
Dy		8%
Yb		1%
La + Ce	20%	

In connection with a general survey of TBP extraction properties, the extraction of aluminum, iron, nickel, and cobalt from 16 *N* HNO_3 into 100% TBP was tried. Ferric iron was readily extracted nearly quantitatively, while the other elements did not appear to extract. This fact may be useful in the purification of large amounts of radioactive iron.

Tritium

An analysis of the tritium remaining in the glass system was made by using a micro-gas density balance. The gas was found to be 29% tritium; the remainder was hydrogen. The accuracy of the above result will be checked by determining the density of known gases, such as helium and helium-hydrogen mixtures.

Work continued on the all-metal gas system for tritium. It is almost completed and will be in use by the latter part of June.

Processed Radioisotopes

Table 4 is a list of radioisotope product solutions that were made from pile-irradiated targets.

Cyclotron Radioisotopes

The following radioisotope product solution was prepared from cyclotron targets:

Beryllium (Be^7 – 52.9 d) 37.2 mc, carrier-free

TABLE 4

Radioisotopes Produced from Pile-irradiated Targets

Product Solution	Amount (mc)	Specific Activity (mc/g)
Calcium (Ca^{45} – 180 d) (from enriched Ca^{44})	72	3690
Chromium (Cr^{51} – 26 d)	510	1531
Mercury (Hg^{203} – 43.5 d)	380	473
Thallium (Tl^{204} – 2.7 y)	3400	424
Tungsten (W^{185} – 73.2 d)	378	241
Iron (Fe^{55} – 2.91 y) (from enriched Fe^{54})	103	981

Special Preparations

Twenty-eight Co^{60} sources were loaded with a total of 155 curies.

Two iridium metal sources were prepared for irradiation.

Eight 5-mc S^{35} sources were prepared from high specific activity elemental sulfur.

An isotonic solution (39 mc) of Be^{7} was prepared.

Miscellaneous Work

A leaking Cs^{137} source was received from the National Bureau of Standards for resealing. Preliminary examination indicated that the source could not be salvaged.

Two sketches for Cs^{137} source sheaths were made; one for millicurie amounts and one for amounts up to several curies.

A ring-seal type source sheath was designed for an experimental beta source. This type of source holder may be sealed by pressing.

Corrosion tests on titanium tubing in molten sulfur and HNO_3 are continuing.

Design criteria for new equipment to melt, purify, and load sulfur were established.

A study of the effects of 80% zinc bromide solution on iron and galvanized iron in the presence and absence of zinc metal was started.

Tentative design criteria were established and a preliminary cost estimate was made (for budget purposes) of a proposed canal for the isotope area.

The quarter section of stainless steel floor covering in Building 3036 was completed this month.

The installation of a small stainless steel tank was begun in Building 3036 to aid in cleaning heavy radioisotope shipping containers. The tank was removed from Building 3038 where it was not used.

WASTE DISPOSAL

The leaking underground cell-ventilation duct from Building 3026-C was replaced with an aboveground duct. The remaining leaks in the hood-ventilation duct in the radioisotope area were caulked and cemented.

The telemetering system is now tied into an alarm that warns the operator when any monitoring tank liquid-level has reached 70% of tank capacity. This system is complete except for its being tied to the tanks servicing the new areas and the replacement of the incorrect size gears on some gage boards.

The first proportional sampler and flow-measurement instrument was placed in the process waste system manhole east of Building 3500. This station monitors all the waste that goes to process waste system from the radioisotope area, which includes Buildings 3028 through 3038, as well as Buildings 3001, 3006, and 3012. There is an indicated uninterrupted flow through this system of 4000 gal/hr with a rise during the working hours from 8:00 AM to 4:30 PM. The average daily flow is about 115,000 gal with about a 0.10-curie-per-day discharge.

As a result of this flow measurement, a survey was instituted to determine if some of the sources to this system could be rerouted to other systems. To date, several air-conditioners, water stills, and compressors have been found that will be rerouted to the storm sewer.

The settling basin baffles were raised so that they now are all above water. To accomplish this, it was necessary to install new supporting poles.

Work is progressing slowly on the shielding of the tank farm transfer line. Approximately 60% of this line has been shielded to date.

The W-7 pump was repaired with the installation of a new shaft, new bearings, and a new impeller. The pump was put back into service.

To speed up the transfer of metal slurry from tank W-7 to W-10, a new type of sparger and nozzle on the recirculating line were installed. These changes in the equipment, plus an accelerated operating procedure, has resulted in the movement of 10,000 gal of precipitated metal this month.

The chemical-waste storage pit was completed this month.

Wastes Discharged to White Oak Creek

The sampling procedures at the settling-basin outlet and retention-pond outlet have been revised so that one composite sample is taken for a 24-hr instead of a 4-hr period. This change should result in considerable saving of analytical work.

A total of 46.5 curies of beta activity was discharged to White Oak Creek from the settling basin and retention pond (see Table 5). This discharge is 140% greater than that of last month. An operating error, during the decontamination of the waste evaporator for repairs, resulted in the discharge of roughly 20 curies when about 600 gal of decontaminating solutions were discharged to the settling basin instead of tank W-5. An error in analytical results on a control sample accounted for an additional 10 curies being sent to the settling basin from W-2 instead of being processed through the evaporator. Purging of the Building 3001 canal and draining of Building 3505 canal contributed a large share of the remainder of the activity discharged.

TABLE 5

Activity Discharged to White Oak Creek

Discharged from	May 1952		April 1952	
	Gallons	Beta Curies	Gallons	Beta Curies
Settling basin	25,453,000	46.43*	22,136,000	19.33
Retention pond	300,000	0.07	295,000	0.06
Total	25,753,000	46.50	22,431,000	19.39

*Less than 0.33 curie contributed by normal evaporator operation.

Chemical–Waste Evaporator

The evaporator was shut down for 54 hr this month for general overhauling. After decontamination of the equipment, the evaporator to W-6 tank jet was removed and replaced with a 2-in. pipe, the automatic feed valve was repaired, new pins were placed in the evaporator drain valve extension shafts, all packing glands were tightened, and steam coil leaks were welded. Operations and inventory are given in Tables 6 and 7.

TABLE 6

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 1952	208,000	17,200	12.1:1	11,161	0.33
April 1952	219,000	20,100	10.9:1	10,506	5.09

TABLE 7

Waste-Tank Inventory

Tanks	Capacity (gal)	Free Space (gal)	
		May	April
Hot-Pilot-Plant Storage			
W-3, 13, 14, 15	48,500	32,175	32,500
Chemical-Waste Storage			
W-5	170,000	85,000	68,500
Evaporator-Concentrate Storage			
W-6, 8	340,000	52,000	59,000
Metal-Waste Storage			
W-4, 7, 9, 10	543,000	279,000	283,500

RaLa

A process change, which had been developed in the laboratory and which was thought might eliminate the troublesome pH adjustment encountered in the past, was checked with a test run.

The run was made with 65 "X" slugs that were dissolved and extracted in one batch. Five grams of inactive barium as $Ba(NO_3)_2$ was added to the run in the extraction step to simulate the amount that would be present in a 30,000-curie run.

The run was processed through to the point at which it normally would be transferred to the cone, then the small amount of product was discarded.

Special samples were taken of the extraction tank contents to determine whether any loss of product resulted from the "crud" filtration after the dissolving and after each metathesis to determine which metathesis produced the high loss.

The analyses indicated that a 5% product loss does occur in the "crud" filtration. A procedure change, which incorporates a 15% HNO_3 wash of the "crud" filters following the dissolving filtration, is expected to eliminate this loss. Analyses also indicated that the fuming HNO_3 metathesis resulted in a 7% loss, as compared with about 0.3% for each K_2CO_3 metathesis.

An analysis, to determine the acid content of the feed to the column as it came from the extraction tank, showed the presence of 9.4 moles of HNO_3. Recent laboratory checks show that this amount is not excessive; the feed may contain 10 moles of acid without interfering with the process.

The revised procedure was not a success since it produced a 7% loss in the fuming HNO_3 metathesis, 35% loss in extractor rinse, and 9% loss in the sodium Versene elution step, in spite of the fact that the amount of Versene used for the strontium removal was substantially lowered from 17 liters containing 1.19 moles of Versene to 11 liters containing 0.77 mole.

The analytical results of the test run follow:

	Curies	Per Cent
Dissolver solution (65 ORNL slugs)	161.0	100.00
Cell A losses		
"Crud" filter loss	7.0	4.4
Extraction and washes	3.0	1.9
K_2CO_3 metatheses		
First	0.1	
Second	0.1	
Third and washes	1.2	
Fuming HNO_3	10.6	
Total metatheses losses	12.0	7.5
Extractor and process filter rinse	56.0	34.8
Total cell A losses	78.0	48.6
Resin-cubicle losses		
Feed-tank product	81.0	
Feed effluent		
Feed tank rinse	1.0	0.6
NaOH elution	0.1	
Sodium versenate elution	14.0	8.7

HCl elution	2.5	1.6
Fuming HNO_3 precipitation	1.0	0.6
Total resin cubicle losses	18.6	11.5
Total process losses	96.6	60.1
Product	59.0	36.7
Material balance		96.5

As a result of the failure of the test run to prove the laboratory process, another run using 65 unirradiated "X" slugs was made to determine a sulfate-ion material balance to see where the metatheses were failing to convert all the insoluble sulfate ion to the soluble carbonate ion, thus holding some product out of solution.

The 65 "X" slugs were dissolved and extracted in one batch. Five grams of inactive barium, as $Ba(NO_3)_2$, was added to the run in the extraction step to simulate the amount that should be present in a 30,000-curie run.

This run was processed through the solution of the metathesized cake. Three K_2CO_3 metatheses and one fuming HNO_3 precipitation were performed in the extraction tank according to the revised procedure. Special samples were taken for sulfate-ion content after the extraction filtration's fourth and fifth water wash, and again after each individual metathesis. A final sample was taken for sulfate-ion content of the Versene wash of the process filters and extraction tank.

No definite results have been obtained as yet, but the tentative figures do indicate that enough sulfate ion remains behind in the process after the metatheses to tie up at least 25% of the product in an insoluble form.

Analyses of the extraction washes indicated that all of the free sulfate ion was not washed from the tank, lines, and accessory equipment prior to the metatheses thus interfering with the success of the metatheses. For the next run, a special wash using 100 gal of 0.4 *M* K_2CO_3 will be made that should completely wash the soluble sulfate ion from the equipment.

If the sulfate-ion content cannot be eliminated by the weak K_2CO_3 wash and the metatheses, a pH adjustment of the Versene feed solution will always be necessary to dissolve all the product. The next run, which is scheduled to start on May 31, 1952, will utilize pH adjustment of the Versene feed.

During the test runs it was found that tremendous quantities of water were leaking into cell A and the make-up room pit. Investigation revealed a large section of broken process-waste drain pipe, as well as a partly plugged line. This line has been repaired.

No additional work was done on the Tucson carrier left at the Laboratory for repairs.

The panel board, which contained instruments that had recorded the monitron readings throughout Building 3026, was removed since it was not being used and instruments were turned into the instrument pool.

RADIOISOTOPE CONTROL DEPARTMENT

There were 869 radioisotope shipments during May compared with 939 during April and 820 during May 1951. Table 8 shows a breakdown according to separated, unseparated, project, nonproject, and foreign shipments.

TABLE 8

Radioisotope Shipments

	May 1952	April 1952	May 1951	August 1946 to May 1952, Inclusive
Separated material	708	731	657	26,191
Unseparated material	161	208	163	7,351
Total	869	939	820	33,542
Nonproject	761	814	618	
Project	92	113	180	
Foreign	16	12	22	
Total	869	939	820	

HANFORD IRRADIATIONS

The radioisotope samples listed in Table 9 were received from Hanford during May.

TABLE 9

Radioisotopes Received from Hanford

Sample No.	Material	No. of Pieces	Date Discharged	Date Received
ORNL-145	Enriched Fe^{58}	1	May 1952	5/23/52
ORNL-144	Chromium metal	1	May 1952	5/23/52
ORNL-129	Calcium	1	May 1952	5/23/52
ORNL-80	Mercury	1	May 1952	5/31/52

CYCLOTRON RADIOISOTOPES

Table 10 is a list of the outstanding orders for cyclotron radioisotopes.

Table 11 is a list of the number of radioisotope bombardments received and requested during May.

Table 12 lists the number of radioisotopes cyclotron-processed during May 1952 by millicuries or service irradiations.

TABLE 10

Cyclotron Radioisotope Orders

Material	Amount (mc)	Status
Mn^{54}	11.2	Material in process
As^{73}	2.0	Material has been requested
Sr^{85}	5.0	Material has been requested

TABLE 11

Bombardments Received and Requested

Material	Mass. Institute of Technology		University of California		University of Pittsburgh		Washington University	
	Bombard-ments	Beam Hours	Bombard-ments	Beam Hours	Bombard-ments	Beam Hours	Bombard-ments	Beam Hours
Bombardments Received								
Be^{7}			1	47.20	15	342.00		
Na^{22}	2	190.00			9	400.25	4	300.00
Mn^{52}					2	20.00		
Mn^{54}	1	50.00	1	95.00			7	400.00
Fe^{54}			1	18.70				
Co^{57}	1	10.00					4	140.00
Fe^{59}			7	332.80	2	80.60	1	34.00
Zn^{65}	1	100.00	1	47.80				
Ga^{67}					11	77.75		
As^{73}			1	10.50	3	30.50		
Sr^{85}	2	59.75			1	10.00		
Y^{88}	1	10.00						
I^{125}							2	60.00
Molybdenum metal					2	15.70	5	50.40
Sulfur					1	2.00		
Total Received	8	419.75	12	552.00	46	978.80	23	984.40

Material	Mass. Institute of Technology		University of California		University of Pittsburgh		Washington University	
	Bombard-ments	Beam Hours	Bombard-ments	Beam Hours	Bombard-ments	Beam Hours	Bombard-ments	Beam Hours
Requested but not Received								
Ti^{46}			1	3.00				
Ti^{48}			1	3.00				
Fe^{57}			1	3.00				
As^{74}	1	5.00						
KCl	1	1.00						
Sr^{85}	1	30.00						
Total hours outstanding (not received or requested)		1044.25		939.00		521.20		515.60

TABLE 12

Shipments of Cyclotron-processed Radioisotopes

Material	No. Shipments May 1952	Total Millicuries and Service Irradiations			
		May 1952		To Date	
		mc	S.I.	mc	S.I.
Be^{7}	2	34		352.243	4
Na^{22}	5	4.300		77.704	
Mn^{52}				10.991	
Mn^{54}				7.52	
$Fe^{55,59}$				63.64	4
Co^{57}	2	1.044		4.144	
Zn^{65}				42	4
Ga^{67}	4		4		17
As^{73}				4.560	
Sr^{85}				6	
Sr^{90}					1
Mo^{95}	1		1		7

ACTIVATION ANALYSES

A system has been worked out for accumulation of costs for all activation analyses.

SF MATERIAL CONTROL

On May 31, 1952, two carload-lot shipments were received from Hanford which consisted of 7 large, 3-ton carriers loaded with 234 irradiated uranium slugs for the RaLa process.

On May 22, 1952, one carload-lot shipment was received from Chalk River, Canada, which consisted of 268 pieces of irradiated uranium for the SCRUP program.

An additional 9696 silicon-bonded, aluminum-jacketed, normal uranium slugs were received from Y-12 during May 1952. The slugs are for testing and subsequent loading into the 3001 pile.

Other notable fissionable material receipts consisted of 2217.85 g of 90 to 95% enriched uranium for use in the Homogeneous Reactor Experiment and 6440.13 g of 90 to 95% enriched uranium for use in fabricating MTR assemblies.

During the month, two large batches of separated U^{233} (approximately 930 g) were shipped to Y-12 for use by A. D. Callihan in an experiment to determine the conditions for a sustained nuclear chain reaction in aqueous solutions of U^{233}.

Twelve MTR fuel assemblies and two MTR shim rods were shipped to Phillips Petroleum Company, Scoville, Idaho, during May. The total number of assemblies and shim rods shipped to date is 78 and 10, respectively.

Plutonium separations programs were accelerated during May, which resulted in the shipment of 422.16 g to Los Alamos. The amount shipped is subdivided by the program as follows: 299.02 g was separated from material designated as Sr^{90} slugs and 123.14 g was separated by the Purex process.

In connection with the recommendations contained in SF Accountability Survey Report No. 35, it is noted that recommendations Nos. 5, 6, 7, and 8 have now been incorporated in the ORNL accountability system. The research work associated with recommendation No. 1 was continued and resulting data sent to A. de la Garza, K-25 plant. The data collected may be sufficient to warrant conclusion of the research; however, in the event it does not, additional data will be collected. Recommendations Nos. 2, 3, and 4 are still under study. Regarding recommendation No. 5, it is still necessary to modify Standard Practice Procedure No. 58. Nevertheless, the new forms referred to in the April report have been distributed and are now being used.

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

During May, there were 19 receipts and 32 outgoing shipments, compared with 29 receipts and 30 shipments last month. Tables 13 and 14 are summaries of receipts and shipments for the month of May.

TABLE 13

SF Materials Received

From	Material	Amount (g)
Battelle Memorial Institute	Thorium metal	2,162.00
Carbide and Carbon Chemicals Co., K-25 Area	Depleted uranium (waste)	662.00
	Plutonium (waste)	0.03
	Normal uranium (metal)	1,778.00
Carbide and Carbon Chemicals Co., Y-12 Area	Enriched uranium (UO_2SO_4)	2,069.01
	Enriched uranium (metal)	6,000.31
	Normal uranium (slugs) net	2,419,830.00
	Depleted uranium (metal)	32.78
	Normal uranium (slugs) net	2,424,450.00
	Normal uranium (UF_4)	32.10
	Normal uranium (UNH)	100,649.51
	Normal uranium (slugs) net	2,256,813.00
	Normal uranium (UO_2SO_4)	1,549.50
	Normal uranium (oxide waste)	3,800.00
	Normal uranium (slugs) net	2,197,920.00
	Normal uranium (slugs) net	2,370,538.00
Chalk River, Canada	Plutonium (slugs)	497.90
General Electric Co. HGE	Depleted uranium (slugs)	124,465.00
	Plutonium (slugs)	22.00
	Depleted uranium (slugs)	291,604.00
	Plutonium (slugs)	52.00
General Electric Co. SGE	D_2O	87.80 lb
Lindsay Light and Chemical Co.	Thorium (compounds)	748.50
National Research Council	Depleted uranium (slugs)	1,463,120.00

TABLE 14

SF Materials Shipped

To	Material	Amount (g)
Argonne National Laboratory	Enriched uranium (foils)	0.00072
Carbide and Carbon Chemicals Co., K-25 Area	Normal uranium (slugs)	7,112.00
	Normal uranium (slug)	1,750.00
Carbide and Carbon Chemicals Co., Y-12 Area	U^{233} (UO_2SO_4)	0.0018
	U^{233} [$UO_2(NO_3)_2$]	0.054
	Normal uranium (UNH)	70,873.11
	Depleted uranium (U_3O_8)	9.94
	U^{233} [$UO_2(NO_3)_2$]	0.176
	Depleted uranium (Purex)	2,258.69
	Normal uranium (donuts)	36,864.00
	Normal uranium (oxide)	3,800.00
	U^{233} [$UO_2(NO_3)_2$]	0.06
	Enriched uranium (MTR)	12.204
	Enriched uranium (MTR)	5.709
	Normal uranium (slugs)	3,521.49
	Enriched uranium [$UO_2(NO_3)_2$]	1.148
	Enriched uranium (oxide)	Negligible
	U^{233} [$UO_2(NO_3)_2$]	627.77
	Enriched uranium (UO_2SO_4)	0.68
	U^{233} [$UO_2(NO_3)_2$]	0.047
	Enriched uranium (UO_2SO_4)	0.684
	U^{233} [$UO_2(NO_3)_2$] net	302.15
General Electric Co., AGT	Enriched uranium (UO_2)	0.23
Los Alamos Scientific Laboratory	Plutonium (Sr^{90})	299.02
	Plutonium (Purex)	71.71
	Plutonium (Purex)	51.43
Phillips Petroleum Co.	Enriched uranium (MTR)	215.608
	Enriched uranium (MTR)	840.556
	Enriched uranium (MTR)	837.372
University of California Radiation Laboratory	Normal uranium (U/Zr)	1,555.00
	Normal uranium (plates)	600.00
	Thorium (metal)	250.00
USAEC, Idaho Operations Office	Normal uranium (U/Al)	2,516.13
USAEC, Oak Ridge Operations Office	U^{233} (HCl)	0.001
	$Pu(NO_3)_4$	0.011