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1954

OPERATIONS DIVISION MONTHLY REPORT

FOR MONTH ENDING APRIL 30, 1953

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OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending April 30, 1953

by
M. E. Ramsey

DATE ISSUED

MAY 28 1953

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Operated by
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OPERATIONS DIVISION MONTHLY REPORT

SUMMARY

The activities of the Operations Division for the month ending April 30, 1953 are summarized and indexed below:

1. Lost graphite reactor operating time averaged 10.4%, compared with 8.9% for March (p. 3).
2. The stored-energy release, when graphite from the center of the reactor was heated to 200°C, was found to be approximately 15 cal/g (p. 4).
3. The LITR down time was 10.0% compared with 13.4% last month (p. 4).
4. Use of the LITR bypass demineralizer reduced the corrosion rate of steel by approximately one-third (p. 4).
5. Approximately 840 curies of Cs^{137} has been separated and will be further purified before use in the fabrication of a kilocurie source (p. 6).
6. Severe resin damage was encountered when Al^{+++} was separated from batches containing 200 to 300 curies of Cs^{137}. An alternate method consisting in the precipitation of aluminum as the hydrated oxide by hydrolysis of urea is much more satisfactory (p. 6).
7. Recent results from the study of the solubility of $BaCl_2$ in concentrated HCl are presented (p. 7).
8. Two promethium sources of about 10 curies each have been prepared by incorporating promethium oxide with glass (p. 8).
9. A total of 34.7 curies of beta activity was discharged to White Oak Creek, compared with 88.1 curies last month (p. 9).
10. The RaLa product-drying conditions have been changed because tests indicated that the presence of iron oxide in the RaLa products may have resulted from the use of improper conditions (p. 11).
11. The next RaLa run is scheduled to start at midnight on May 26, 1953 (p. 11).
12. There were 1022 radioisotope shipments this month, compared with 1115 during March (p. 12).

REACTOR OPERATIONS DEPARTMENT

OPERATING DATA

	APRIL 1953	MARCH 1953	YEAR TO DATE 1953
ORNL Graphite Reactor			
Reactor power			
Total accumulated (kwhr)	257,184,126	2,536,931	9,997,973
Average kw/operating hr	3635.47	3741.42	3811.80
Average kw/24-hr day	3256.19	3409.85	3471.52
Lost time (%)	10.43	8.86	8.93
Excess reactivity (inhr)	30	10	
Slugs discharged	96	106	362
Slugs charged	72	106	282
Product made (g)	85.56	92.59	364.89
Product discharged (g)	2.25	2.42	7.73
Low-Intensity Test Reactor			
Reactor power			
Total accumulated (kwhr)	968,694	956,717	3,507,749
Average kw/operating hr	1,495	1,484	1,440
Average kw/24-hr day	1,345	1,286	1,218
Lost time (%)	10.0	13.4	15.4
Position of No. 2 shim rod (in. out)	23.550*	25.250	

*This corresponds to approximately 1.6% excess reactivity.

REACTOR OPERATIONS

ORNL Graphite Reactor

There were no slug ruptures during the month, and the excess reactivity was again adequate to permit operation at 3800 kw. All the old "spiders" in the reflector zones have been discharged and new ones have been inserted. This change has caused a marked increase in the cooling in the central zones of the reactor and a gain in excess reactivity. In addition, the tantalum slugs being irradiated for the Army Chemical Corps were pulled to the east side of the reactor where they absorb approximately 50 inhr less than when they were uniformly distributed.

Ten tantalum slugs that were being irradiated for the Army Chemical Corps and which had been discharged previously were recharged on April 7 to channel 0376, and 14 of these slugs were recharged to channel 0682 on April 27.

Some consideration has been given to the plugging of the slots in the bridge tubes in the outer zones of the reactor so that more of the cooling air would flow through the central channels and thus reduce temperatures in the center and permit higher power operation at the present maximum metal temperatures. Preliminary tests on channel 3268 show that the temperature can be increased about 15°C by restricting the air flow, which indicates that an appreciable amount of the air now flowing through the outer channels of the reactor can be diverted to the inner portion where it is needed.

Some difficulty has been experienced recently in removing lead shields from the north side of the reactor via the east balcony to the elevator on the south side. Since the balcony is not built to take heavy loads, this work has resulted in considerable vibration of the east side of the building, and some damage to the concrete balcony has been observed.

Consideration is being given to an alternate way of removing the shields.

Measurements of the stored energy in graphite removed from the center of hole 6 have been completed by M. C. Wittels of the Solid State Division. It was found that approximately 15 cal/g is released up to 200°C and that this represents approximately one-fourth of the total stored energy. Additional analyses are to be performed on sections of graphite removed from cooler regions of the reactor.

Slugs discharged along with ruptured slug No. 111 on March 30 are being measured by representatives of the Metallurgy Division, and the slugs appear to have increased slightly in length. Most of these slugs were not beta transformed, and similar slugs cycled in a furnace have had jacket growth of as much as 0.5 inch.

The slugs in metal channel 1868 were discharged so that a request could be filled; the row has been recharged and a thermocouple slug has been included. However, the slug row was not pushed west to its normal position but will be pushed a few feet forward each week in order to obtain a temperature traverse.

The hydrogen liquefier is practically complete and ready for testing. It is expected that liquid hydrogen will be produced early in May.

Low-Intensity Test Reactor

The LITR operated very satisfactorily during April and had a down time of 10%.

New nozzles for the spray tank have been installed; they were placed under the guide rings and the spider supports at the bottom of tank A to protect them from objects being moved inside the tank.

The bypass demineralizer was removed on April 21 after less than four weeks of operation. Because of the short life of the present resin columns and the difficulty of regenerating the monobed units now in use, it is planned to install separate cation and anion columns. This should increase the time between regeneration and simplify the regeneration procedures.

Sufficient data have been collected to compare the corrosion rate of steel in the LITR before and after installation of the bypass demineralizer on January 14, 1953. The corrosion rate has been reduced to approximately one-third of the rate observed before the demineralizer was put into use. A steel specimen, for example, tested for 1512 hr gave a rate of 15.3 mils per year before installation of the demineralizer, compared with the present rate of 4.1 mils per year. The corrosion rate of aluminum is considerably less than that of steel and is approximately 0.4 mil per year, whereas beryllium samples exhibit an almost negligible rate of about 0.1 mil per year. The measurement of the sample was done by J. L. English of the Reactor Experimental Engineering Division.

The fluid cooler has operated without further trouble since the turbulators were removed. An analysis of the silt found in the tubes showed that 75% of the material was aluminum and about 20% was iron. Small amounts of Be, Ca, Cr, Cu, Mg, Mn, Ni, and about 3% Pb were also found.

An activity analysis of the silt, which accounts for about 85% of the total radioactivity, is shown below:

Beta Components	Radioactivity (%)
Np^{239}	40
Rare earths La^{140}, Ce^{141}, Pr^{143}, Nd^{147}, etc.	33
$I^{131,132}$	~ 3
$Te^{131,132}$ (others ?)	3
Fe^{59}	2
Na^{24}	< 2
Mo^{99}	1.5
Zr^{95}	1.3
Unknown (1)	~ 0.4
Ag^{110}	~ 0.2
Zn^{65}	~ 0.1
Sr^{89}	~ 0.1
Ba^{140}	~ 0.02
$Cs^{136,137}$	< 0.02
Error and undetermined	~15

On April 7, a leak was found in tank A of the LITR at an instrument-line connection and was repaired; water from the leak had apparently soaked the concrete-block shielding on the north side of the reactor and had caused the No. 1 safety chamber and servochamber to read low.

(1) Carried by sodium.

The LITR carrier that arrived on April 7 has been filled with lead and is now ready for the shipment of spent fuel elements to Arco.

An auxiliary water head tank was installed at the LITR to supply 2 to 3 gpm from the potable water system for experiments. The tank must be used when the bulk shielding facility takes a full stream of water from the process water system, since the line pressure is too low at other times to supply the needed cooling water.

FILTER HOUSE

Table 1 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.

On April 9, the glass-wool filters in cell No. 2 were changed; Table 2 shows data for the filter house before and after the change.

FAN HOUSE

Both fans functioned normally throughout the month.

RADIOISOTOPES

Stringers 13, 14, and 16 contained 373 cans of target material at the end of April, as compared with 330 cans of target material at the end of March.

Table 3 shows a comparison of the radioisotope and research samples charged into the ORNL graphite reactor during April with those handled in March.

TABLE 1. PRESSURE-DROP DATA

DATE	PRESSURE DROP (in. water gage)		
	Glass Wool	CWS No. 6	Total Across House
4/30/53	2.3	2.6	6.1
3/31/53	3.7	2.6	7.6
Clean filters	1.1	1.3	3.3

TABLE 2. PRESSURE-DROP DATA FOR CHANGE IN FILTERS

DATE	PRESSURE DROP (in. water gage)		
	Glass Wool	CWS No. 6	Total Across House
4/5/53 (before change)	3.8	2.3	7.7
4/12/53 (after change)	2.6	2.5	6.0

TABLE 3. RADIOISOTOPE AND RESEARCH SAMPLES

	APRIL 1953		MARCH 1953	
	Research	Radioisotopes	Research	Radioisotopes
Stringers 13, 14, 16	12	220	9	210
Hole 22	54	3	43	4
All other holes	4	23	4	38
Total by groups	70	246	56	252
Total for month	316		308	

WATER-DEMINERALIZATION PLANT

The following list shows the water-treatment data for April, as compared with those of March:

	April 1953	March 1953
Water demineralized (gal)	311,760	337,140

CHEMICAL SEPARATIONS AND RADIOISOTOPE DEVELOPMENT DEPARTMENTS

RADIOISOTOPES

Iodine (I^{131} – 8 d)

Eighty ORNL slugs were processed and 40,872 mc of I^{131} was shipped.

One run this month was highly concentrated to provide 750 mc of special material for the Chemistry Division. When this material was removed from the product, the remainder was diluted to the normal volume for ordinary shipments.

Two 8-slug runs caused considerable difficulty in processing. The crude product coming into the final glassware purification in one of the two runs was found to be acidic instead of basic. In the final purification of the other, the distillate was acidic. These difficulties caused a higher-than-usual nitrate content in both products.

Iodine Development Work, Building 3028

Only one piece of equipment, the caustic scrubber, has been delivered for the new I^{131} plant. The delivery date for all remaining equipment has been extended to June 15, 1953.

A complete file was made of I^{131} prints, notes, and sketches.

Phosphorus (P^{32} – 14.3 d)

Nineteen 2500-g cans of bombarded sulfur were processed and 11,090 mc of P^{32} was shipped.

The product from one 4-can run contained a moderate precipitate at a pH of 7. Another batch contained an excessive amount of heavy metals and had to be reprocessed four times before it was acceptable for shipment.

Phosphorus Development Work

A particularly bad-looking lot of sulfur was tested for impurities by extraction at 130°C with 0.2 *N* HNO_3; the sulfur had been purified by the MgO process. A relatively large amount of salts was recovered from the aqueous extract, which was shown by spectrographic analysis to consist mainly of calcium and magnesium. Further work on the purification of sulfur will be done to find a method for the elimination of these elements.

Precipitation Process, Building 3515

Analysis of the product solutions withdrawn from precipitator No. 2 during the month indicated that the stainless steel dip tubes are contributing an undesirable amount of corrosive products to the product solution; consequently, it was decided that the agitator shaft to be included in the revised vessel should be made of tantalum or glass to conform with the use of tantalum dip tubes. Two designs were drawn up for the agitator shaft and propeller; pyrex is to be used in one and tantalum tubing will be used in the other. A test model of each design is being fabricated.

Revisions in the piping of cell No. 2 were made on the working drawings in preparation for work to be done in the cells during May and June.

Two microporous porcelain filters were received from Selas Corp. to be tested for use as filters for precipitator No. 2. Fabrication of the new top for precipitator No. 2 was completed.

A supply of tubing fittings to be used in the revision of cell No. 2 was stockpiled.

The first phase of operations on the separation of a kilocurie quantity of Cs^{137} was completed. Most of the material was separated from old Redox waste in tank 14, which was emptied and cleaned for temporary use by the Pilot Plant during Thorex operations.

A total of 840 curies of Cs^{137} was obtained and stored in the underground garden. After the correction for a mechanical loss of 250 curies, the over-all yield of the process was 90%. The final stages of the separation to remove Al^{+++} from the last crop of alum crystals were accomplished in two ways for testing purposes: ion-exchange removal of aluminum as the oxalate complex, and precipitation of aluminum as the hydrated oxide by hydrolysis of urea. Severe damage of the ion-exchange resin resulted while batches containing

200 to 300 curies of Cs^{137} were being processed on a 1-liter Dowex-50 resin column; the product contained large amounts of gelatinous, decomposed resin. The precipitation method was more satisfactory. In order to decompose the resin in the ion-exchange products, prolonged boiling in H_2O_2 and 70% HNO_3 was used; as a result, large amounts of Fe, Cr, and Ni were obtained in solution from the corrosion of the stainless steel. A typical analysis follows: Cs^{137}, 0.15 curie/ml; total solids, 64 mg/ml; nonvolatile material, 41 mg/ml; Fe, 14 mg/ml; Cr, 2.2 mg/ml; Ni, 3.3 mg/ml; Al, 5.0 mg/ml; SO_4^{--}, 50 mg/ml. The best product, as shown by the following results, was obtained by the precipitation process: Cs^{137}, 74 mc/ml; nonvolatile matter, 6 mg/ml. This material contains only about three times the theoretical amount of solids per curie of Cs^{137}.

All the stored product will be subjected to further purification before the radiochemical $Cs^{137}{}_2SO_4$ is used for fabrication of a kilocurie source.

Source Assembly Station, Building 3013

A Vycor evaporator was installed in the source assembly cell.

Difficulties were encountered in the removal of sulfates from synthetic, cesium product solutions. Laboratory experiments are in progress to determine better ways of removing excess sulfate.

It was decided to install equipment in cubicles 1 and 2, Building 3029, to perform an intermediate purification step on the cesium product solution from Building 3515. Experimental equipment was set up for the purification work, and several test runs have been made. This setup will be used in the hot chemistry cell to purify a 50-curie batch of Cs^{137} for regular radioisotope orders.

Experiments in the Purification of Sr^{90}

Several previous monthly reports have presented data on the solubility of $BaCl_2$ in concentrated HCl, a matter of some importance in the purification of Sr^{90} which is usually processed with inactive barium carrier.

The experimental method follows, and the results are presented graphically in Fig. 1. Solutions of $BaCl_2$ were labelled with 20-y Ba^{133} and analyzed gravimetrically for Ba^{++}; the Ba^{133} gamma was counted with a well-type crystal counter. Very concentrated HCl solutions were produced by the absorption of HCl gas in concentrated HCl. In all cases the solutions were allowed to come to equilibrium with excess crystalline $BaCl_2$; temperatures were controlled by the samples being placed in a water bath. After equilibrium was reached, portions of the supernatant were withdrawn for analysis by titration of the HCl and radiometric analysis of the barium. Attention is called to the minima in the solubility curve at about 12 *N*.

It has been shown that the solubility of $SrCl_2$ in 13 *N* HCl decreases rapidly at subzero temperatures, and advantage has been taken of this to precipitate pure $Sr^{90}Cl_2$ after the Ba^{++} carrier has been removed at a lower HCl concentration and higher temperature. Purification precipitations were made on two identical 2-curie Sr^{90} preparations by the strontium of one being precipitated in 83% HNO_3 and the other in 13 *N* HCl at −10°C. The analyses of the products are compared below. Yields are not of great significance in these operations because all wastes are recirculated.

	83% HNO_3	13 *N* HCl
Concentration	110 mc/ml	121 mc/ml
Total solids	12 mg/ml	14 mg/ml
Nonvolatile matter	6 mg/ml	7 mg/ml
Spectrographic analysis		
Calcium	Trace	Very faint trace
Magnesium	Faint trace	
Strontium	Moderate	Moderate

Old RaLa $Sr^{89,90}$ waste from the Versene-column process was purified to produce approximately 5 curies of $Sr^{89,90}$ with a Sr^{89} content of 20%.

For a special order, 300 mc of Y^{90} (daughter of Sr^{90}) was separated from Sr^{90} waste (by repeated precipitations of strontium hold-back carrier in 83% HNO_3). Although the half life of this 2.18-Mev beta emitter is only 2.54 days, there seems to be some demand developing for it when it is separated from the parent Sr^{90}.

$Eu^{152,154}$ Experiments

The first Eu_2O_3 pellet was removed from the LITR after 25 days of exposure. The cobalt monitor included with the sample indicated a flux of 1.12×10^{13} neutrons/cm^2·sec for the exposure period. The radiation intensity was measured after 13 days (for decay of short-lived activities) with three different thin-walled ionization chambers. The three readings, taken at a distance of 1 meter, were: 295, 300, and 330 mr/hr.

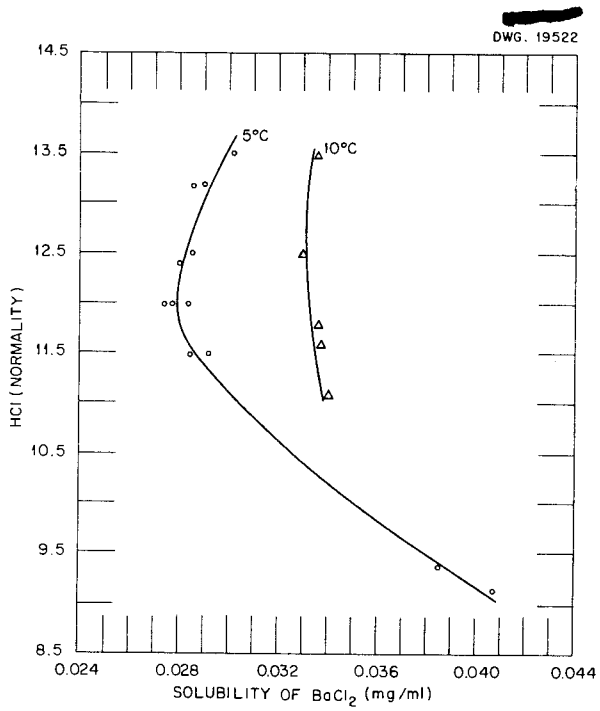

Fig. 1. Solubility of $BaCl_2$ in Concentrated HCl.

The best average reading was taken as 300 mr/hr at 1 meter. This measurement indicates that activity is building up slightly slower than the calculated rate, probably because of self-absorption of neutrons.

Promethium (Pm^{147} – 2.7 y) Sources

Two promethium sources were made in which about 10 curies per source were used. The promethium oxide was incorporated with glass and fused to platinum. The first source is to be covered with a very thin film of aluminum (evaporated on); the second source was heated at 1100°C to produce a thin layer of glass, which was smooth on the surface but irregular on the edges. This second source is to be shipped to a customer for evaluation.

Long-Lived Barium in Uranium Slug Solution

Barium which had been used as a carrier for Sr^{90} in the present precipitation process for recovery of fission products from waste was purified to remove the last traces of Sr^{90} by repeated HCl-ether, concentrated HCl, and 83% HNO_3 precipitations. A gamma activity remained, which was counted by the scintillation counter and which was identified by the Analytical Chemistry Division as (>20-y) Ba^{133}.

There is no fission chain for the production of Ba^{133} or for the production of Ba^{132} from which Ba^{133} could be made by a (n,γ) reaction. There is also no chain to produce Ba^{134} from which Ba^{133} could be made by a $(n,2n)$ reaction. It is assumed that the activity is produced by normal barium impurity in the uranium slugs.

As opportunities arise, further studies will be made on old, irradiated uranium slugs on which the history is well known.

Separation of Co^{58} and Ni^{63} with Anion-Exchange Resin

The recently developed technique for separating cations in strong HCl by the use of anion-exchange resin (K. Kraus, Nelson, and others, Chemistry Division) was used for separating Co^{58} from irradiated nickel targets. Indications are that the method will be satisfactory, but severe damage of the resin was noted in the Co^{58} band. An effort will be made to lower the time of contact and concentration of radioelement per gram of resin to reduce the radiation damage.

Processed Radioisotope Production

Table 4 is a list of radioisotope product solutions that were prepared during April.

Special Preparations

The following special preparations were made: 131 Co^{60} sources were loaded with a total of 517 curies; 2000 Cs^{134} sources with a total of 20 curies; two 50-mc sources of Cs^{137} in standard capsules; an Ir^{192} source with approximately 100 curies; a Sr^{90} source with 3 mc; 16 units of KH_2PO_4 processed for the U. S. Department of Agriculture – a continuation of a project previously reported; 7 ampoules of H^3, assay showed a total of 7.76 curies; 3 ampoules of helium, 90% purity, 775 cc total; 1 ampoule of helium, 3 to 4% purity, 1000 cc total; 5 ampoules of A^{37}, assay showed a total of 13 mc; a H^3-Zr target with 500 mc of H^3; a special solution of Zn^{65} as the nitrate; a special solution of Bi^{207} as the chloride; I^{130} and other short-lived radioiodine isotopes separated from a tellurium target made on the 86-in. cyclotron for ORINS.

Miscellaneous Work

A channel-can shipping carrier was redesigned for use in shipping Arco irradiation cans.

TABLE 4. RADIOISOTOPES PRODUCED DURING APRIL

PRODUCT SOLUTION	SOURCE	AMOUNT (mc)	SPECIFIC ACTIVITY (mc/g)
Carbon (C^{14} – 5720 y)	Hanford reactors	559	90
		682	75
		401	51
		301	54
Chromium (Cr^{51} – 26.5 d)	LITR	965	1400
Iron (Fe^{59} – 46.3 d)	LITR	25.4	1494
Mercury (Hg^{203} – 43.5 d)	Hanford reactors	990	120
Sodium (Na^{24} – 14.9 h)	LITR	873	932
Strontium (Sr^{90} – 25 y)	ORNL graphite reactor	90	Carrier-free
Sulfur (S^{35} – 87.1 d)	Hanford reactors	12,980	Carrier-free
Tungsten (W^{185} – 73.2 d)	Hanford reactors	450	270
Yttrium (Y^{90} – 2.54 d)	ORNL graphite reactor	237	Carrier-free

A Co^{60} source holder was designed for a 500-curie teletherapy unit proposed by Belgian radiotherapists.

A study was made of the practicability of using a small Co^{60} source attached to a float for the determination of liquid levels in closed tanks. The levels were to be determined by the use of ordinary radiation monitoring instruments.

RADIOACTIVE-WASTE DISPOSAL

Ten pots and 52 drums of waste were received from Argonne National Laboratory. The contents of 22 drums and 8 pots were jetted to chemical-waste tank W-5, and the contents of 30 drums and 2 pots were jetted to metal-waste tank W-7.

The Cottrell precipitator was shut down for 13 hr because of steam service shutdowns and regular inspections of the power pack.

There was 37,800 gal of chemical-waste concentrate containing 1897 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 114,600 gal bearing 3878 curies.

Dissolution tests were conducted on the uranium sludge from tank W-10 in an effort to determine a possible solvent for the sludge remaining in tank W-7. A solution of 1 *M* Na_2CO_3 and 30% H_2O_2 in the ratio of 5:1 was used; the preparation of this solution was based on information obtained from a K-25 report on the dissolution of Hanford-metal sludge. Although too meager to be conclusive, the results indicate that this solvent may be used if it can be determined that the components will not interfere with the recovery process. The slurry used for the experiments had a specific gravity of 1.14 and a uranium content of 86.2 mg/ml or about 7.5%. The uranium dissolved per milliliter of final solution volume was 30 mg, which was reduced to 25 mg/ml upon acidification of the basic solution.

Waste Discharged to White Oak Creek

A total of 34.68 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond (see Table 5). This discharge was only 39.4% of that of last month. About 10 curies, or 40%, of the settling-basin discharge was the result of an accidental spill of cesium to the settling-basin drain in Building 3029 on April 16.

Chemical-Waste Evaporator

The chemical-waste evaporator operation was somewhat troublesome in the early part of the month because of severe foaming conditions and a fluctuating pH of the feed. This condition was alleviated by the evaporation rate being reduced until the feed improved.

The evaporator was shut down for 65 hr this month to decontaminate and repair the broken valve between the evaporator tank and tank W-6. Several other minor leaks were repaired, and the steam regulator to the building was replaced. Evaporator operation is shown in Table 6; waste-tank inventory is shown in Table 7.

TABLE 5. ACTIVITY DISCHARGED TO WHITE OAK CREEK

DISCHARGED FROM	APRIL 1953		MARCH 1953	
	Gallons	Beta Curies	Gallons	Beta Curies
Settling basin	19,312,000	25.01*	20,296,000	31.19
Retention pond	471,000	9.67	742,000	56.87
Total	19,783,000	34.68	21,038,000	88.06

*0.56 curie contributed by the evaporator.

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
April 1953	186,202	18,238	10.2:1	4447	0.56
March 1953	226,824	20,768	10.91:1	2114	0.85

Waste-Tank Inventory

TABLE 7. WASTE-TANK INVENTORY

TANKS	CAPACITY (gal)	FREE SPACE (gal)	
		April 1953	March 1953
Hot-Pilot-Plant Storage			
W-3, 13, 14, 15	48,500	32,100	30,870
Chemical-Waste Storage			
W-5	170,000	98,000	91,000
Evaporator-Concentrate Storage			
W-6, 8	340,000	123,000	83,000
Metal-Waste Storage			
W-4, 7, 9, 10	543,000	218,500	208,500

RaLa (Ba^{140} – 12.5 d)

The new product-drying air heater installed late last month and another replacement unit installed this month burned out after 2 hr of testing. A black iron compound was also found to be deposited in the product-shipping cone during these tests. An investigation of the operating conditions and equipment revealed the following improper conditions:

1. The iron-constantan thermocouple for measuring the exit air temperature was used with an instrument requiring a chromel-alumel thermocouple, and the result was a reading approximately 100°C higher than actual temperature. The thermocouple was replaced.

2. The thermocouple had been inserted into the insulating, dead-air space of a thermowell and had no contact with the metal of the thermowell, nor had it been surrounded by a good heat conductor. The result was a reading lower than the true temperature. This condition was corrected by drilling through the thermowell and inserting the thermocouple directly into the moving hot-air stream.

3. The heating elements were being burned out because they were heated to too high a level.

4. The temperature at the elements was in excess of the minimum scaling temperature of the type 347 stainless steel jacket. This condition caused the iron to become oxidized and appear as scale in the product cone.

5. The air-flow measurement orifice had been installed in such a manner as to allow the lines to fill with condensate; this condition has been corrected. The lines from the orifice to the instrument were also found to be leaking.

The above conditions were corrected by making the necessary repairs, and the exit-air operating temperature, as recorded on the instrument, was lowered from 450 to 350°C.

Drying tests conducted in which the revised temperature specification was used again proved that the minimum drying time, best product distribution in the cone, and minimum product loss were obtained by the use of a differential of 4 in. H_2O, as measured on the air-flow instrument. These conditions will be incorporated in the operating procedure.

The equipment is presently considered to be in operating condition for the next run, which is scheduled to start at midnight on May 26, 1953.

Almost all the equipment has been removed from the inside and outside of cell B and has been salvaged wherever possible. The work has progressed very slowly because of its low priority on the maintenance schedule.

A filtration test, which uses a $Ba(NO_3)_2$ precipitate slurry, was made through the recently acquired tantalum filter that was to be part of the newly designed product-evaporator tank for a future cubicle rebuilding. The inefficiency of the apparatus was demonstrated when approximately 55% of the precipitate passed through the filter. The equipment has been sent back to the manufacturer for repair or replacement.

RADIOISOTOPE SALES DEPARTMENT

The Bureau of Explosives has issued permit No. 75 to cover the uses of a steel drum for shipping polonium-neutron sources, a specially adapted cobalt container for loading gamma irradiators, and a container for transporting material from the MTR to Oak Ridge.

Approval of several new requests for irradiation of materials at Hanford has been received. For the most part, these approvals will be held in abeyance, since the use of the LITR is anticipated for the irradiation of some of the materials.

Radioisotope shipments made during April 1953 are compared in Table 8 with those made during March 1953 and April 1952. A breakdown according to separated and unseparated material (including totals for August 1946 through April 1953), and for project, nonproject, and foreign shipments is also shown.

HANFORD IRRADIATIONS

No samples were received during the month of April.

CYCLOTRON RADIOISOTOPES

No cyclotron targets were received during the month of April.

ACTIVATION ANALYSES

A total of 103 requests for information concerning activation analyses has been received; 33 have developed into requests for analyses, 23 of which have been completed.

SF MATERIAL CONTROL

Four shipments consisting of 114 drums containing depleted UNH solutions with a total uranium content of 9210 kg were sent to Mallinckrodt Chemical Works, St. Louis, Missouri, during April. These were the fourth, fifth, sixth, and seventh shipments of uranium recovered under the Metal Recovery Program and make a total of 14,320 kg shipped to date.

During April, 55 MTR fuel assemblies and 2 shim safety-control rods were shipped to Phillips Petroleum Co., Scoville, Idaho. This makes the total number shipped to date 385 fuel assemblies and 48 control rods.

Other important shipments of fissionable material consisted of 26 uranium-aluminum alloy fuel plates containing 408.89 g of U^{235} to Argonne National Laboratory and 2 sheets of metal foil containing 935.39 g of U^{235} to Carbide and Carbon Chemicals Co., Y-12.

Important quantities of fissionable material were received from Y-12 during the month; namely, 11.13 kg of contained U^{235}, of which 1.12 kg was in the form of metal to be used in the rolling of foil for Y-12. The remaining 10.01 kg was in the form of metal and was used to fabricate MTR fuel elements.

Work was started on a new SF accounting manual. Thus far, the work has been confined to the outlining of major and minor subsections for the general procedure, SF accountability procedure,

TABLE 8. RADIOISOTOPE SHIPMENTS

	APRIL 1953	MARCH 1953	APRIL 1952	AUGUST 1946 TO APRIL 1953, INCLUSIVE
Separated material	815	840	731	34,274
Unseparated material	207	275	208	9,298
Total	1022	1115	939	43,572
Nonproject	910	1022	814	
Project	89	72	113	
Foreign	23	21	12	
Total	1022	1115	939	

and health and safety procedures. Security and criticality procedure outlines will be completed during the first half of May. It is anticipated that the general procedure portion of the manual will be published during June; other major sections are scheduled for issuance in July, but the measurement-method portion of the manual may be delayed until August.

SF surveys during the month consisted in visiting six persons possessing SF material. The material in their possession was inspected and weighed where feasible, and no apparent discrepancies were encountered. In addition, the records of four 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 29 receipts and 47 outgoing shipments of SF material during April, compared with 38 receipts and 46 outgoing shipments during March. Tables 9 and 10 are summaries of receipts and shipments for April.

TABLE 9. SF MATERIALS RECEIVED

FROM	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Argonne National Laboratory, ANL	Depleted uranium	1	42,117.00
	Plutonium		11.48
Carbide and Carbon Chemicals Co., Y-12, CYT	Enriched uranium	5	11,132.58
	Plutonium	2	0.06
	Normal uranium	8	291,575.00
	Thorium	3	1,363.00
	Depleted uranium	1	0.04
	U^{236}	1	0.05
Iowa State College, ISC	Thorium	2	467,600.00
Los Alamos Scientific Laboratory, SFC	Plutonium	2	334.20
Naval Radiological Defense Laboratory, NDL	Thorium	1	4.67
	Normal uranium	1	1.28
Phillips Petroleum Co., MTI	Enriched uranium	2	0.03

TABLE 10. SF MATERIALS SHIPPED

TO	MATERIAL	NUMBER OF SHIPMENTS	AMOUNT (g)
Argonne National Laboratory, ANL	Normal uranium	1	667.00
	Enriched uranium	1	408.85
California Research and Development Co., CRD	Normal uranium	1	11,385.00
Carbide and Carbon Chemicals Co., K-25, CCC	Normal uranium	1	158.48
Carbide and Carbon Chemicals Co., Y-12, CYT	Normal uranium	4	1,668,181.70
	Plutonium	5	323.64
	Enriched uranium	9	1,743.75
	Depleted uranium	4	58.04
	U^{233}	2	104.03
E. I. du Pont de Nemours & Co., SDA	Normal uranium	1	45,300.00
Mallinckrodt Chemical Works, MCW	Depleted uranium	[illegible]	9,210,940.00
	Normal uranium	1	441,298.00
Phillips Petroleum Co., MTI	Enriched uranium	13	9,515.91