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OPERATIONS DIVISION REPORT

FOR

MONTH ENDING AUGUST 31, 1948

BY

M. E. RAMSEY
E. J. WITKOWSKI
A. F. RUPP
J. A. COX
L. B. EMLET

AEC RESEARCH AND DEVELOPMENT REPORT

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ORNL-157
Progress Report

OAK RIDGE NATIONAL LABORATORY

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OPERATIONS DIVISION REPORT

for

Month Ending August 31, 1948

PILE DEPARTMENT
CHEMICAL SEPARATIONS DEPARTMENT
RADIOISOTOPE DEVELOPMENT DEPARTMENT
ISOTOPE CONTROL DEPARTMENT

by

M. E. Ramsey
E. J. Witkowski
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SUMMARY

1. Two incidents of ruptured slug jackets were detected during August, 1948. In one case considerable difficulty was experienced in removing the oxidized slugs from the pile.

2. Failure of the insulation on the 2300-volt cable to the fan motors caused a short circuit which tripped the circuit breakers in the electrical sub-station.

3. The inboard motor bearing on the #3 fan unit failed and was replaced.

4. A newly formed Pile Advisory Committee will periodically review pile operating problems and experimental equipment for use in conjunction with the pile.

5. Isotope production continued normally with a minimum of processing difficulties.

6. The fission product iodine process has been developed to a point where it can be placed into routine production. This will be done by the end of September, 1948.

7. A study of the various methods of extracting P^{32} from irradiated sulfur indicates that the present dilute-nitric-acid method results in the best yields.

8. RaLa run #27 was started on August 25, 1948, and completed on September 3, 1948. Approximately 2,205 curies were shipped on September 4, 1948.

9. A total of 313 isotope shipments were made during August to bring the total-to-date figure to 4,444.

SUMMARY - Continued

10. The preliminary design report for the Isotope Production Area has been received from Patchen and Zimmerman. The report was accepted by the Laboratory with only minor exceptions and a recommendation made to the Atomic Energy Commission urging their approval of immediate construction.

A. PILE DEPARTMENT

I. Operating Data:

	August 1948	July 1948	1948 Year-to-Date
Total Accumulated KWH	2,444,357	2,542,636	19,980,968
Average KW/operating hour	3665.36	3790.17	3745.73
Average KW/24-hour day	3285.42	3417.52	3412.05
Percent Lost Time	10.4%	9.8%	8.9%
Approx. Excess Pile Reactivity	190-200 inhours	170-175 inhours	
Slugs Charged	1129	1989	8488
Slugs Discharged	1144	1852	5821
Product Made (grams)	89.21	92.80	729.24
Product Discharged (grams)	22.42	75.75	159.93

II. Pile Operation:

Ruptured slugs were detected in two metal channels during the month.

Date	Channel No.	Days Exposure	Metal Temp.	Slugs in Row
August 3, 1948	2678	1369	Approx. 125°C.	54
August 31, 1948, (Discharged 9-3-48)	1069	1404	Approx. 175°C.	47

The ruptured slugs were detected in both cases during routine visual inspection of the metal channels. In the case of Channel 2678 the slug had not oxidized to an advanced state and the discharge of the row was accomplished without difficulty. The discharge of the metal from Channel 1069 was extremely difficult, however, due to five slugs being completely oxidized and two others partially oxidized. Initial attempts to discharge the channel were made by the customary method of pushing the slugs with a rod. This moved the row of metal about one and a half feet where it finally jammed due to the distorted shapes of the oxidized slugs. At this point there were perhaps two places where slugs had started to run over other slugs causing the whole row to jam. The discharge of these slugs was started on August 31, 1948, and com-

pleted about two and a half days later (September 3, 1948). Specially designed tools such as small rods, hooks, harpoons, etc., were used to work the jam free. These tools were inserted through Hole 43 on the rear wall of the pile, as well as through the front face channel.

Channel 1069 was slightly damaged in the process of removing the ruptured slugs and was not reloaded with metal. It is planned to use this channel for special exposure samples.

The presence of ruptured slugs in the pile was not detected by the normal exhaust air monitoring instruments. This can be partially explained by the very high radiation background that has existed in the pile since about December, 1947, when the first serious slug jam occurred. In an attempt to prevent slugs oxidizing excessively after rupturing several immediate steps are planned.

a. Visual inspection of all loaded metal channels weekly.

b. Modification of the scanning equipment to increase its sensiticity.

c. Installation of larger air pumps on the scanner and on the exhaust air monitor to handle more representative samples of exhaust air.

d. Design and install a continuous recording exhaust duct probe.

The eleven slugs loaded into Channel 1964 in April, 1948, continue to operate satisfactorily at temperatures between 250 and 350° C. This test is being run by the Physics Division to evaluate aluminum slug jackets at temperatures above the present 250° C. level.

Seven hundred and eighty X-slugs were discharged on August 25, 26, and 28, 1948, for the 706-D Building.

The current excess pile reactivity is about 190 inhours. Approximately one hundred inhours are expected to be consumed in the immediate future by the installation of two pieces of experimental equipment.

III. Fan Operation:

The insulation on the 2300-volt cable from the fan cubicle to the No. 2 fan motor failed on August 19, 1948, at the point where the cable enters the motor junction box. The resulting short circuit burned the cable in two and tripped the circuit breaker at the sub-station. The short was cleared and the sub-station put back in service approximately four hours later. The No. 3 fan was started at this time and the pile run at one-half power for about six hours until the cable was replaced on the No. 2 fan motor.

The inboard motor bearing failed on the No. 3 fan unit on August 26, 1948. The pile was run at one-half power for the twenty-four period during the bearing replacement. The failure appeared to be due to normal wear. The bearings on this motor had been in service since March, 1945.

The No. 2 fan motor bearings were inspected on August 31, 1948, and the inboard motor bearing replaced since the Babbit showed considerable wear and had several cracks in it. The bearing on this motor had been in service since November, 1946.

IV. Radioisotopes:

The following table is a record of the radioisotope and research samples charged into the pile during July and August, 1948:

	JULY, 1948		AUGUST, 1948	
	Research	Radioisotopes	Research	Radioisotopes
Stringers 13, 14, and 16	13	92	17	95
Hole 22 (Pneumatic Tube)	24	7	29	4
All Other Holes	13	10	13	13
TOTAL BY GROUPS	50	109	59	112
TOTAL FOR MONTH	159		171	

At the end of August, 1948, there were 341 cans of target material in Stringers 13, 14, and 16, as compared to 342 cans of material in these stringers at the end of July, 1948.

V. Experimental Work:

A hole was drilled through the concrete shield of the exit air duct between the back of the pile and venturi on August 31, 1948. This opening is required for the installation of an additional thermocouple for use with the automatic pile power calculator which will be installed during September, 1948.

B. CHEMICAL SEPARATIONS AND ISOTOPE DEVELOPMENT DEPARTMENTS

I. Radioisotopes:

1. Iodine (I^{131} - 8d)

Thirty-two, seventy-two-gram cans and sixteen, sixty-two-gram cans of irradiated tellurium were processed and approximately 4,650 millicuries were shipped. All products were within specifications.

Fission Product Iodine Development

Three dissolvings were made during the month for iodine development work. A marked improvement was noted in the iodine release from the dissolver. Less than twenty percent of the iodine remained in the dissolver. The crude cell-distillates from two of the dissolvings were combined and purified in one batch. The other dissolving was processed separately. All of the final product purifications were accomplished with good results by using the procedure of iodine oxidation to iodate with alkaline permanganate, nitrates distilled out, the permanganate reduced with phosphorus acid, and the iodine distilled. This procedure has proven to be more efficient and simpler than the ferric sulfate method which has also been used. These two runs yielded final product solutions with concentrations of 7.5 mc/ml and 5.6 mc/ml, respectively. The three-slug run yielded a total of 1,090 millicuries (radiochemical basis) six days after discharging from the pile. The combined run (six slugs total) yielded 3,000 millicuries (radiochemical basis) six days after removal from the pile. The above products were within the required limits for activity, total solids, and contaminants.

Approximately 729 millicuries of product from the fission product process were also shipped to various customers for evaluation against the I^{131} prepared from tellurium. Replies from several of these people indicate that they found the fission product iodine satisfactory and their only stipulation is that the short-lived iodine activity (I^{133} - 22h) be limited to two percent. This can be accomplished by delaying shipment for the proper decay time. It is thought that the development of this project is essentially complete. The remainder of the work consists of painting, repairs, final improvements, and the writing of operating procedures.

2. Phosphorus (P^{32} - 14.3d)

Eight, 2000-gram cans of irradiated sulfur were processed and approximately 3,945 millicuries of P^{32} were shipped.

Plugging of the sulfur transfer lines was at a minimum. This difficulty occurred only once during the month.

Phosphorus Development Work

The present method of phosphorus extraction from sulfur using dilute nitric acid has been found to be the most satisfactory. The yields are consistently 98 to 100 percent in Laboratory equipment. Agitation was found to be unnecessary. Eighty percent of the P^{32} is extracted almost immediately upon melting the sulfur. The mass transfer coefficient for one-hundred-percent yield is approximately one millicurie per square centimeter of sulfur-nitric acid interface area per hour. The second best method would be the extraction with 0.2N hydrogen peroxide. This method yielded 91.5%. The

glacial acetic acid method of extraction gave a yield of 48.5%. The sodium hydroxide extraction does not give as good yields as the 0.2N nitric acid procedure. It was found that the extraction of phosphorus from sulfur proceeded most satisfactorily between 120° C. and 140° C. Further development work will proceed on the simplification and improvement of the present method which has demonstrated the best yields.

3. Carbon (C^{14} - 5100y) (from $Ca(NO_3)_2$)

No runs were made during August, 1948, but several are planned for the latter part of September, 1948.

Beryllium Nitride Development Work

Two dummy jacket removal runs were tried on beryllium nitride in Clinton jackets. Nitrogen was passed through the furnace and scrubbed in $Ba(OH)_2$ during the run. Indications are that some CO_2 is present in the beryllium nitride. The installation of chemical separation and electronic equipment is now in progress.

4. Sulfur (S^{35} - 87d)

About 2,795 millicuries of carrier-free S^{35} as sulfate were produced during the month.

5. Fission Products

The installation of equipment in fission product column cell has been completed and testing work is now in progress.

6. Ruthenium (Ru^{106} - 1y)

Tank W-10 supernatant liquor is being processed by the ferrous hydroxide precipitation method. This method is being used due to the excessive corrosion of the CuS procedure. Further concentration

is proceeding on the cross-over runs that have been completed. Future cross-over runs are not contemplated due to the corrosion problem. The Ru purification equipment is now in operation.

7. Calcium (Ca^{45} - 180d)

Three Hanford-irradiated cans were processed and combined to yield the following analysis:

Total Volume----------200 ml
Concentration----------2.28 mc/ml
Calcium----------49.8 mg/ml
Total Solids----------181 mg/ml
Specific Activity-------46 mc Ca^{45}/gm Ca
Spectrographic Analysis-No important contaminants.

A special sample was prepared for a customer who desired Ca^{45} as $Ca^{45}CO_3$. This sample contained 2.3 millicuries.

8. Strontium ($Sr^{89,90}$ - 55d, 30y)

One run was made to yield approximately 420 millicuries of $Sr^{89,90}$. The product analyzed eighty-six percent Sr^{89}.

9. Iron ($Fe^{55,59}$ - 44d, 4y)

Sufficient iron is on hand to meet all normal requests. There are several orders waiting for the exposure of enriched Fe^{54} and Fe^{58} in the Hanford pile.

10. Miscellaneous

a. Chlorine (Cl^{36} - 106y)

A sample of Cl^{36} was recovered from KCl irradiated at Hanford. The analysis is not available at this time.

b. Mercury ($Hg^{203,205}$ - 51.5d)

Two mercury samples were processed with the following analyses:

	HgO Processed	$Hg(NO_3)_2$ Processed
Total Volume	100 ml	100 ml
Concentration	1.16 mc/ml	2.02 mc/ml
Hg	102.0 mg/ml	336.5 mg/ml
Specific Activity	11.3 mc/gm Hg	6.1 mc/gm Hg

The sample of $Hg(NO_3)_2$ processed last month had the following analysis:

Total Volume	121 ml
Concentration	1.54 mc/ml
Hg	198.0 mg/ml
Specific Activity	7.8 mc/gm Hg.

II. Tank Farm and Burial Ground:

1. Special Wastes

Other than the routine disposal of plant wastes, the following wastes were handled:

a. Five alpha shipments were received from Dayton for burial.

b. Twenty-three pots and nine drums were received from Chicago. The pots contained solutions with fission products only. Three drums contained 57.36 kg of uranium; the remaining six contained chemical waste.

One drum which contained 26.38 kg of uranium was erroneously reported to contain chemical waste. It was discharged into the chemical waste system instead of the metal waste storage tank before the SF transfer form which contained the correct information was received.

c. The Hot Pilot Plant transferred 56.11 kg of uranium to W-4 tank and 17.67 grams of plutonium to W-3.

d. The Semi-Works transferred 5.26 kg of uranium to W-4 tank.

e. Precipitation of waste metal in tank W-7 was accomplished this month. A total of 5,285 gallons of fifty percent NaOH was added.

f. The Chemistry Division transferred 3.2 mg of plutonium to W-4 tank.

g. A shipment of alpha contaminated trash from K-25 was buried.

h. Upon recommendation of Health Physics, copper sulfate in the amount of two parts per million was added to the Settling Basin in an effort to kill the algae; little effect was noted.

i. 706-D transferred 6,129 gallons of metal waste to W-9 tank.

j. Extraction of ruthenium from the precipitated metal supernatant in W-10 was begun this month. About 3,600 gallons of waste have been used containing an average of .0098% uranium.

2. Wastes Discharged to White Oak Creek

A total of 70.4 curies of beta activity was discharged to the creek during the month. The tolerance level for discharge of five curies per day was exceeded on one occasion; a total of seven curies were sent to the creek. This was caused by the presence of a flocculent precipitate in the effluent jetted from W-6 which was not detected until the transfer was completed. The procedure for sampling and analyzing this material will be modified to eliminate similar occurrences in the future.

A summary of the wastes discharged follows:

a. From Settling Basin

Gallons Discharged	To	Curies
12,103,000	White Oak Creek	69.95

b. From East Pond

131,000	White Oak Creek	.3

c. Retention Pond

317,800	White Oak Creek	.15

3. Waste Tank Inventory

CHEMICAL WASTE

Tanks	Gallons Capacity	Gallons In	Gallons Out	Discharged To	Free Space
W-1-2-5 -6	348,800	596,986	562,180	White Oak Creek	112,000

METAL WASTE

W-4-7-8 -9-10	713,000	13,168	2,400	Ru Extraction	167,128

Al-Pu WASTE

W-3	41,300	296	0	---	38,480

4. Maintenance

a. Little work has been done on the transfer line project in the Tank Farm this month. Some painting and insulation remains to be completed.

b. The baffles have been removed and the new cables have been swung across the Settling Basin. The new baffles are to be installed next month.

c. Concrete pads have been poured around the five remaining four-inch terra cotta pipe openings of the storage tanks.

d. Water leaks around the V-notched stainless weir plates in the Settling Basin diversion box were repaired.

III. RaLa (Ba^{140} - 12.5d):

Some of the major maintenance items completed prior to the start of run #27 included the following jobs:

1. The replacement of a completely corroded HNO_3 pump and the repair of the concrete pad.
2. The replacement of the corroded dissolver tank pressure-vacuum Ring Balance instrument which failed during run #26.
3. The fabrication of a new cone adapter to fit the product cone which was revised by Los Alamos. The new type of cone will be used in all future product shipments beginning with run #27.

Run #27 was started on August 25, 1948. Eight hundred fifty-four slugs were charged in four separate loadings and dissolved in fourteen batches. The last load of seventy-eight slugs was made necessary by the low product content of the slugs.

No unusual difficulties have been encountered. L.S.T. was reached at 0820, September 3, 1948, and the run shipped on September 4, 1948. Approximately 2,205 curies were isolated. The complete analytical results for the run will be reported next month.

At the request of the Atomic Energy Commission, several minor alterations have been made to the Hanford slug carrier (coded Phoenix). Plans are now being made to ship the carrier to Hanford for testing under actual conditions. Several special studies requested by the Atomic Energy Commission regarding the stability of the container to airplane crashes are underway.

Two special dissolvings, using 78 and 104 twenty-hour irradiated slugs, were made for the Chemistry Division to enable them to isolate short-lived fission products from the dissolver off-gases. The Chemistry Division also scrubbed ten percent of the dissolver off-gases from Batches A, D, and L of run #27 for the same purpose.

C. ISOTOPE CONTROL DEPARTMENT

I. General:

During the month of August, 1948, there were 313 isotope shipments, a decrease of two compared with the month of July, 1948.

The following table shows the number of shipments for July and August, 1948, and the total-to-date figure for all shipments made since August, 1946, the start of the Isotope Distribution Program:

	JULY 1948	AUGUST 1948	TOTAL August, 1946, to August, 1948, Inc.
Separated Material 706-D Area	237	274	3,301
Unseparated Material 100 Area	78	39	1,143
	315	313	4,444

II. Radioiodine:

Samples of fission iodine were shipped this month to eight customers and several reports have been received. No difference has been observed in this material as compared with the radioiodine which we have been preparing from tellurium.

The problem of whether to send fission iodine while it still has a considerable percentage of the twenty-two-hour isotope (I^{133}) has been discussed with several customers and the general opinion is that since most medical investigators have been used to administering I^{131} and since the presence of some twenty-two-hour iodine will affect the radiation which the patient receives, it would be preferable to let most of the twenty-two-hour isotope decay before shipping.

III. Radiocobalt:

A specification has been received from the Naval Radiation Defense Laboratory, San Francisco, regarding the radiocobalt which they wish to have prepared. This material is to be in the form of rods, 1/8-inch diameter by four-inches long. It appears that there will be a demand for a considerable number of different sizes of radiocobalt sources. At the present time we expect to prepare sources of the size mentioned above, as well as 5/16-inch diameter by $\frac{1}{2}$-inch long, and in the form of wire about one millimeter in diameter.

IV. Shipping Regulations:

A representative of the Pan American Airlines visited the Laboratory early in the month and reviewed the isotope shipping problem. His airline is reluctant to accept shipments of these materials because of the lack of information about radiation. A suggestion has been made to the Atomic Energy Commission that a group of representatives of the various airlines be invited to Oak Ridge for an unclassified tour and a demonstration of the proper methods of handling radioactive materials. It is hoped that the education they will receive will persuade them to accept the recently proposed shipping regulations which are more liberal than the temporary ones now in effect.

V. Isotope Production Area:

The preliminary design report for the new Isotope Production Area was received from Patchen and Zimmerman on September 1, 1948. The report was accepted by the Laboratory management with only minor exceptions. A recommendation was made to the Atomic Energy Commission urging them to approve immediate construction. The design includes:

1. A 250-foot high brick stack with a diameter of eight feet at the top.
2. Fans and fan enclosure at the base of the stack to handle 100,000 cfm with provisions for expansion to 180,000 cfm.
3. Ventilation of the present 706-C and 706-D Buildings to the new stack.
4. A one-story (about 8,000 sq. ft.) building to house analytical, storage, packing, shipping, and decontamination facilities.
5. A two-story (about 7,000 sq. ft.) building housing locker rooms, offices, etc.
6. Four, one story (about 800 sq. ft. each) buildings to house processing equipment.
7. One, thirty-foot high structure of about 900 sq. ft. floor space adapted to column extraction of radioisotopes.
8. A small building with a concrete pad for the decontamination of large equipment including trucks.

If the Atomic Energy Commission approves the plans immediately, construction can possibly be started by October 1, 1948, with completion by March or April of 1949.

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VI. Source and Fissionable Material Accountability:

Following is a summary of shipments and receipts of S. F. Materials for the month of August, 1948:

RECEIPTS

Received From	Material	S.F. Content
Argonne National Laboratory	N.U. - UNH Solution	57.36 kgs.
" " "	N.U. - UNH Solution	55.65 kgs.
A.E.C. - St. Louis Area	Uranyl Nitrate Hexahydrate	167.53 kgs.
Carbide & Carbon Chemicals, K-25	Normal Uranium	20.00 gms.
" " " " "	Hanford Waste Scrap (Radioactive Glass & Paper)	369.00 gms.
" " " " "	Plutonium	.037 mgs.
General Electric Company	Enriched Uranium	135.498 gms.
" " "	Normal Uranium	10.00 gms.
" " "	Normal Uranium	51.75 kgs.
" " "	Plutonium	8.37 gms.

SHIPMENTS

Shipped To	Material	S.F. Content
Argonne National Laboratory	Normal Uranium	6.00 gms.
" " "	Normal Uranium	6.99 kgs.
" " "	Normal Uranium	6.99 kgs.
Carbide & Carbon Chemicals, K-25	Plutonium	105.00micrograms
" " " " "	U. Acetate	.25 kg.
General Electric Research Lab.	U. 233	108.00 mgs.
" " " "	Enriched Uranium	1,172.00 mgs.

L. B. Emlet.
9/13/48

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