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OPERATIONS DIVISION

MONTHLY REPORT

For

MONTH ENDING SEPTEMBER 30, 1948

By

M.E. Ramsey
E.J. Witkowski
A.F. Rupp
J.A. Cox
L.B. Emlet

OAK RIDGE NATIONAL LABORATORY

OPERATED BY
CARBIDE AND CARBON CHEMICALS CORPORATION
FOR THE
ATOMIC ENERGY COMMISSION
POST OFFICE BOX P
OAK RIDGE, TENNESSEE

[redacted]

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O A K R I D G E N A T I O N A L L A B O R A T O R Y

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Oak Ridge, Tennessee

[redacted]

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SUMMARY

1. Excessive lost operating time (32.5%) resulted from recent precautions adopted because of the emphasis placed on the "Particle Problem".
2. The design and installation of decontamination facilities for the pile exhaust air are in process.
3. One swollen slug was detected and discharged during the past month. This brings the number of incidents to fifty-one since the start of pile operations in November, 1943.
4. Radioisotope production continued normally but with lowered efficiencies and some canceled orders because of the excessive pile down time.
5. The production of I^{131} from tellurium will be discontinued during October and fission product I^{131} made available. This method will provide a larger supply reducing operating costs.
6. RaLa Run #28 scheduled to start October 4, 1948, has been postponed pending further investigation of the "Particle Problem".
7. A total of 277 radioisotope shipments were made during the month to bring the total-to-date figure to 4,721. This is a decrease of about 12% from August and can be attributed largely to the cancellation of shipments due to excessive pile down time.
8. One large order (500 curies) of Co^{60} has been received and several other persons have made inquiries about obtaining large amounts of Co^{60}.
9. The ground was broken on September 20, 1948, for the Isotope Production Area. The grading is being completed and construction will get under way during October, 1948. A completion date of March or April, 1949, has been requested.

A. PILE DEPARTMENT

I. Operating Data:

	September 1948	August 1948	1948 Year-to-Date
Total Accumulated KWH	1,767,590	2,444,357	21,748,558
Average KW/operating hour	3638.81	3665.36	3736.81
Average KW/24-hour day	2454.99	3285.42	3307.26
Percent Lost Time	32.5%	10.4%	11.5%
Approx. Excess Pile Reactivity	180-190 inhours	190-200 inhours	
Slugs Charged	464	1129	8952
Slugs Discharged	517	1144	6338
Product Made (grams)	64.51	89.21	793.75
Product Discharged (grams)	36.196	22.42	196.126

II. Pile Operation:

The quantity and the health hazard implications of the discharge of radioactive particles in the pile cooling air were more fully recognized by the Laboratory during the month. Design and construction of filters for removal of radioactive particles from the pile exhaust air is progressing satisfactorily with completion of the filter installation expected by the end of October, 1948. The filter house will consist of a bank of American Air Filters, No. 50 F.G., filter down followed by a bank of filters covered with chemical warfare service No. 6 paper. The filters are to be located between the pile and the fans.

In addition to the filtration unit, it is planned to install as soon as possible cyclone separators and electrostatic precipitators. After the pile cooling air leaves the pile, it will pass in series through cyclone separators, the electrostatic precipitators, and finally through the filter house before reaching the discharge fans. Until the separators and precipitators can be installed, the filters are expected to carry the entire load.

The practice of visually scanning the pile each day for ruptured slugs was started on September 17, 1948, and will be continued until the exit air filtration unit is completed.

During the visual inspection of the metal channels on September 25, 1948, six rows which appeared to contain abnormal (swollen) slugs were re-examined. The scanner failed to detect any increase in the activity of the exit air from these channels. Rather than gamble, all six rows were discharged. Slug #47 (eighth from front face) in channel 0869 was found to be slightly swollen around the welded end. When this slug was retrieved from the canal, the aluminum cap was found to be separated from the can. It is believed that this occurred during the drop into the canal and that the can was not actually broken open while in the pile. The slugs in Channel 0869 had been in the pile for 1,478 days at a maximum temperature of about 140° C. No other bulged or ruptured slugs were detected in the other five channels discharged.

A recently issued report discusses the slug rupture problem in the Oak Ridge National Laboratory pile in detail - Report No. ORNL-170 by C. D. Cagle and L. B. Emlet, entitled Slug Ruptures in the Oak Ridge National Laboratory Pile, dated September 28, 1948.

The cooling air ducts, both inlet and exit, were thoroughly cleaned during the past month in an attempt to remove any residual particles that might be exhausted up the stack. The twenty-five slugs which have been in the inlet duct since December, 1947, were removed and the duct-work washed with a pressure hose. The fans and water seals were cleaned as thoroughly as possible. It is doubtful if many active particles from the duct system will find their way up the stack. Some residual activity probably remains in the graphite channels from

previously ruptured slugs which will be dislodged from time to time, particularly during slug discharges. In addition, it is believed that dust collects around the stringer of slugs in a channel and this too will be exhausted into the air stream when the slugs are removed.

The pile only operated 67.5% of the time (compared with an average of 91.1% of the time for the period from January through August, 1948) this month. The excessive down time was due to the following:

1. Removal of slug that ruptured on August 31, 1948. (See last month's report.)
2. Visual scanning of the loaded channels that started on September 17, 1948.
3. Cleaning of the ductwork and decontamination of the fans.
4. Limited operating time because of adverse meteorological conditions following the detection of the swollen slug on September 25, 1948. (See memorandum from K. Z. Morgan to C. N. Rucker; dated September 15, 1948; entitled Remedial Measures Regarding the Particle Problem; C.F. No. 48-9-123.)

The eleven slugs loaded into the pile during April, 1948, and operated satisfactorily at 350° C. since that time were discharged on September 30, 1948, because they presented a potential slug rupture problem. This test was being conducted by the Physics Division to evaluate aluminum slug jackets at temperatures above the present 250° C. operating level.

The excess pile reactivity is currently about 180 - 190 inhours. Approximately 100 inhours are expected to be consumed by experimental installations that are in the process of fabrication.

III. Fan Operation:

Both fans have operated normally throughout the month.

Considerable decontamination work was done on both fans with the bulk of the radioactive material being removed from the fans.

The No. 2 fan cubicle was completely overhauled. New wiring was installed as necessary with a new cable bring run between the central cubicle and the fan motor.

IV. Radioisotopes:

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

	AUGUST, 1948		SEPTEMBER, 1948	
	Research	Radioisotopes	Research	Radioisotopes
Stringers 13, 14, and 16	17	95	20	90
Hole 22 (Pneumatic Tube)	29	4	23	6
All other holes	13	13	5	8
TOTAL BY GROUPS	59	112	48	104
TOTAL FOR MONTH	171		152	

At the end of September, 1948, there were 359 cans of target material in Stringers 13, 14, and 16 compared to 341 cans of material in these stringers at the end of August, 1948. Several shipments of irradiation units were canceled because of the excessive down time of the pile.

V. Experimental Work:

The automatic pile power calculator was not installed this month since the installation of particle removal equipment will require by-passing of the existing venturi which would have been in the control circuit.

B. CHEMICAL SEPARATIONS AND ISOTOPE DEVELOPMENT DEPARTMENTS

I. Radioisotopes:

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

Six, seventy-two-gram cans and fifty-eight, sixty-two-gram cans of irradiated tellurium were processed and approximately 4,536 millicuries were shipped. Lower yields were a result of excessive pile down time.

A total of 215 millicuries of I^{131} from the fission products were shipped this month. Starting with the first week in October, the processing of tellurium will be discontinued and that equipment will be kept in standby condition. Fission product iodine will then be used for all shipments.

Fission Product Iodine Development

Painting, minor repairs, and preparation of spare glass equipment were completed during the month. Personnel are being trained in routine operation of the equipment.

One complete run was made during the month, yielding 800 millicuries I^{131} (radiochemical basis) seven days after removal of slugs from the pile. The amount of iodine produced was less than normally expected because of excessive pile down time. Another run is now in progress. Product from these runs will be used to fill orders beginning October 4, 1948.

A satisfactory tellurium run was made in the Room 10 equipment with a yield of 91%. This indicates that the Room 10 equipment can be used to produce iodine from either source, thereby providing emergency service in case of breakdown in the fission product iodine equipment.

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

Twelve, 2000-gram cans of irradiated sulfur were processed and approximately 5,164 millicuries were shipped. All products were within specifications. Lower yields were a result of pile down time.

Phosphorus Development Work

The work reported last month on the extraction of P32 from molten sulfur was done in large Carius tubes (100 ml), using approximately twenty grams of sulfur for each test. A stainless steel, steam-jacketed autoclave which will hold a glass vessel about two liters in volume has been fabricated so that large scale extraction experiments may be made. It will be possible to make half-scale (1000 grams of sulfur) runs in this equipment. It is hoped that these experiments will furnish data for the design of P32 production equipment for the new isotope area.

3. Carbon (C^{14} - 5100y)

A preliminary check of the equipment and two preliminary runs were made during which the equipment was tested and repaired. Forty-four irradiated calcium nitrate slugs used for these runs yielded approximately 17.6 millicuries with an average isotopic ratio of 1.76%.

Eight hundred irradiated calcium nitrate slugs were processed to yield approximately 700 millicuries. The average isotopic ratio was 5.45% and ranged from 2.12% to 6.90%.

Beryllium Nitride Development Work

The installation of chemical separations and electronic equipment has been completed. Cold runs to check air leakage and dead

carbonate in beryllium nitride slugs will be started during the first week in October. If trial runs indicate that the process is working satisfactorily, runs will be made on active material.

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

One special run of carrier-free sulfate was made. This highly concentrated batch contained 263 mc/ml.

5. Fission Products

Test work with cold solutions was completed on equipment in the fission product column cell. Flow rates of liquids in various parts in the equipment were checked and found satisfactory. Some mechanical difficulties were encountered with the heater support and HCl distillation apparatus, which were later corrected.

A run using a starting solution containing 100 millicuries of mixed fission products is now in progress. A full-scale run will be made as soon as the tracer runs indicate that the process will give satisfactory results; this will probably be during the coming month.

Several chelating agents which were prepared for us by the Chemistry Division are being compared with TTA from the standpoint of efficiency of separation of Pu from fission products.

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

Isolation

Following the establishment of a final operating procedure, twenty-two concentrates from tank W-10 were made using 200 gallons of waste per concentrate. Analysis of the waste from tank W-7 showed that as much Ru was contained in W-7 as in W-10 but that the sodium ion concentration was low enough to

enable the processing of 400 gallons of waste per concentrate. The switch to W-7 tank was made and twenty concentrates have been made with the yields approaching a high of 53%.

Purification

Approximately 180 millicuries of purified Ru^{106} was produced during the month. The material now being processed has a higher specific activity than that produced several months ago (10 mc Ru^{106}/mg Ru - v.s. 1 mc Ru^{106}/mg Ru).

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

No calcium was produced this month. The carrier-free calcium apparatus is in operation and it is anticipated that some will be produced in October, 1948.

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

Two runs were made to yield approximately 900 millicuries, analyzing approximately 98.7% Sr^{89} and 1.3% Sr^{90}.

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

No iron was produced during the month there being an adequate supply on hand. Analysis received from the Chemistry Division indicated the iron prepared in May, 1948, contained approximately 70% Fe^{59} and 30% Fe^{55} at the time it was processed.

10. Miscellaneous

a. Chlorine (Cl^{36} - 1,000,000y)

The Cl^{36} separated and purified as HCl (reported last month) was analyzed and found radiochemically pure. A total of 0.23 millicurie was produced having a specific activity of 0.206 millicurie per gram of chlorine. The specific activity of this material produced by Hanford irradiation is

considerably higher than any offered to date. The increased specific activity makes this Cl^{36} more valuable as a biological research tool.

b. A highly purified sample of carrier-free P^{32} was made for a customer. The concentration of this sample was 5.5 mc/ml, total solids 0.0 mg/ml, non-volatile matter 0.0 mg/ml.

c. Cobalt metal in the form of wire needles, rods, and spheres were packed in slugs for irradiation at Hanford. Three slugs were prepared.

II. Tank Farm and Burial Ground:

1. Special Wastes

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

a. Four shipments were received from Dayton for burial.

b. Seven pots were received from Chicago. All of these contained solutions with fission products only.

c. The Hot Pilot Plant transferred 29.5 kg uranium to tank W-4.

d. The Semi-Works transferred 215.52 kg of uranium to W-4.

e. Due to the high alkalinity of the precipitated metal supernatant in W10 tank, its use in Ruthenium Process was discontinued. A total of 8200 gallons of this material was processed in forty-two runs; the supernatant contained .0082% uranium.

The processing of the W7 supernatant was begun; to date, 9,200 gallons, containing .006% uranium have been used.

f. After the Ruthenium Process began using supernatant from W7, 13,200 gallons of metal waste were jetted from W8 to W10

in order to reduce the excess caustic in W-10 by precipitat-
the additional uranium.

g. K-25 transferred eight cans of contaminated trash to the Burial Ground, and 600 gallons of liquid waste to W-5 tank,

h. W-3 tank was put back in metal waste storage service this month. Prior to this time, it was used to store aluminum-plutonium waste from the Hot Pilot Plant. Before the uranium waste was transferred to W-3, between 1050 and 1225 gallons of 50% caustic were added to this tank to convert the aluminum nitrate to sodium aluninate. After the aluminum was in solution, 14,400 gallons of metal waste from W-9 were added to W-3 and precipitated. The supernatant, containing the aluminum, will be decanted to the chemical waste system after the precipitate settles out.

i. Two attempts were made this month to destroy the algae in the Settling Basin by chemical means. Copper sulfate, in the amount of two parts per million, and sodium arsenate, half part per million, were added at separate intervals. Neither was successful.

Until a better means of destroying algae is found, the Settling Basin will be hosed down daily in order to keep the algae below the surface of the water.

j. 706-D transferred 3,682 gallons of metal waste to W-9.

2. Wastes Discharged to the White Oak Creek

Twice this month, the five-curies-per-day limit on the amount of activity entering the White Oak Creek was exceeded. On September 2, 1948, 5.91 curies were discharged, primarily due to the fact that the Pile Building was purging the canal deep

pit after the recent slug rupture. Much of the oxide from these slugs went to the Settling Basin.

Due to the large volume of chemical wastes entering tank W-5, it became necessary on September 13, 1948, to dispose of some of the water to the creek through the East and West Ponds. In doing so, a total of 6.13 curies were discharged on that day.

A summary of the waste discharged follows:

a. From Settling Basin

Gallons Discharged	To	Curies
11,945,000	White Oak Creek	87.30

b. From East and West Ponds

252,850	White Oak Creek	4,73

c. From Retention Pond

246,600	White Oak Creek	.105

3. Waste Tank Inventory

CHEMICAL WASTE

Tanks	Gallons Capacity	Gallons In	Gallons Out	Discharged To	Free Space
W-1-2-5 -6	348,800	475,600	493,660	White Oak Creek	126,400
		METAL WASTE			
W-3-4-7 -8-9-10	754,300	28,564	12,000	Ru Process	194,288

4. Maintenance

a. The Tank Farm transfer line project has been completed and closed out.

b. The Settling Basin repair project is about 98% complete. The new baffles have been installed. Some clean-up work remains to be done.

c. Work on replacement of the East and West Pond catwalks is about 10% completed.

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

The analytical summary for Run #27, which was started on August 25, 1948, and shipped on September 4, 1948, is given below. All values are corrected to LST 0820 on September 3, 1948.

Slugs Loaded 854

	CURIES	PERCENT
Total Curies Dissolved	3,087	100.00
Cell A Losses	547	18.6
Cell B Losses	223	7.2
Losses Accounted For	797	25.8
Product Shipped (Skyshine)	2,196	71.1
Product Shipped (Radiochemical)	2,072	67.12
Material Balance		92.90
Loss Unaccounted For		7.10.

The original A-16 fan, which was shut down during the run because of poor performance, burned out during a test run. A new spare, totally enclosed vapor-proof, 3-H.P. motor, was installed to replace the original 2.5-H.P. motor. The fan is now operating satisfactorily.

A crude experiment was made during the run to determine the possibility of reducing the volume of 4% caustic used to scrub the dissolver off-gases. Results indicate that no changes can be made.

The Hanford slug carrier (coded Phoenix) and the slug tongs were shipped to Hanford for tests under operating conditions. No official AEC notification has yet been received in regards to the acceptance of the carrier.

Both building hoists were dismantled and inspected. Several faulty bearings were replaced. The hoists are back in operation.

The start of Run #28, which was requested by Los Alamos to be shipped on October 4, 1948, has been postponed pending further investigation of the particle problem.

Investigation is underway to determine the feasibility of producing 10,000 to 20,000 curie-runs with the present equipment. Revised glassware is being fabricated and the results will be published when known.

C. ISOTOPE CONTROL DEPARTMENT

I. General:

During the month of September there were 277 isotope shipments, a decrease of 36 compared with the month of August. The following table shows the number of shipments for August and September, 1948, and the total-to-date figure for all shipments made since August, 1946, the start of the Isotope Distribution Program.

	AUGUST 1948	SEPTEMBER 1948	TOTAL August, 1946, to September, 1948, Inc.
Separated Material 706-D Area	274	245	3546
Unseparated Material 100 Area	39	32	1175
	313	277	4721

The decrease in September, as far as non-project shipments are concerned, is mostly due to the fact that there is a shortage of P 32 which has prevented us from making a number of shipments. The shortage of P 32 and the cancellation of several other shipments resulted from excessive pile down time.

The breakdown according to non-project, project, and foreign shipments for August and September is as follows:

	August	September
Non-project	216	198
Project	66	50
Foreign	31	29

II. Radioiodine:

Replies from the persons who tested fission iodine samples sent them in August have been favorable and it has been decided to begin shipment of fission iodine next month. The Sub Committee for Human Applications of the AEC has approved this change.

III. Radiophosphorus :

The demand for radiophosphorus lately has been very high and a number of shipments have had to be delayed. The pile being down for the past week is expected to considerably restrict phosphorus production for the next several weeks.

There are several tubes of P_2O_5 at Hanford for such emergencies and Hanford has been requested to begin irradiating these samples. If the ORNL pile continues to run steadily after the first of October, we will probably not need this material.

IV. Cobalt:

A purchase order for 500 curies of radiocobalt from the National Naval Medical Center at Bethesda, Maryland, has been received. This order is for irradiation of 100 cans of cobalt rods 1/8" diameter with about 100 grams per can. It is expected to irradiate this material in a low flux portion of the pile so that it will reach the desired activity of 5 curies/can in about five months.

In addition, there is a tentative request for a 350-curie source of cobalt 60 from the Los Angeles Tumor Institute and a 575-curie source from Cook County Hospital. To fill such requests we expect to irradiate enough cobalt to make about 10,000 curies within the next year. These irradiations will be done at Hanford.

V. Shipping Regulations:

An exhibit is being arranged for the representatives of the airlines to demonstrate the proper methods of handling radioactive shipments. No word has been received on the clearance of the representatives by the AEC security.

VI. Antimony-Beryllium Neutron Sources:

A considerable amount of work has been done with antimony-beryllium sources in the Physics Division and it is now proposed to make these thermal neutron sources available to off-project customers as soon as suitable containers and a method of surrounding the antimony with beryllium has been developed. A price estimate will be made on these sources. They are expected to be useful to physicists and in any applications where a low flux source of thermal neutrons is desired.

VII. Isotope Production Area:

The ground was broken on September 20, 1948, for the new Isotope Area. Grading is proceeding and active construction is expected to start within the next two weeks. The Austin Company will design the off-gas and exhaust-air decontamination equipment while Patchen and Zimmerman will provide all construction design for the remainder of the area. The J. A. Jones Company will handle the construction.

[redacted]

VIII. Source and Fissionable Material Accountability:

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

RECEIPTS

Received From	Material	S.F. Content
Carbide & Carbon Chemicals, K-25	Normal Uranium	8.00 g.
" " " " "	Plutonium	.008 mg.
Carbide & Carbon Chemicals, Y-12	N.U., U_3O_8	220.31 g.
General Electric Company	Normal Uranium	20.00 g.
" " "	Enriched Uranium	294.00 mg.
" " "	Enriched Uranium	4,879.00 mg.
" " "	Normal Uranium	127.20 kg.
" " "	Plutonium	26.97 g.
" " "	Normal Uranium	127.20 kg.
" " "	Plutonium	26.97 g.
" " "	Thorium	150.47 kg.
Mallinckrodt Chemical Co.	Normal Uranium	294.83 kg.
" " "	Normal Uranium	589.66 kg.

SHIPMENTS

Shipped To	Material	S.F. Content
Argonne National Laboratory	Normal Uranium	6.99 kg.
" " "	Normal Uranium	6.99 kg.
Carbide & Carbon Chemicals, Y-12	Enriched Uranium	11.80 g.
General Electric Company	Thorium	243.26 kg.

[redacted]