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OPERATIONS DIVISION MONTHLY REPORT

FOR

MONTH ENDING AUGUST 31, 1954

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OPERATIONS DIVISION MONTHLY REPORT

for

Month Ending August 31, 1954

by

A. F. Rupp

DATE ISSUED

OCT 2 1954

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OPERATIONS DIVISION MONTHLY REPORT

REACTOR OPERATIONS

ORNL Graphite Reactor

There were no slug ruptures during August. Since two slugs were found ruptured in July, a number of rows of slugs are being measured to determine whether the over-all length has increased in the last few months; no significant increase has been found so far. Operating data for the ORNL Graphite Reactor and the LITR are given in Table 1.

On August 13, while an experimental assembly was being removed from hole 11, the cable connected to the boron-shot tube was inadvertently moved. This should have dumped the boron-steel shot into the reactor, but, since no loss of reactivity resulted, the shot tube apparently is not in good working condition and will probably be removed in the near future.

The underwater slug cutter is again functioning satisfactorily, with an electric motor being used instead of the air motor. All outstanding orders for sliced slugs have been filled, and several new ones have been received.

Revision of the canal demineralizer is nearly complete. It will be necessary to install a caustic-soda storage tank, however, since liquid caustic soda will not be available from the pilot plant as was originally expected.

On August 22 a voltage surge induced by lightning caused considerable damage in the No. 2 fan starter cubicle. The damage in this case was very similar to that caused by lightning in June when the No. 3 cubicle was damaged.

On August 28 a voltage surge or a direct hit by lightning burned out the stator coils of the No. 2 motor. It was necessary to assemble a usable motor from parts of the burned-out motor and the spare. A new motor has been ordered but has not yet arrived. From August 28 to August 31 the reactor was operated at half power.

The glass-wool filters in cell No. 4 were changed on August 16. It is now planned to delay further filter changes until next spring or summer. Enough paper-filter units have been made up to change cells Nos. 1 and 2 when needed. Pressure-drop data are given in Table 2.

The usage of experimental facilities in the ORNL Graphite Reactor is given in Table 3.

Low-Intensity Test Reactor

Operation of the LITR was uneventful during August except for a high down time of 21.1%, which resulted from the large number of shutdowns for the corrosion test work in facility HB-6.

	August	July
Unscheduled shutdowns for operational reasons, hr	6.55	1.13
Regular operations shutdowns, hr	20.33	46.37
Special shutdowns for research, hr	130.38	42.23

TABLE 1. REACTOR DATA

	ORNL GRAPHITE REACTOR			LITR		
	August 1954	July 1954	Year to Date	August 1954	July 1954	Year to Date
Total energy, Mwd	92.3	100	805.1	69.1	81.7	608.6
Average power/operating hr, kw	3276	3477	3578	2825	2996	2977
Average power/24-hr day, kw	2978	3225	3313	2228	2635	2505
Lost time, %	9.1	7.2	7.4	21.1	12.1	15.9
Excess reactivity	138 inhr	103 inhr		2.9%	3.4%	
Fuel pieces charged	88	51	702	0	2	13
Fuel pieces discharged	88	105	924	0	2	13
Research samples	146	95	715	20	12	80
Radioisotope samples	231	226	1754	25	24	175

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TABLE 2. PRESSURE-DROP DATA

	PRESSURE DROP (in. water gage)		
	Glass Wool	CWS No. 6	Total Across House
8/31/54	1.4	1.3	4.1
7/31/54	2.0	1.7	4.9
Clean filters	1.1	1.3	3.3

The revised pneumatic tube mentioned in previous monthly reports has been installed in facility HR-B and is now functioning satisfactorily. The temperature in the center of the tube is approximately 95°C.

In confirmation of previous data, further analyses of the LITR water indicate that no U^{239} is present. It now appears that the Np^{239} found in the cooling water diffuses through the cladding in the fuel plates selectively; most of the fission products found in the water are either fission-product gases or their daughters.

The new demineralizer equipment has been installed, but sufficient ion-exchange resin has not yet been received to load it.

The usage of experimental facilities in the LITR is given in Table 4.

RADIOISOTOPE PRODUCTION AND SALES

Data on the production of processed and unprocessed radioisotopes are given in Tables 5 and 6; special-preparation data are given in Table 7.

A teletherapy source containing 1600 curies of Co^{60} was assembled and loaded into a customer's specially designed shipping container. The source was loaded in the existing remote manipulator cell by improvising equipment and methods and by dividing the radiation dose among five persons so that there would be no overexposures. Because of many delays, construction of the new high-level cell that is designed to handle such operations will probably not be started until about September 20. Every effort will be made to fill urgent, long-standing orders for large teletherapy sources, within the limits of existing facilities and radiation safety requirements.

During the month of August, new prices were established for several items. A fivefold reduction in price was made for Cl^{36}, but because of the low demand for certain fission products it was necessary to raise the prices in an effort to meet production costs.

	Range (mc)	Price per Millicurie	
		New	Old
Sr^{89}	1–100	$ 2.00	$1.00
	>100	1.00	0.50
Y^{91}	1–100	2.00	1.00
	>100	1.00	0.50
$Zr\text{-}Nb^{95}$	1–100	2.00	1.00
	>100	1.00	0.50
Ba^{140}	1–100	2.00	1.00
	>100	1.00	1.50
Ru^{103}	1–50	10.00	5.00
	>50	4.00	2.00
Ce^{141}	1–100	2.00	1.00
	>100	1.00	0.50
Cl^{36}		1.00/μc	5.00/μc

Also in an effort to meet costs the price of reactor units was generally increased from $12 to $15 per unit for a one-week irradiation and from $33 to $45 per unit for a one-month irradiation. The cost of expensive target materials will be added to the unit prices. In many instances, the amount of target material was increased to benefit the customer. Charges for service irradiation were changed from $12 to $15 per week and from $33 to $45 per month for irradiations in neutron fluxes up to 10^{12} neutrons/sec/cm^2.

A summary of radioisotope shipments is given Table 8.

RADIOISOTOPE DEVELOPMENT

I^{131} Plant, Building 3028

The first hot run with 16 ORNL Graphite Reactor slugs was made, and during the run it was found that the inner dissolver tank was leaking into the

TABLE 3. USAGE OF EXPERIMENTAL FACILITIES – ORNL GRAPHITE REACTOR

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
1, 2, north and south	4 × 4			Regulating rods
3, north and south	4 × 4	Operations	J. A. Cox	Sulfur exposure for radiophosphorus production
4, north and south	4 × 4	Operations	J. A. Cox	Miscellaneous exposures of special samples
5, 6, north and south	4 × 4			Shim rods
7, 8, 9, vertical	4 × 4			Safety rods
10, vertical	4 × 4	Solid State	J. H. Crawford	Low-temperature sample-exposure facility (no samples during month)
11, vertical	4 × 4	Operations and Chemical Technology	J. P. McBride	Boron shot safety tube and HRP fuel studies
12, vertical	4 × 4	Operations	J. A. Cox	General exposures of samples in water-cooled facility
13, 14, north and south	4 × 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
15, north	4 × 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Miscellaneous large-sample exposures
15, south	4 × 4	Operations	J. A. Cox	Miscellaneous large-sample exposures
16, north and south	4 × 4	Operations	J. A. Cox	Target exposures for radioisotopes and research
17, north	4 × 4	Unassigned		Empty
17, south	4 × 4	Physics	E. O. Wollan	Neutron polarization
18, north and south	4 × 4	Operations	J. A. Cox	Miscellaneous large-sample exposures
19, north and south	4 × 4	Solid State	O. Sisman	Water-cooled exposure facility
20, north	4 × 4			Graphite temperature thermocouples
20, south	4 × 4	Solid State	J. C. Wilson	Creep of metals (no samples during month)
21, north and south	4 × 4	Operations	J. A. Cox	Sulfur exposure for radiophosphorus production
22, north	4 × 4	Solid State (G.E.)		Ionization-chamber tests
22, south	4 × 4	Operations	J. A. Cox	Two pneumatic tubes for general usage
30	9 × 9	Solid State (G.E.)	L. E. Stanford (G.E.)	Life tests of equipment in radiation (no tests during month)
31	9 × 9			Blocked by one end of air seol H beam across top of graphite
32, 33	9 × 9			Contain chamber for high-power-level trip circuit
34	9 × 9			Contains chamber for No. 2 power-level galvanometer
35	9 × 9			Blocked by one end of air seal H beam across top of graphite

TABLE 3. (continued)

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
36	9 × 9			Contains chamber for high-power-level trip circuit
37	9 × 9			Test facility for ionization chambers
40	9 × 9			Contains chamber for No. 1 power-level galvanometer
41	6-in. dia			Rear wall suction-pressure tap; hole into discharge manifold
42	6-in. dia			Unit pressure differential tap; hole into discharge manifold
43	6-in. dia			Unused (inaccessible); hole into discharge manifold
44	6-in. dia			Unused; hole into discharge manifold
45	6-in. dia			Gas discharge from hole 22 pneumatic tubes; hole into discharge manifold
46, 47	6-in. dia			Used for viewing west end of graphite with periscope; vertical holes into discharge manifold
50, north	4 × 4	Solid State	J. H. Crawford	General sample-exposure facility
50, south	4 × 4	Physics	E. O. Wollan	Neutron spectrometer
51, north	4 × 4	Solid State	J. H. Crawford	Water-cooled U^{235} neutron converter
51, south	4 × 4	Physics	C. G. Shull	Neutron spectrometer
52, north	4 × 4	Solid State	J. H. Crawford	Facility for exposing samples at liquid-nitrogen temperatures
52, south	4 × 4	Physics	L. D. Roberts	Low-temperature work
53, 54, 55	4 × 4	Solid State (G.E.)	L. E. Stanford (G.E.)	Half-holes for miscellaneous large-sample exposures
56, north	4 × 4	Physics	E. C. Campbell	Fast pneumatic tube
56, south	4 × 4	Physics	H. S. Pomerance	Oscillator for measuring neutron absorption cross sections
57, north	4 × 4	Training School	H. S. Pomerance	General-purpose neutron collimator
57, south	4 × 4	Physics	S. Bernstein	Neutron polarization
58, north	4 × 4	Unassigned		Empty
58, south	4 × 4	Chemistry	H. Levy	Neutron spectrometer
59	4 × 4	Unassigned		Half-hole; blocked by work at hole 17, south
60	4 × 4	Solid State	J. C. Wilson	Half-hole for creep of metals (no samples during month)
61	4 × 4	Operations	J. A. Cox	Half-hole for miscellaneous large-sample exposures
East and west animal tunnels				General exposures of large samples to low flux

TABLE 3. (continued)

HOLE NUMBER AND ORIENTATION	DIMENSIONS (in.)	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
Thermal column		Physics		Used by several groups for low-level neutron flux work
Inclined animal tunnel in thermal column				Exposures of biological specimens
West core hole		Physics		Lid tank for shielding studies
A	1.68-in. dia	Operations	E. E. Beauchamp	Charging-face hole containing 20 small cans of $CaCO_3$
B	1.68-in. dia	Unassigned		Charging-face hole; empty
C	1.68-in. dia	Solid State	J. C. Pigg	Charging-face hole; insulation test
D	1.68-in. dia	Solid State	C. E. Schilling	Charging-face hole; uranium samples
1069	1.5-in. dia	Unassigned		Charging hole containing an aluminum liner used for general exposure of suitable samples
1768, 1867, 1968	1.75-in. square	Solid State	R. H. Kernohan	Charging holes containing neutron converter donut; used for general exposures of samples to fast-neutron flux
2079	1.5-in. dia	Operations	J. A. Cox	Charging hole containing pneumatic tube; used for exposure of research and radioisotope samples
0857, 0880, 1484, 1853, 2857, 2880				Charging-face holes containing boron-coated thermopiles for reactor instrumentation
Others				Seven uncharged peripheral holes contain $CaCO_3$ for radioisotope production; 409 uncharged peripheral holes remain unused

TABLE 4. USAGE OF EXPERIMENTAL FACILITIES – LITR

FACILITY NUMBER	TYPE OF FACILITY	DIVISION ASSIGNED TO	PERSON IN CHARGE	TYPE OF EXPERIMENT OR USAGE
HB-1	6-in.-ID beam hole	Physics	E. C. Smith	Chopper-type neutron velocity selector
HB-2	6-in.-ID beam hole	Solid State (G.E.)	D. S. Billington	General exposures of large samples and loops*
HB-3	6-in.-ID beam hole	Solid State	J. C. Wilson	Creep of metals
HB-4	6-in.-ID beam hole	Chemistry	G. H. Jenks	Experiment being prepared
HB-5	6-in.-ID beam hole	Chemistry	G. H. Jenks	HRP fuel stability and corrosion tests*
HB-6	6-in.-ID beam hole	Chemistry	G. H. Jenks	HRP fuel stability and corrosion tests
HR-1, 2	Pneumatic tubes	Operations	J. A. Cox	General short exposures of research and radioisotope samples
C-28	Hollow fuel element in core	Solid State	T. H. Blewitt	Exposure of metal crystals to high, fast flux
C-38	Hollow fuel element in core	Solid State	J. B. Trice	Exposure of specimens for flux determination methods
C-42	Hollow Be core piece with access tube from top plug	Solid State (G.E.)	L. E. Stanford (G.E.)	Exposure of miscellaneous small specimens
C-44	Hollow Be core piece with access tube from tap plug	Chemistry	G. H. Jenks	
C-46, 48	Hollow Be core pieces with access tube from top plug	Solid State	G. W. Keilholtz	ANP fuel tests*
C-49	Be core piece with four vertical holes	Operations	J. A. Cox	Exposures of research and radioisotope samples
C-53, 56	Mg trays in core space	Operations	J. A. Cox	Exposures of research and radioisotope samples
V-1	Inclined low-flux hole			Contains boron-coated thermopile for reactor instrumentation
V-2	Inclined low-flux hole	Analytical Chemistry	G. W. Leddicotte	Exposure facility for activation analyses
V-3, 4	Inclined low-flux holes	Unassigned		Empty

*No tests during month.

TABLE 5. PROCESSED RADIOISOTOPE PRODUCTION DURING AUGUST 1954

PRODUCT	SOURCE	AMOUNT (mc)	SPECIFIC ACTIVITY (mc/g)
Calcium-45	W irradiation	515	22,200
Calcium-45	W irradiation	0.0675	No carrier added
Chlorine-36	W irradiation	106.76	0.380
Chromium-51	LITR irradiation	3,519	2,090
Iodine-131	Grophite Reactor metal	55,199	No carrier added
Iron-55	W irradiation	513	46.2
Mercury-203	W irradiation	2,343	260
Niobium-95	W reactor metal	22	No carrier added
Phosphorus-32	Graphite Reactor irradiation	10,968	40,000
Scandium-46	W irradiation	7,500	6,750
Sodium-24	LITR irradiation	1,101	2,100
Sodium-22	University of Pittsburgh cyclotron	51.4	302
Strontium-89	Graphite Reactor metal	136	No carrier added
Selenium-75	W irradiation	10,395	450
Yttrium-91	Graphite Reactor metal	127	No carrier added

steam jacket. The dissolver was decontaminated and the leak repaired. The segregation of important units of equipment into separate cubicles proved its worth during this period. The removal and repair of the dissolver were accomplished quickly and easily, as compared with the difficulties which were usually encountered when all equipment was in one cell. Several other repair and rearrangement jobs were done at the same time: repair of a thermocouple-well leak in the still, relocation of manometer lines to the evaporator, installation of slug chute valves, and shortening of downcomers in the bubble-cap column scrubber. The downcomers had to be shortened because the column was siphoning liquid from the plates during large changes in pressure across the column.

Leak tests are now being made with Na^{24} solution. Test operations will be resumed September 13.

Activation of $Eu^{152,154}$

Measurements of the samples of europium being irradiated in the LITR were continued in order to determine whether a maximum occurs in the $Eu^{152,154}$ production curve. The last measurement was made after 4868 hr of irradiation at an average flux of 1.7×10^{13} neutrons/sec/cm^2. The point obtained for the graph of the activation rate indicates that the curve is still approximately linear. The calculated activation curve indicates a maximum at this point for a flux of only 10^{13} neutrons/sec/cm^2; so it is apparent that some of the constants used in the calculation are in error. The experiment will be continued to locate the maximum, if one exists.

Anion-Exchange Resin, Stamex-S-44

A new type of anion-exchange resin containing a cross-linked sulfonium-ion grouping is being tested for use in radiochemical processes. The capacity of the resin was checked with chloride and sulfate ion and found to be 0.38 milliequivalent per milliliter of wet column-packed resin. The exchanger appears to be strongly basic. The radiation stability will be checked by adsorbing $P^{32}O_4^{---}$ on the resin and observing resin degradation and capacity changes.

Kr^{85} Hood, Building 3033

Construction work on the shielded hood that is to house equipment for the purification of Kr^{85} is 90% complete. Approximately 200 curies of crude

TABLE 6. UNPROCESSED RADIOISOTOPE PRODUCTION DURING AUGUST

PRODUCT	UNITS
Service irradiations	53
Arsenic-76	3
Arsenic-77	1
Bismuth-210	1
Cadmium-115 (I-1)	1
Chlorine-36	1
Copper-64	3
Europium-152,154	1
Gallium-72	1
Gold-198	57
Gold-199	4
Hafnium-181	1
Mercury-203	1
Iodine-131	4
Iridium-192	4
Molybdenum-99	1
Nickel-63	1
Osmium-191	2
Phosphorus-32	27
Potassium-42	18
Praseodymium-142	1
Rubidium-86	6
Selenium-75	1
Silver-110	3
Sodium-24	28
Strontium-89	1
Zinc-65	1
Total	226

Kr^{85} from Arco is now on hand for purification, assay, and packaging.

Technetium Process Development

Technetium is precipitated from acid wastes almost completely with phenyl arsonium permanganate, but the subsequent steps to recover technetium are not so clear-cut. The element is readily reduced, and approximately 16% of the technetium passes into the effluent from an anion-exchange column during the absorption of technetium from a 30% acetone, 0.5 *N* HNO_3, 0.25 *N* H_2O_2 solution of technetium. Removal of technetium from the anion column with 8 *N* HCl is also difficult; only about 65% can be removed. However, in a plant-type process, the waste effluent can be recycled and the residual technetium can be recovered from the column by combustion of the resin. Other methods are being considered for

TABLE 7. SPECIAL RADIOISOTOPE PREPARATIONS DURING AUGUST

	NUMBER	TOTAL AMOUNT
Co^{60} sources	150	2,350 curies
Ir^{192}	7	96.6 curies
H^3-Zr targets	4	11.72 curies
H^3 ampoules	37	41.68 curies
H^2-Zr deuterium targets	6	57 cc
He^3 ampoules	2	90 cc

TABLE 8. RADIOISOTOPE SHIPMENTS

	AUGUST 1954	JULY 1954	AUGUST 1953	AUGUST 1946 THROUGH AUGUST 1954
Separated material	826	796	759	47,714
Unseparated material	240	185	228	12,582
Total	1066	981	987	60,296
Nonproject	960	858	840	
Project	96	96	103	
Foreign	10	27	44	
Total	1066	981	987	

removal of technetium from the acidic acetone solution.

Irradiation of UO_3

The use of pressed UO_3 slugs for I^{131} production is being evaluated in preliminary experiments. The fact that UO_3 dissolves quickly and smoothly in 30% HNO_3 without NO_2 being evolved could make possible a faster processing of uranium to separate I^{131}. Tests are concerned with the production of pressed UO_3 pellets that will remain solid during the removal of aluminum jackets in caustic solution. Consideration is being given to pressing the pellets inside nickel foil before they are canned so that the aluminum jacket can be removed without disturbing the UO_3 pellet.

RADIOACTIVE-WASTE DISPOSAL

A total of 15.8 curies of beta activity was discharged to White Oak Creek from the settling basin and the retention pond (see Table 9); this total is 88% of that for last month and 44% of the average per month for 1953.

A total of 135,000 gal of waste was received into the chemical waste system this month.

A 130,200-gal quantity of radioactive wastes containing 415 curies of radioactivity was pumped from tank W-8 to chemical waste storage pit No. 2. In addition, 4025 gal of highly concentrated inactive $Al(NO_3)_3$ waste was transferred to the pit from Unit Operations, Building 4505. The total of all wastes discharged to waste storage pit No. 2 to date is 762,858 gal, containing 16,678 curies.

The pump used to transfer wastes from tank W-8 to waste storage pit No. 2 failed and had to be removed for repair. Inspection revealed a plugging of the suction line and the pump casing with an unidentified white precipitate readily soluble in HNO_3. The pump was reinstalled and now operates satisfactorily.

MISCELLANEOUS OPERATIONS

Demineralized Water

Demineralized-water production was 336,600 gal in August, compared with 314,580 gal in July.

No report on the defective resin sample submitted to the manufacturer has yet been received; a different brand of resin will be purchased in the future.

Hydrogen Liquefaction

Only 2 liters of liquid hydrogen was produced during August. The new liquefier is being leak-tested in the shops and should be ready for use in October.

Activation Analyses

A total of 179 requests for information concerning activation analyses has been received; 74 have developed into requests for analyses, 60 of which have been completed.

TABLE 9. ACTIVITY DISCHARGED TO WHITE OAK CREEK

DISCHARGED FROM	AUGUST 1954		AVERAGE PER MONTH, YEAR TO DATE		AVERAGE PER MONTH, 1953	
	Gallons	Beta Curies	Gallons	Beta Curies	Gallons	Beta Curies
Settling basin	12,240,000	14.4	13,950,000	16.7	19,450,000	24.1
Retention pond	410,000	1.4	510,000	1.8	500,000	11.7
Total	12,650,000	15.8	14,460,000	18.5	19,950,000	35.8