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RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD OCTOBER, NOVEMBER, AND DECEMBER, 1954

HANFORD TECHNICAL RECORD

April 29, 1955

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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER 1954

By

Members of
Regional Radiation Measurements Unit

April 29, 1955

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ABSTRACT

SECTION I: RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

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The combined average I^{131} emission rate from both T and S Plants this quarter was 1.5 c/day with the maximum rate of emission being 7.9 curies at S Plant during a 19 hour period on October 29. Comparatively low ruthenium emission rates from the 291-S stack, noted during September, continued into the present quarter when average emission was less than 2.3×10^{-2} c/day including a maximum of 0.43 c/day. The second highest tritium oxide emission rate of 1954 was observed at the 105-D Area where 2.2 c/day were emitted during December. Average values of C^{14} emission rates were below the detection limit of 4.5×10^{-3} c/day at all reactor areas this quarter. Average emission of 1.3×10^{-2} curie of S^{35} per day from 105-F continued to be relatively high although average values of S^{35} emission rates at 105-B and 105-DR Area stacks this quarter represented the highest values found at these facilities during the past year. Reversal of the decreasing trends noted last quarter in the average emission rates of alpha and beta particle emitters from the reactor stacks raised these values to the order of 1 to 5×10^{-7} curie of alpha particle per day; these values were of the same orders of magnitude as those noted during the second quarter of 1954.

SECTION II: RADIOACTIVE CONTAMINATION ON VEGETATION

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Significant increases in the deposition of I^{131} on vegetation were noted during November and December when vegetation having I^{131} concentrations above 5×10^{-6} μc/g covered areas of 150 and 60 square miles respectively; the area off-site where the I^{131} on the vegetation exceeded acceptable limits of 1×10^{-5} μc/g was less than one square mile during each of the three months. Non-volatile beta particle emitters on vegetation increased significantly during the last two months at locations throughout the Pacific Northwest; specific analyses indicated a source other than Hanford. Concentrations of alpha particle emitters on vegetation were within normal limits.

SECTION III: RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

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Dose rates measured by Victoreen Integrons increased to average values ranging from 1.1 to 5.9 mrad/day in and near the production areas. No significant changes were measured by detachable ionization chambers in the average dose rates present at stations outside the manufacturing areas and in residential areas. General increases were measured in the activity density of filterable beta particle emitters in the atmosphere where concentrations averaged between 7.5×10^{-13} μc/ml and 1.3×10^{-12} μc/ml at residential locations and between 1.2×10^{-12} μc/ml and 1.6×10^{-12} μc/ml near the separation areas. Higher than normal concentrations of radioactive particles continued to be noted at nearly all sampling locations near the separation areas. The average concentrations measured at locations off-site increased significantly and ranged from 0.06 to 0.32 ptle/cubic meter. Airborne I^{131} concentrations averaged less than 0.3×10^{-12} μc/ml in residential areas and averaged less than 0.7×10^{-12} μc/ml at all locations near manufacturing areas. The activity density of alpha particle emitters in the atmosphere was normal during the quarter.

SECTION IV: RADIOACTIVE CONTAMINATION IN HANFORD WASTES

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The activity of beta particle emitters discharged to the Columbia River from reactor coolant water retention basins averaged between 12,000 μc/sec and 19,000 μc/sec from each area. Trace quantities of alpha particle emitters, uranium, plutonium, and polonium continued to be found in the individual samples from the retention basins in each area. I^{131} discharged to the river from the Animal Farm averaged 60 μc/day in October, a factor of 2 increase above normal; November and December values again averaged 28 μc/day. Relatively large fluctuations noted in contamination measured in 200 Area and 300 Area waste sources were consistent with previous observations; no significant changes in activity density were observed in these wastes. Abnormal ground contamination continued to exist in the project and in the local environs with some increases noted during November and December in the vicinity of Redox.

SECTION V: RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER AND RELATED WATERS

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Seasonal decreases in the flow rate of the river and increases in the concentration of beta particle emitters in the reactor effluent water resulted in two-to four-fold increases in the activity density of beta particle emitters in the Columbia River between the reactor areas and McNary Dam. Average river flow rate during the present quarter was 6.0×10^5 gps compared to an average of 1.8×10^6 gps during the previous quarter. Maximum activity density of beta particle emitters in the river was again found along the south bank of the Columbia near the Hanford Ferry; average and maximum values for this quarter were 2.0×10^{-5} and 3.8×10^{-5} μc/ml, respectively. Trace quantities of beta particle emitters detected in the river between McNary Dam and Portland ranged from 1.0×10^{-8} to 1.6×10^{-7} μc/ml; the maximum measurement was again located in the Maryhill-Arlington region.

Activity density of alpha particle emitters in the Columbia River averaged at or below the detection limit in all samples except those collected below 300 Area. The average for this location was 3.0×10^{-8} μc of alpha particle emitters per ml of river water, with a maximum of 1.3×10^{-7} μc/ml. Increases in the activity density of beta particle emitters in raw water samples were associated with increased river activity density; maximum values of 3.6×10^{-6} μc/ml were found at 183-D, 183-H and 283-E during the present quarter.

SECTION VI: RADIOACTIVE CONTAMINATION IN RAIN

Page 66

The average activity density of beta particle emitters in rain was below the detection limit of 1×10^{-6} μc/ml for most of the stations except those located in the 200-W Area where a maximum concentration of 3.2×10^{-5} μc/ml was obtained at the Redox Station. All other concentrations were comparable to those observed during the third quarter of 1954.

SECTION VII: RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Page 69

Average concentrations of alpha particle emitters exceeded the detection limit of 5×10^{-9} μc/ml in samples of drinking water collected from two Richland wells, two Benton City wells, and from sources at Sacajawea Park, Paterson, and 3000 Area Well #F. Maximum concentration in an individual sample collected from a Richland well was 2.8×10^{-8} μc/ml which is well below the maximum permissible concentrations of plutonium or uranium in water. Average concentrations of beta particle emitters in the drinking water supplies originating from river water purified in the 100 Areas increased significantly during the quarter due to decreased dilution of the beta particle emitters in upstream reactor effluent water by the lower flow of the Columbia River. Concentrations of beta particle emitters in water entering the Pasco Filter Plant increased by over a factor of two to 3.0×10^{-6} μc/ml; efficiency of the filter plant returned to normal to give an average concentration of these emitters in the water leaving the plant of 4.3×10^{-7} μc/ml. Unexplained increases in concentrations of beta particle emitters were noted in several test wells but more recent samples have shown normal content.

INTRODUCTION

This document summarizes the results obtained from monitoring the HAPO environs for radioactive contamination during the period October, November, and December, 1954. Regional Monitoring (formerly Regional Survey) forces collected the necessary samples according to procedures outlined in previous documents of this series.[1, 2, 3] The Radio-Analysis Laboratory (formerly Control Laboratory) of the Regional Radiation Measurements Unit (formerly Control Unit) analyzed these samples according to procedures outlined in the standard laboratory manual.[4] Radiation Measurement Evaluation (formerly Control Services) forces corrected the counting rates from these analyses for geometry, back-scatter, air-window absorption, source size, self absorption, chemical yield and collection efficiency using factors described in previous reports.[5, 6, 7] Additional corrections for decay were applied to those samples in which significant amounts of short half-life beta particle emitters were found. The findings obtained from analyzing the direct samples were supplemented with readings obtained from portable and fixed instrumentation.

The final results for the quarter are presented in Sections I through VII which are written by various members of the organizations responsible for them. The information in these sections describes the amounts of active material discharged from plant facilities and their effect on the contamination of vegetation, air, soil, and water.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

By

J. K. Soldat

Radioactive contamination in effluent gases released to the atmosphere from the separation and reactor areas stacks was measured by sampling the effluents from the stacks and the stack breechings. Filter and scrubber samples from the separation facility stacks were collected daily and analyzed for the activity density of I^{131} and ruthenium; various types of samples collected from the reactor areas stacks at frequencies ranging from daily to weekly, were analyzed for the activity density of S^{35}, C^{14}, tritium oxide, and gross alpha and beta particle emitters collected by filters. The results obtained for each manufacturing area are discussed.

SEPARATION AREAS

200 EAST AREA SEMI-WORKS

Samples of the Semi-works effluent gases collected from the fifty-foot level of the 291-C stack were analyzed for beta particle emitters in particulate form; the results of these analyses are summarized in Table I.

TABLE I

BETA PARTICLE EMITTERS FILTERED FROM THE C-PLANT STACK EFFLUENT OCTOBER, NOVEMBER, DECEMBER 1954

Month	Units of Curie Per Day	
	Maximum	Average
October	9.6×10^{-6}	$<7.3 \times 10^{-7}$
November	1.5×10^{-5}	5.3×10^{-6}
December	5.5×10^{-6}	3.4×10^{-6}
Quarter	1.5×10^{-5}	$<3.0 \times 10^{-6}$
Last Quarter	$<2.0 \times 10^{-5}$	$<7.6 \times 10^{-6}$

The extended shut down of the Semi-works facility which began in September, 1953, was continued throughout the present quarter. No significant changes were observed in the activity emitted from this facility during the past year.

200 WEST AREA T PLANT

Table II contains a summary of the results obtained from I^{131} monitoring at the fifty foot level of the T Plant stack.

TABLE II

IODINE-131 DISCHARGED FROM THE T-PLANT STACK
OCTOBER, NOVEMBER, DECEMBER
1954

Month	Units of Curies Per Day	
	Maximum	Average
October	2.1	0.96
November	2.4	1.0
December	2.9	1.2
Quarter	2.9	1.1
Last Quarter	9.7	0.49

Increased amounts of I^{131} were available in the metal dissolved at the T Plant facility this quarter; the average value for the present period was 100 curies per day compared to 70 curies per day during the previous quarter. There has been no significant change in the average cooling period of the dissolved metal during the past three quarters. Several periods of continued high I^{131} emission were noted this quarter; but no exceptionally high daily I^{131} emission rates were noted. Increased production rates could have contributed only about two-thirds of the additional I^{131} emitted; reduced efficiency of the silver reactors may account for the remainder of the increased emission.

200 WEST AREA S PLANT

A summary of the results obtained from monitoring for I^{131} at the twenty foot level of the 291-S stack is presented in Table III.

TABLE III

IODINE-131 DISCHARGED FROM THE S-PLANT STACK

OCTOBER, NOVEMBER, DECEMBER

1954

Month	Units of Curies Per Day	
	Maximum	Average
October	0.35	0.086
November	9.5	1.0
December	1.3	0.22
Quarter	9.5	0.46
Last Quarter	12	0.96

An increase was noted in the cooling period of the metal dissolved this quarter; the average value was 134 days compared to 117 days during the previous quarter. This increase was reflected in the decreased amount of I^{131} available in the metal dissolved, and in the decreased I^{131} emission rate during this quarter. Even though the average I^{131} emission rate from the 291-S stack was only 0.46 curie per day during this period, the per cent of the total I^{131} available which was released to the atmosphere was still relatively high.

Filter and scrubber samples collected from the twenty-foot level of the S plant stack were analyzed for ruthenium, and the results of these analyses are summarized in Table IV.

TABLE IV

RADIOACTIVE RUTHENIUM DISCHARGED FROM THE S-PLANT STACK OCTOBER, NOVEMBER, DECEMBER 1954

Month	Units of Curie Per Day	
	Maximum	Average
October	0.038	<0.010
November	0.43	<0.027
December	0.12	<0.028
Quarter	0.43	<0.023
Last Quarter	1.9	0.23

Immediately following the rerouting of the ruthenium vessel off-gases through the sand filter in the summer of 1954 only a slight decrease was noted in the ruthenium emission rate from the S-Plant stack. A significantly decreasing trend to average values on the order of 5×10^{-2} c/day was noted during September and continued into the present quarter, when average values were below detection limits. The combined effects of continued flushing of the 291-S stack lines and elimination of the major sources of ruthenium may well be responsible for these reductions.

200 WEST AREA U-PLANT

Samples collected from the 291-U stack were passed through a CWS type filter paper which was collected and analyzed on a semi-weekly frequency for filterable material. Table V summarizes the results of the analyses of these filters for gross beta and alpha particle emitters as well as the number of radioactive particles.

TABLE V

RADIOACTIVE MATERIAL FILTERED FROM THE U-PLANT STACK EFFLUENT GAS OCTOBER, NOVEMBER, DECEMBER 1954

Month	Alpha Particle Emitters, Units of 10^{-8} curie/day		Beta Particle Emitters, Units of 10^{-5} curie/day		Radioactive Particles, Units of 10^{4} particles/day	
	Maximum	Average	Maximum	Average	Maximum	Average
October	1.3	0.35	7.5	0.095	37	15
November	2.2	0.74	0.04	0.030	8.6	3.9
December	6.3	1.6	3.1	0.56	5.4	2.6
Quarter	6.3	0.90	7.5	0.26	37	7.5
Last Quarter	21	1.5	28	4.4	46	20

The decreases noted in the average activity density of gross beta and gross alpha particle emitters and in the concentration of radioactive particles in the effluents from this stack were not highly significant when compared to previous widely fluctuating values.

REACTOR AREAS

Samples of the reactor areas stack effluents were collected from samples lines originating in the stack breechings. A sample of the gas was drawn through a silica gel absorber which removed ordinary water vapor and tritium oxide from the gases; another aliquot of the gases was passed through a scrubber bottle containing caustic solution which was later analyzed for C^{14} and S^{35}. A third aliquot of these gases was filtered through a CWS type filter paper to evaluate the particulate activity present as gross alpha and gross beta particle emitters. Summaries of the results of these measurements are presented in Tables VI through X.

TABLE VI

TRITIUM OXIDE DISCHARGED FROM REACTOR STACKS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of Curie Per Day

	October		November		December		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	0.34	0.21	0.87	0.58	0.32	0.26	0.87	0.36
100-C	0.12	0.04	0.22	0.07	0.53	0.10	0.53	0.07
100-D	0.84	0.42	0.57	0.36	2.2	1.1	2.2	0.52
100-DR	0.16	0.07	0.18	0.08	0.14	0.09	0.18	0.08
100-F	0.43	0.16	0.82	0.29	0.24	0.15	0.82	0.21
100-H	0.51	0.15	0.25	0.12	0.09	0.06	0.51	0.12

TABLE VII

CARBON-14 DISCHARGED FROM REACTOR STACKS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-3} Curie Per Day

	October		November		December		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	4.8	<4.5	<4.5	<4.5	30	10	30	<4.5
100-C	<4.5	<4.5	4.5	<4.5	<4.5	<4.5	4.5	<4.5
100-D	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-DR	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-F	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-H	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5

TABLE VIII

SULFUR-35 DISCHARGED FROM REACTOR STACKS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-4} Curie Per Day

	October		November		December		Quarterly	
Stacks	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	60	17	35	15	7.4	<4.5	60	12
100-C	7.0	<4.5	14	4.8	6.4	<4.5	14	<4.5
100-D	22	13	39	20	37	28	39	20
100-DR	110	42	160	62	81	42	160	50
100-F	160	85	870	250	110	51	870	130
100-H	4.9	<4.5	10	4.5	9.0	<4.5	10	<4.5

TABLE IX

ALPHA PARTICLE EMITTERS FILTERED FROM
REACTOR STACKS EFFLUENTS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-7} Curie Per Day

	October		November		December		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	4.2	1.5	1.8	0.75	2.1	1.4	4.2	1.2
100-C	6.0	2.5	6.0	1.7	3.7	0.18	6.0	2.0
100-D	5.9	2.3	3.7	2.3	5.6	2.5	5.9	2.3
100-DR	6.9	2.2	32	6.8	73	4.2	73	4.3
100-F	10	4.5	5.6	3.0	6.5	3.2	10	3.4
100-H	4.2	1.5	1.8	0.75	2.1	1.4	4.2	1.2

TABLE X

BETA PARTICLE EMITTERS FILTERED FROM REACTOR STACKS EFFLUENTS OCTOBER, NOVEMBER, DECEMBER 1954

Units of 10^{-5} Curie Per Day

	October		November		December		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	25	15	130	42	120	86	130	51
100-C	14	7.1	9.2	4.2	5.5	4.0	14	5.0
100-D	1200	380	340	180	1100	577	1200	370
100-DR	3.0	1.1	9.8	5.6	11	8.1	11	5.0
100-F	290	210	250	140	710	290	710	210
100-H	25	15	130	42	120	86	130	51

Small increases in maximum and average emission rates of tritium oxide were noted at all reactor area stacks this quarter. No significant changes were found when comparing the average values for this quarter with those obtained from these areas in the past year. One significant emission rate of 2.2 c/day obtained at 105-D Area represents the second highest daily emission of tritium oxide measured during 1954 (the highest value of 2.5 c/day was measured at 105-F in the first quarter of the year).

During the present quarter the maximum emission rates of C^{14} from the reactor area stacks exceeded the detection limit of 4.5×10^{-3} c/day on a few occasions at the 105-B and 105-C Areas (Table VII). Maximum emission of 3.0×10^{-2} c/day from the 105-B stack during December was the highest daily emission of C^{14} recorded during 1954. Occasional values on the order of 1×10^{-2} c/day were recorded for most of the reactor areas during the year, and no unusual significance was attached to this measurement. Average emission rates of C^{14} at all areas remained below the detection limit this quarter.

The average of 1.2×10^{-3} curie of S^{35} per day noted at 105-B Area this quarter (Table VIII) was higher by a factor of 2 than all three previous quarterly averages obtained during 1954. The highest S^{35} emission rate recorded at the 105-DR reactor stack during 1954 was measured in November 18, when 1.6×10^{-2} c/day was released to the atmosphere. The quarterly average value for this reactor stack was also higher than any noted during the past nine months when the average figures were on the order of 1×10^{-3} c/day. The average S^{35} emission from the 105-F stack was weighted by a high emission of 8.7×10^{-2} c/day resulting in average and maximum values which compared faborably with similar values obtained in the second quarter of 1954. No significant changes in the S^{35} emission rates were noted at the other reactor area stacks.

The decreasing trends noted in the previous quarterly average emission rates of alpha and beta particle emitters were reversed this quarter as the average values, given in Tables IX and X, compared favorably with those obtained during the second quarter of the year. The only notable changes occurred at the 105-D and 105-DR Areas where the average emission rates were higher this quarter by factors ranging from two to ten than similar values obtained during the previous six months Even these changes were of doubtful significance, however, because of the previously observed fluctuations around the low average values at all reactor area stacks.

No measurements of the concentrations of radioactive particles in the reactor effluent gases were obtained this quarter. Autoradiographing of these filters will be resumed during the next quarter.

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

By

Z. E. Carey

Approximately 1700 vegetation samples were collected from the nearby environs and an additional 500 samples were collected from remote locations in eastern Washington, southern Washington, and northern Oregon to determine the deposition of radioactive contamination in the Hanford environs. The samples were analyzed for the activity of iodine and non-volatile beta particle emitters; selected samples collected in the immediate environs were analyzed for the activity of alpha particle emitters. Tables I and II summarize the results of measurements of beta particle emitters in the nearby environs and at remote locations, repsectively.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

1954

Location	No. Samples	I^{131} Units of 10^{-6} µc/g Max.	Avg.	Avg. Last Qtr.	Non-Volatile Beta Particle Emitters Units of 10^{-6} µc/g Max.	Avg.	Avg. Last Qtr.
North of 200 Areas	205	15	<3	<3	520	100	77
Near the 200 Areas	190	48	3	<3	780	110	68
Route 3	13	130	15	3	350	110	92
200 West Gate	54	140	26	4	550	120	73
Batch Plant	30	44	7	<3	310	120	130
Meteorology Tower	13	140	16	<3	260	110	61
South of 200 Areas	335	21	<3	<3	840	90	58
Richland	155	12	<3	<3	240	67	46
Pasco Environs	125	9	<3	<3	290	56	33
Kennewick Environs	164	45	<3	<3	340	56	36
Benton City - Kiona	39	5	<3	<3	230	56	41
Richland "Y"	13	5	<3	<3	---	---	---
Hanford	12	3	<3	<3	---	---	---
200 East Area	48	7	<3	<3	470	110	85
200 West Area - Redox Area	66	45	6	4	15000	820	130
Wahluke Slope	97	10	3	<3	420	170	52
Goose Egg Hill	21	10	4	<3	110	72	180
Rattlesnake Mountain	7	5	3	<3	80	65	51
PSN-61, 51, 50	39	16	4	<3	400	96	41
Redox Construction	72	67	9	<3	8900	370	110
Off Area Sampling							
Pasco to Ringold	52	5	<3	<3	120	60	44
Prosser to Paterson - McNary	170	37	<3	<3	180	52	39
Eastern Washington	186	57	3	<3	740	82	33
So. Washington and No. Oregon	148	7	<3	<3	910	77	28

TABLE II

RADIOACTIVE CONTAMINATION ON VEGETATION

OFF-AREA LOCATIONS

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-6} μc/g

Location	I^{131} No. Samples	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters No. Samples	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Wallula	6	5	<3	6	150	87
Touchet	6	7	<3	6	110	48
Lowden	6	4	<3	6	81	52
Walla Walla	10	3	<3	10	180	82
Dixie	6	5	<3	6	740	190
Waitsburg	10	6	<3	10	140	70
Dayton	10	3	<3	10	96	63
Pomeroy	10	3	<3	10	91	66
Lewiston	10	4	<3	10	86	50
Uniontown	6	6	<3	10	150	53
Pullman	10	57	7	10	350	92
Colfax	6	3	<3	6	130	52
Steptoe	6	7	<3	6	79	47
Rosalia	6	24	6	6	250	110
Spangle	6	21	5	6	120	56
Spokane	10	9	<3	10	260	92
Cheney	--	--	--	--	--	--
Reardon	8	17	4	6	270	110
Davenport	8	8	<3	6	290	140
Harrington	8	37	5	6	300	140
Sprague	8	11	<3	10	410	120
Ritzville	8	6	<3	10	150	86
Lind	8	7	<3	10	170	67
Connell	10	5	<3	10	120	73
Moxee	8	5	<3	8	130	39
Union Gap	6	<3	<3	6	52	29
Wapato	8	5	<3	8	54	33
Toppenish	8	<3	<3	8	130	48
Toppenish to Goldendale	14	<3	<3	14	190	68
Goldendale	8	3	<3	8	89	43

[redacted]

TABLE II (contd.)

Units of 10^{-6} μc/g

Location	I^{131} No. Samples	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters No. Samples	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Goldendale to Wishram	4	3	<3	4	140	100
Lyle	6	<3	<3	6	75	37
Bingen	6	<3	<3	6	160	67
Camas	8	5	<3	8	440	160
Vancouver	8	3	<3	8	240	110
Portland	8	4	<3	8	320	110
Troutdale	6	3	<3	6	200	100
Bonneville	6	6	<3	6	910	280
Hood River	6	4	<3	6	120	77
Dalles	8	7	<3	8	140	72
Moody	4	<3	<3	4	130	56
Rufus	4	<3	<3	4	62	48
Blalock	6	4	<3	6	120	69
Arlington	6	3	<3	6	110	47
Heppner Junction	4	<3	<3	4	41	37
Boardman	6	<3	<3	6	120	58

The activity densities of iodine reported for October are similar to those reported for September but significant increases in these concentrations were observed during the last two months of the quarter. The maximum concentrations observed in the vicinity of 200-W resulted from emissions occurring during weekly periods ending November 11 and December 20 when 15 and 13 curies were emitted, respectively. Average monthly concentrations of iodine on vegetation are given in Table III.

TABLE III

CONCENTRATIONS OF IODINE-131 ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-6} μc/g

Location	October		November		December	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	<3	<3	10	<3	15	<3
Near the 200 Areas	5	<3	10	3	48	6
Route 3	9	3	130	31	19	7
200 West Gate	19	7	140	26	110	46
Batch Plant	3	<3	12	6	44	9
Meteorology Tower	7	5	8	5	140	38
South of 200 Areas	<3	<3	21	4	15	3
Richland	<3	<3	10	<3	24	3
Pasco Environs	3	<3	9	4	8	<3
Kennewick Environs	7	<3	45	4	5	<3
Benton City - Kiona	<3	<3	5	<3	5	<3
Richland "Y"	<3	<3	4	4	3	<3
Hanford	<3	<3	3	<3	<3	<3
200 East Area	4	<3	4	<3	7	4
200 West Area - Redox Area	17	3	13	5	45	11
Wahluke Slope	--	--	10	4	6	<3
Goose Egg Hill	--	--	---	--	10	4
Rattlesnake Mountain	--	--	---	--	5	3
PSN-300-310-330	3	<3	12	4	16	8
Redox Construction	16	5	17	8	67	18
Off Area Sampling						
Pasco to Ringold	--	--	5	<3	5	3
Prosser to Paterson - McNary	<3	<3	37	4	6	<3
Eastern Washington	<3	<3	57	5	7	<3
So. Washington and No. Oregon	3.5	<3	<3	<3	7	<3

Vegetation with I^{131} concentrations above 5×10^{-6} μc/g covered areas of 150 and 60 square miles in November and December, respectively, compared to less than 5 square miles during October and the previous quarter. The area off the project where the concentrations of I^{131} deposition exceeded 1×10^{-5} μc/g, the maximum acceptable at Hanford, (8) was less than one square mile for each of the three months. Figures 1, 2 and 3 give the average deposition patterns for October, November, and December, respectively.

The monthly average and maximum activity densities of non-volatile beta particle emitters on vegetation are summarized in Table IV.

[redacted]

TABLE IV

CONCENTRATIONS OF NON-VOLATILE
BETA PARTICLE EMITTERS ON VEGETATION
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-6} μc/g

Location	October		November		December	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	110	57	520	120	240	110
Near the 200 Areas	130	61	530	110	780	160
Route 3	71	52	350	200	88	79
200 West Gate	156	70	550	136	540	150
Batch Plant	220	93	310	120	200	130
Meteorology Tower	110	82	150	96	260	150
South of 200 Areas	60	41	840	140	230	120
Richland	70	37	240	69	240	99
Pasco Environs	64	34	290	68	170	70
Kennewick Environs	64	31	340	72	180	65
Benton City - Kiona	41	32	130	56	230	80
Richland "Y"	---	---	---	---	---	---
Hanford	---	---	---	---	---	---
200 East Area	180	79	190	76	470	190
200 West Area - Redox Area	5000	310	15000	1200	14000	920
Wahluke Slope	---	---	420	180	400	130
Goose Egg Hill	---	---	---	---	110	70
Rattlesnake Mountain	---	---	---	---	80	65
PSN-300-310-330	75	44	400	120	280	120
Redox Construction	730	190	8900	540	1800	330
Off Area Sampling						
Pasco to Ringold	---	---	84	45	120	90
Prosser to Paterson - McNary	71	27	160	64	180	73
Eastern Washington	154	47	740	110	180	87
So. Washington and No. Oregon	94	33	120	44	910	120

[redacted]

Non-volatile beta particle emitters remained at about the same level as in September during the month of October but significant increases were noted during the month of November which also affected the concentrations present at the end of the quarter. While vegetation collected in the vicinity of the 200-W Area continued to remain at relatively high levels possibly due to the higher levels of ground contamination in the same area, significant activities of these emitters were also detected at most other locations in the Pacific Northwest during the last two months reflecting increased concentrations of airborne beta particle emitters noted during November in the same area. Radiochemical analysis and decay studies of the contaminating material indicated a source other than Hanford.

Table V summarizes the results from measurements of alpha particle emitters on vegetation made during the quarter.

[redacted]

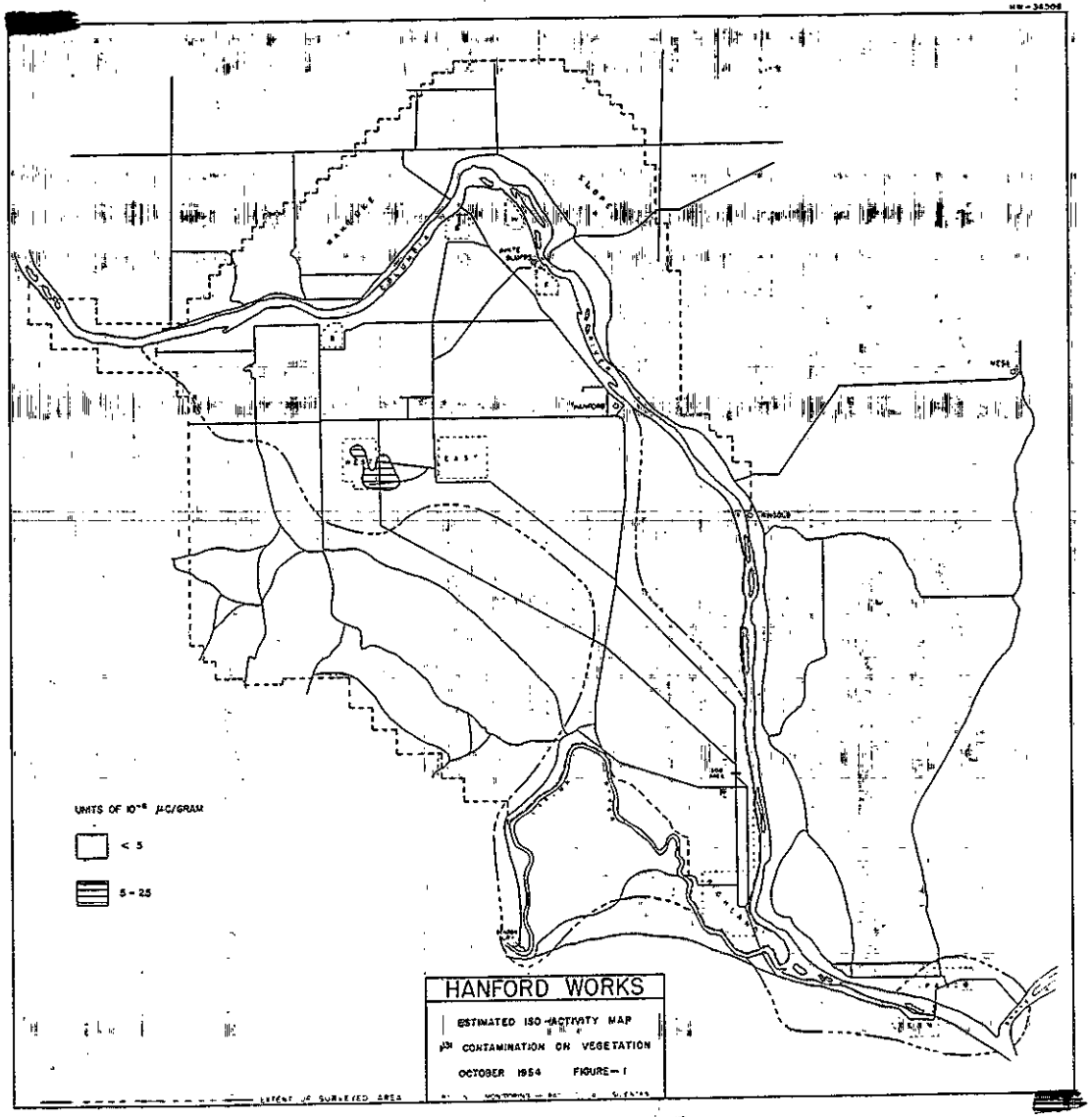
TABLE V

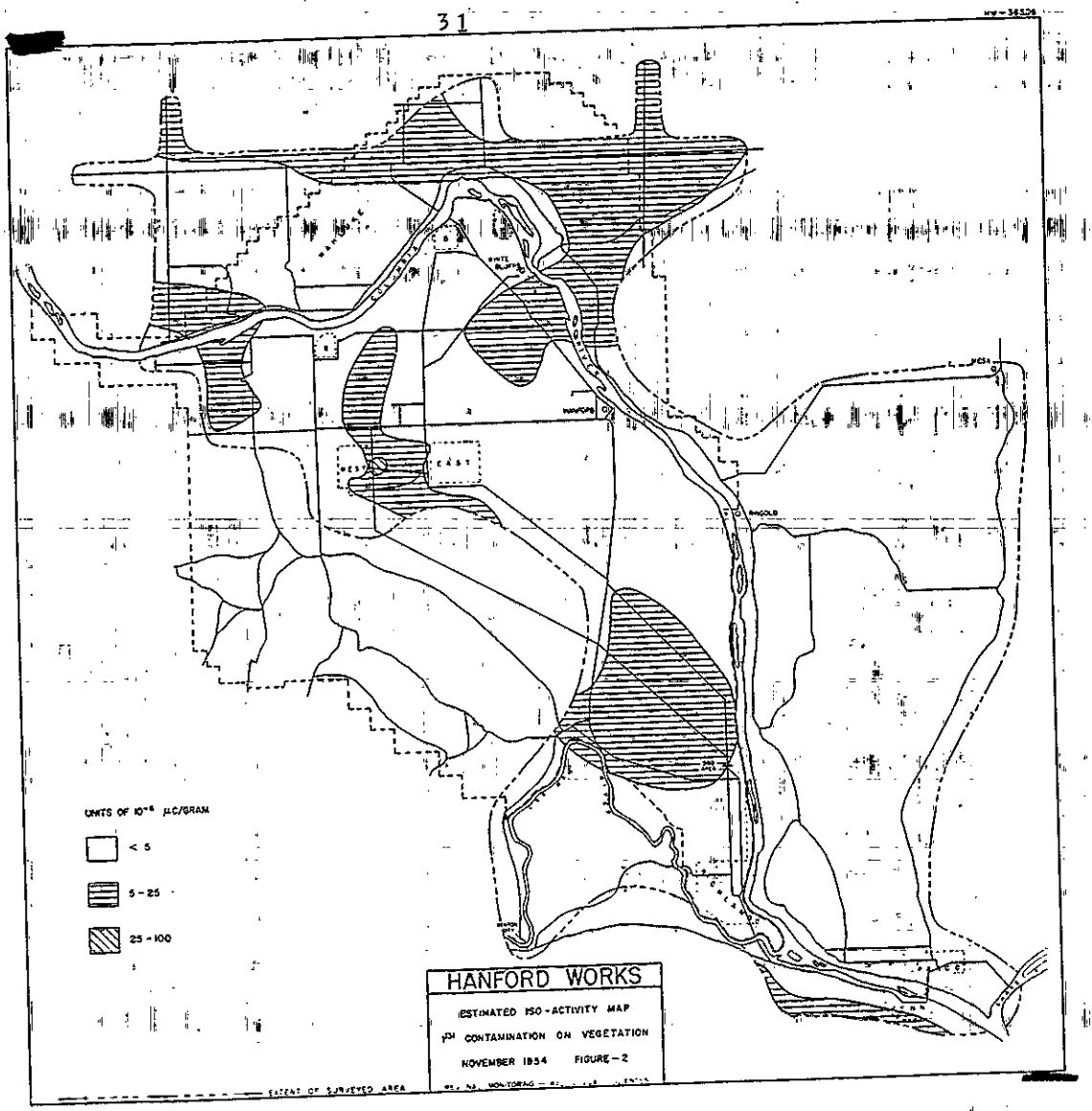
CONCENTRATIONS OF ALPHA PARTICLE EMITTERS
ON VEGETATION
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-8} μc/g

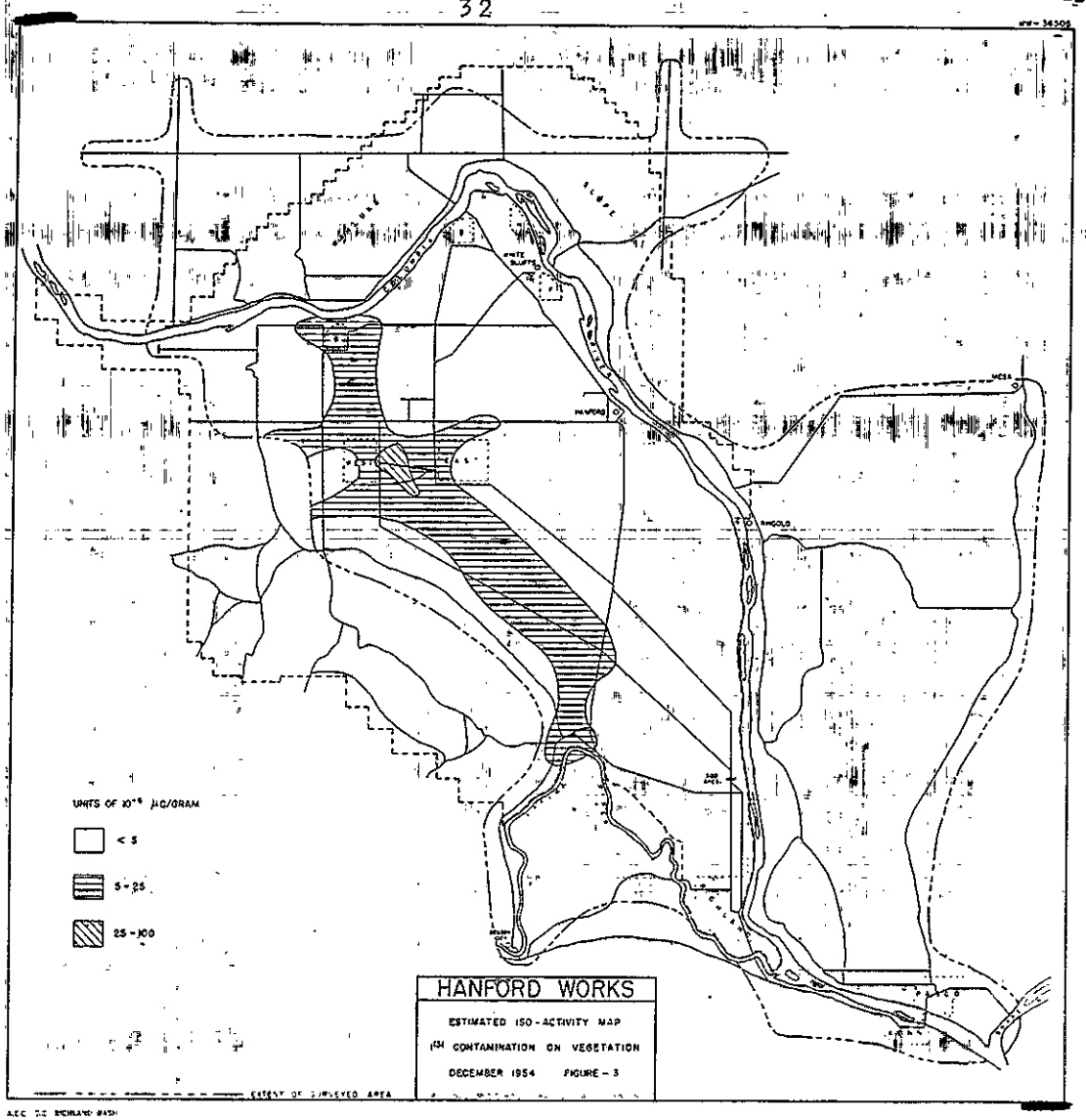
Location	October	November	December	Quarterly Average	Quarterly Maximum
Near 200 Areas					
200 West Gatehouse	19	43	71	44	110
Batch Plant	<10	18	50	24	82
Rt. 4 S Mile 4	<10	<10	15	11	18
Meteorology	13	27	36	25	50
Rt. 4 S Mile 6	<10	<10	16	<10	20
300 Area	19	<10	23	16	29
Outlying					
Richland	23	<10	20	17	45
Pasco	<10	--	12	<10	13
Benton City	<10	<10	22	10	22

While the values reported for samples collected from the 200-W Area during November and from most locations during December represent increases over concentrations reported last quarter, they are generally lower than values reported earlier in the year.





AEC, GE RICHLAND WASH



SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

By

G. E. Pilcher

The magnitude and extent of airborne contamination in the HAPO environs were determined from analyses of filter and scrubber samples and from data recorded in the operation of Victoreen Integrons and detachable ionization chambers. The results obtained by measurements made by each of the monitoring methods during the quarter are summarized in the accompanying tables.

Victoreen Integrons were operated continuously at stations located at the perimeter of the manufacturing areas and in residential communities neighboring the plant. Accumulated dosage readings were tabulated by eight hour intervals and calculated in units of measured dosage per 24 hours. A summary of the average dosage rates for the three month period is given in Table I.

TABLE I

AVERAGE DOSAGE RATES MEASURED BY VICTOREEN INTEGRONS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of mrad per 24 hours

Location	No. of Units	October	November	December	Quarterly Average
100-B Area	3	0.7	2.2	7.7	3.5
100-D Area	3	1.5	4.7	1.2	2.5
100-F Area	3	3.9	0.1	0.3	1.4
100-H Area	3	1.4	5.6	2.3	3.1
200 West Area	2	3.9	1.6	2.5	2.7
200 East Area	2	3.1	2.1	2.4	2.5
Riverland	1	0.7	<0.1	0.3	<0.3
300 Area	1	0.2	<0.1	<0.1	<0.1
Richland	1	0.7	<0.1	<0.1	<0.3
Pasco	1	0.9	<0.1	0.1	<0.4
Benton City	1	0.1	0.3	4.8	1.7
North Richland North	1	<0.1	<0.1	<0.1	<0.1
Hanford	1	0.1	0.1	3.2	1.1
Kennewick	1	<0.1	<0.1	<0.1	<0.1
Redox	1	6.0	9.1	2.7	5.9
200 East Semi-works	1	2.1	<0.1	11.4	<4.5

General increase in average dose rates over those reported during the previous quarter were measured at all locations in the vicinity of the 100 and 200 Areas. The reasons for these increases are obscure; no such increases were noted at more remote locations in the environs.

The dosage rates present at stations located around the perimeter of the plant manufacturing areas were measured using detachable C-type ionization chambers. Duplicate instruments were used at each location with the minimum value of discharge included as the reported value. A summary of these dosage rate measurements is given in Table II.

[redacted]

TABLE II

AVERAGE DOSAGE RATES MEASURED WITH
"C" TYPE DETACHABLE IONIZATION CHAMBERS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of mrad per 24 hours

Location	October	November	December	Quarterly Average
100-B Area	0.7	1.1	1.6	1.1
100-D Area	0.6	0.8	0.8	0.7
100-H Area	0.5	0.8	0.6	0.6
100-F Area	0.5	0.5	0.4	0.5
200 West Area	0.7	0.3	0.5	0.5
200 East Area	0.6	0.7	0.7	0.7
200 East Semi-works	1.6	0.7	0.7	1.0

A comparison of the above data with previous data showed that there were no significant changes in the quarterly average values for the current period from similar measurements made during the past year.

The dosage rates present at intermediate locations on the project and in residential areas around the plant perimeter were measured using detachable M-and S-type ionization chambers. Readings were obtained from these instruments at frequencies ranging from daily to weekly, and dosage rates were again reported from the chamber which showed the minimum discharge at each location. A summary of these measurements is given in Table III.

TABLE III

AVERAGE DOSAGE RATES MEASURED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of mrad per 24 hours

Location	Oct.	Nov.	Dec.	Qtr. Avg.	Group Avg.
100 Areas and Environs					
Route 1, Mile 8	0.78	0.73	0.58	0.70	
Route 2N, Mile 10	0.71	0.71	0.65	0.69	
Route 2N, Mile 5	0.83	0.80	0.70	0.78	
White Bluffs	0.55	0.81	0.63	0.66	
Route 11-A, Mile 1	4.11	0.70	1.17	1.99	
Hanford 614 Building	1.54	1.26	0.66	1.15	0.95
Intersection Rt. 1 and Rt. 4N	0.61	0.78	0.57	0.65	
Within 5 Miles of 200 East Area					
Route 4S, Mile 6	0.91	1.23	0.40	0.85	
Batch Plant	7.51	2.14	2.10	3.92	
Route 11-A, Mile 6	2.13	2.05	1.08	1.75	
Route 3, Mile 1	1.10	3.26	0.77	1.71	
Route 4S, Mile 2.5	1.05	1.13	2.16	1.45	
Redox Area	1.02	1.34	2.16	1.51	>2.69
Route 4S, Mile 4.5	1.10	0.96	1.38	1.15	
Military Camp PSN 61	0.75	1.90	2.47	1.71	
Military Camp PSN 51	0.83	1.17	1.19	1.06	
Military Camp PSN 50	1.08	2.37	1.73	1.73	
Military Camp PSN 40	1.34	0.64	0.99	0.99	
Redox Outside	>13.52	>15.40	*	>14.46	
Within 10 Miles of 200 East					
Route 4S, Mile 10	0.83	1.20	2.74	1.59	
Route 10, Mile 1	6.50	0.77	0.95	2.74	
Route 10, Mile 3	1.40	>8.52	1.61	>3.84	>2.77
Route 2S, Mile 4	1.48	>5.62	1.64	>2.91	

* Discontinued

[redacted]

TABLE III (contd.)

Units of mrad per 24 hours

Location	Oct.	Nov.	Dec.	Qtr. Avg.	Group Avg.
300 Area and Environs					
Route 4S, Mile 16	0.42	0.74	1.40	0.85	
Route 4S, Mile 22	1.72	1.74	0.98	1.48	
North Richland North	0.72	0.58	0.78	0.69	0.95
300 Area	0.83	0.66	0.85	0.78	
Outlying					
Richland	0.90	0.86	0.83	0.86	
Benton City	0.62	0.60	0.76	0.66	
Pasco	0.49	0.46	0.83	0.59	
Kennewick	0.38	0.50	1.25	0.71	0.70

No significant differences in average dose rates were measured at the given grouped locations compared to the values found during the previous reporting period.

The activity density of beta particle emitters in the atmosphere was measured using filters through which air was passed at flow rates of 2 to 2.5 cfm for daily or weekly periods. These samples were analyzed and counted several days after their removal from the sampling location to allow for the decay of the daughter products of the natural airborne particle emitters. A summary of the results obtained from these measurements during the period is given in Table IV.

TABLE IV

CONCENTRATIONS OF BETA PARTICLE EMITTERS FILTERED FROM AIR

SINGLE UNIT MONITORS

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-14} μc/ml

Location	October	November	December	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-D Area	64	230	63	130	450
100-H Area	120	370	130	220	760
Hanford 614 Building	34	100	43	67	190
White Bluffs	62	240	120	160	540
200 Areas and Vicinity					
200 East Semi-Works	71	200	97	130	460
200 West - West Center	72	170	110	120	360
200 West - Redox Area	110	190	160	160	310
Gable Mountain	51	280	78	120	420
PSN-50	140	180	140	160	270
300 Area - 614 Building	56	33	41	44	120
Outlying Areas					
North Richland	140	150	80	130	470
Pasco	49	96	74	75	220
Benton City	82	150	65	100	260
Riverland	86	160	110	120	270

General increases in the activity density of beta particle emitters collected on air filter samples were noted at all locations both on-site and in the neighborhing residential areas. Though these increases were prevalent during nearly the entire quarter, they are weighted most heavily by concentrations measured during the month of November. Though the exact source of these increases is not known, radiochemical analyses indicate the contaminants to be from off-site sources.

Additional evaluations of the concentrations of beta particle emitters in the atmosphere were made by analyzing the small air filters removed from dual air monitors operated at two locations. The results of these measurements are given in Table V.

TABLE V

CONCENTRATIONS OF BETA PARTICLE EMITTERS FILTERED FROM AIR

DUAL UNIT MONITORS

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-4} μc/ml

Location	October	November	December	Quarterly Average	Weekly Maximum
200-WEC #1	43	220	140	150	460
200-WEC #2	60	180	53	110	450
200-ESE #1	38	90	74	69	300
200-ESE #2	59	64	66	63	210
Richland #1	30	120	68	77	290
Richland #2	In-operative	46	100	82	180

The quarterly averages shown in Table V reflect the same increases noted in the results shown in Table IV. Again, the highest values were recorded during the month of November at each location.

The number of radioactive particles in the atmosphere was determined by autoradiographing air filters through which sample air flow rates of from 2.5 to 10 cfm were passed for periods ranging from daily to weekly. Monitoring stations were maintained throughout the immediate plant environs and at several remote locations in Washington, Oregon, Idaho, and Montana in order to evaluate particles originating both from HAPO and from outside sources. All filters were autoradiographed for seven days using type K X-ray film. A summary of the results of measurements near the separation areas is given in Table VI; similar results of measurements made outside the separation areas and at remote locations are given in Table VII.

[redacted]

TABLE VI

SUMMARY OF PARTICLE CONCENTRATIONS

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-3} particle/meter^3

Location	Total Volume Of Air Sampled Cubic Meters	Oct.	Nov.	Dec.	Present Qtr. Avg.	Previous Qtr. Avg.
200-E Vicinity						
2704 Outside	9388	73	160	130	110	110
BY - SE	8445	170	180	71	150	190
"B" Gate	8896	97	200	110	130	100
2704 Inside	9389	100	160	130	130	63
2-EWC-614 Bldg.	9339	80	140	110	110	
200-W Vicinity						
2701 Outside	9112	140	330	170	210	170
2722	9408	110	160	100	120	110
"T" Gate	9393	74	120	100	97	120
222-T Outside	6775	200	200	170	190	200
231	9333	120	200	84	130	220
Redox	8913	200	380	190	250	180
"W" Guard Tower	Discontinued					140
2701 Inside	9044	130	280	110	170	180
272	8959	120	200	98	140	89
2-WEC-614 Bldg.	9393	90	190	110	130	
U-Gate	9380	98	150	94	110	93
222-U Lab. Inside	9384	68	130	87	93	81
Meteorology Tower						
3'	37519	29	63	43	43	23
50'	37519	27	53	42	39	28
100'	27216	30	67	50	47	33
150'	26042	39	100	58	64	32
200'	24057	41	110	61	68	38
250'	24057	44	110	67	70	35
300'	20595	23	140	73	78	42
350'	22290	38	100	54	62	36
400'	15007	49	160	88	94	43

TABLE VII

SUMMARY OF PARTICLE CONCENTRATIONS

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-3} particle/meter^3

Location	Total Volume Of Air Sampled Cubic Meters	Oct.	Nov.	Dec.	Present Qtr. Avg.	Previous Qtr. Avg.
Area Locations						
100-B Area	1007	--	--	50	50	88
100-D Area	33779	75	110	130	110	23
White Bluffs	19614	99	100	110	110	19
100-F Area	19389	47	140	110	110	31
300 Area	35632	100	110	190	130	57
Off Area Locations						
Benton City, Wn.	36516	69	58	95	73	42
Pasco, Wn.	34731	44	83	76	65	32
Richland, Wn.	37026	73	280	140	150	48
Boise, Idaho	9282	280	410	280	320	150
Klamath Falls, Ore.	9393	260	240	210	240	110
Great Falls, Mont.	8445	31	110	180	91	53
Walla Walla, Wn.	9126	190	380	220	320	100
Meacham, Ore.	9274	99	140	110	120	68
Lewiston, Idaho	9100	150	350	370	280	110
Spokane, Wn.	37502	40	160	120	100	51
Kennewick, Wn.	9231	110	370	130	200	65
Yakima, Wn.	35394	56	130	120	96	20
Seattle, Wn.	9240	28	61	110	66	15

Higher than normal concentrations of particles were noted during the quarter at nearly all locations, with the concentrations found on-site and at remote stations on the same order of magnitude. Radiochemical analyses indicated that the increases in particles originated from contributions by off-site sources.

The activity density of I^{131} in the atmosphere was determined from the radiochemical analysis of caustic scrubber solutions through which air was passed at flow rates of 2 to 2.5 cfm for periods ranging from one to seven days. The results obtained from these measurements are summarized in Table VIII.

TABLE VIII

CONCENTRATIONS OF IODINE-131 DETECTED BY AIR SCRUBBERS
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-12} µc/ml

Location	October	November	December	Quarterly Average	Weekly Maximum
200 Areas and Vicinity					
200-ESE	<0.1	<0.1	<0.1	<0.1	0.1
Gable Mountin	<0.1	0.1	0.1	0.1	0.2
200 West Gatehouse	0.4	0.3	1.0	0.6	2.5
200 West W Center	0.3	<0.1	<0.1	0.2	1.0
200 East Semi-works	0.2	0.2	<0.1	0.1	0.2
Redox Area	<0.1	0.8	<0.1	0.4	3.1
Outlying Areas					
100-H Area	<0.1	<0.1	<0.1	<0.1	0.1
300 Area	<0.1	0.1	<0.1	<0.1	0.3
North Richland North	0.1	<0.1	<0.1	<0.1	0.4
Richland	<0.1	0.3	0.1	0.2	0.9
Pasco	<0.1	0.1	<0.1	<0.1	0.2
Benton City	<0.1	<0.1	<0.1	<0.1	0.2

[redacted]

There were no significant changes from the previous quarter in the measured I^{131} activity densities either in the vicinity of the separation areas or in the outlying areas.

The concentration of alpha particle emitters in the atmosphere was determined by counting the same filters used for the beta particle emitter measurements which were summarized in Tables IV and V above. A summary of the alpha measurements is given in Table IX.

TABLE IX

CONCENTRATIONS OF ALPHA PARTICLE EMITTERS FILTERED FROM AIR

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-15} μc/ml

Location	Number Samples	Weekly Maximum	Quarterly Average
200 West - West Center	13	6	<4
200 West Redox Area	13	46	6
200 East Semi-works	13	4	<4
Gable Mountain	10	55	8
Pasco	13	21	5
300 Area	12	13	5
100-D Area	12	7	<4
Benton City	11	5	<4
Hanford 614 Building	11	<4	<4
White Bluffs	12	21	5
North Richland	12	18	<4
100-H Area	13	34	6
Riverland	13	8	<4
PSN 50	9	18	6
Dual Unit Monitors			
200 WEC #1	11	18	6
200 WEC #2	12	54	8
200 ESE #1	13	9	<4
200 ESE #2	13	5	<4
Richland #1	12	27	6
Richland #2 *	4	7	4

* Unit in-operative during majority of quarter

[redacted]

The concentrations of alpha particle emitters compared favorably with those previously reported at all locations, and are indicative of normal operations at HAPO.

[redacted]

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

By

G. E. Pilcher and Z. E. Carey

The amount of radioactive contamination discharged in waste material from the manufacturing areas was determined by analyzing liquid and solid samples for the activity density of gross beta and alpha particle emitters. The samples were collected from the various waste sources at frequencies ranging from daily to weekly, and the measurements were supplemented with the results of portable instrument surveys performed at the perimeter of the open waste areas. Special ground contamination surveys were performed after all incidents of known contamination deposition. The results of these measurements are summarized for each of the manufacturing areas.

100 AREAS WASTES

Radioactive contamination discharged to the Columbia River from the reactor areas was determined by analyzing samples collected daily from the outlets of the coolant water retention basins. The samples were analyzed within twelve hours after collection and the measured counting rates of beta particle emitters were corrected for decay. A summary of the activity of beta particle emitters discharged to the river is given in Table I.

TABLE I

BETA PARTICLE EMITTERS DISCHARGED TO COLUMBIA RIVER
IN REACTOR EFFLUENT WATER
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^3 μc/second

Locations	No. Samples	October		November		December		Quarter	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B Area	88	18	14	21	15	17	15	21	15
100-C Area	80	30	19	29	20	21	17	30	19
100-D Area	90	21	14	17	14	17	14	21	14
100-DR Area	108	14	12	19	13	13	11	19	12
100-H Area	86	17	14	18	15	19	15	19	15
100-F Area	86	22	15	18	14	23	16	23	15

A comparison of the total activity of gross beta particle emitters discharged to the river during this period with the results of similar measurements obtained during the previous quarter showed that significant increases in the activity of beta particle emitters admitted to the river occurred at 100-B, 100-D, 100-DR, and 100-F Areas. These increases ranged from 9% at 100-DR to 25% at 100-B and 100-F Areas. No significant differences in discharged activity were found at 100-C and 100-H Areas. The general increases in discharged activity can be ascribed partially to recent increases in reactor operating levels, together with the possible influence of expected seasonal fluctuation in the coolant water quality.

The activity density of alpha particle emitters in reactor effluent water averaged less than 5×10^{-9} μc/ml at all areas. Measurable activity from alpha particle emitters was found in individual samples from each area with values ranging up to 5.8×10^{-8} μc/ml.

[redacted]

Analyses completed of 136 effluent water samples from all reactor areas for the activity density of uranium revealed only two values over the detection limit of 2×10^{-9} μc/ml. These trace amounts measured at 100-B and 100-F Areas represented discharge rates of uranium to the river on the order of 1×10^{-2} μc/sec.

As in previous reporting periods, several samples from each reactor area analyzed for plutonium showed values above the detection limit of 3×10^{-9} μc/ml. These samples represented discharge rates of this isotope to the river from each area of from 1.0×10^{-2} μc/sec to 0.12 μc/sec.

Positive quantities of polonium were found in samples of effluent water from each of the reactors representing discharge rates of this isotope to the river of from 2×10^{-3} μc/sec to 0.18 μc/sec.

The activity density of I^{131} in waste discharged to the Columbia River from the Biology Farm at 100-F Area was measured by analyzing composite samples collected from the sump in the waste discharge line. During October, 60 μc/day were admitted to the river, an increase by a factor of 2 over the discharge rates of previous reporting periods. During the latter two months of the quarter, however, an average of 28 μc/day was admitted to the river, a value again comparing favorably with the normal discharge rate.

200 AREA WASTES

Liquid and solid samples were collected directly from the waste sources in the separation areas and analyzed for gross alpha and beta particle emitters. A summary of the results is given in Table II.

TABLE II

RADIOACTIVE CONTAMINATION IN 200 AREA WASTE SYSTEMS

OCTOBER, NOVEMBER, DECEMBER

1954

Liquid Samples

Location	No. Samples	Uranium and Plutonium, Units of 10^{-8} µc/ml, Maximum	Uranium and Plutonium, Units of 10^{-8} µc/ml, Average	Beta Particle Emitters, Units of 10^{-7} µc/ml, Maximum	Beta Particle Emitters, Units of 10^{-7} µc/ml, Average
T-Ditch	12	<0.5	<0.5	250	47
T-Swamp	33	3.6	<0.5	110	20
U-Swamp	23	25	5.0	8200	1100
Laundry Ditch	24	120	8.9	25	10
231 Ditch	24	65	12	41	8.2
200-E "B" Ditch	11	3.5	0.5	5.1	3.2
200-E "B" Swamp	4	0.5	<0.5	3.6	2.7
234-35 Ditch	12	46	7.7	9.1	4.6

Solid Samples

		Units of 10^{-6} µc/g		Units of 10^{-5} µc/g	
T-Ditch	12	31	3.6	640	86
T-Swamp	18	12	4.3	150	47
Laundry Ditch	13	110	33	240	52
200-E "B" Ditch	10	23	9.7	66	29
200-E "B" Swamp	4	5.6	2.0	34	26
234-35 Ditch	11	21000	3000	25	7.7

The concentration of alpha and beta particle emitters in these wastes was within the expected order of magnitude at each location.

Samples from all waste sources indicated in Table II were analyzed specifically for the activity density of uranium. A summary of the liquid and solid sample measurements above the detection limits of 2×10^{-9} μc/ml for liquids and 1×10^{-6} μc/g for solids is given in Table III.

TABLE III

URANIUM ACTIVITY DENSITY IN 200 AREA WASTE SYSTEMS

OCTOBER, NOVEMBER, DECEMBER

1954

Liquid Samples

Location	No. Samples	Activity Density Units of 10^{-9} µc/ml Maximum	Average
231 Ditch 1st Underpass	12	170	15
234-35 Pipe Outlet	12	130	12
Laundry Ditch Inlet	12	22	7.9
Laundry Ditch 600' from Inlet	12	75	14
200-W "T" Swamp S. Side	10	64	7.3
200-W "U" Swamp Inlet	12	62	11
200-W "U" Swamp W. Side	12	160	44

Solid Samples

Location	No. Samples	Activity Density Units of 10^{-6} µc/gm Maximum	Average
200-E "B" Ditch Inlet	7	45	18
234-35 Pipe Outlet	7	9.2	3.4
Laundry Ditch Inlet	11	67	28
200-E "B" Swamp N. Side	1	3.3	3.3
200-W "T" Swamp W. Side	6	3.3	1.8
"U" Ditch Inlet	10	52	13

The order of magnitude of the activity density of uranium at these locations was similar to that reported in previous periods.

300 AREA WASTES

A summary of the results obtained by analyzing liquid and solid samples from 300 Area waste sources is given in Table IV.

TABLE IV

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
OCTOBER, NOVEMBER, DECEMBER
1954

Liquid Samples

Location	No. Samples	Beta Particle Emitters, Units of 10^{-7} µc/ml, Max.	Beta Particle Emitters, Units of 10^{-7} µc/ml, Avg.	Uranium and Plutonium, Units of 10^{-8} µc/ml, Max.	Uranium and Plutonium, Units of 10^{-8} µc/ml, Avg.	Uranium, Units of 10^{-6} µc/ml, Max.	Uranium, Units of 10^{-6} µc/ml, Avg.
Old Pond Inlet	10	110	18	6600	700	1.5	0.42
New Pond Inlet	58	54	8.6	1900	140	15	1.2

Solid Samples

		Units of 10^{-3} µc/g		Units of 10^{-3} µc/g		Units of 10^{-3} µc/g	
Old Pond Inlet	2	6.9	4.4	4.8	3.3	5.6	5.6
New Pond Inlet	9	6.8	3.5	5.6	4.5	28	8.6

The contamination measured in samples collected from 300 Area wastes was again within the expected order of magnitude in all cases based upon results obtained in previous reporting periods.

Radiochemical analyses of approximately 60 samples obtained from the new 300 Area pond showed the average activity density of plutonium to be on the order of 1×10^{-8} μc/ml, a value comparing favorably with data previously reported.

ENVIRONS - GROUND CONTAMINATION

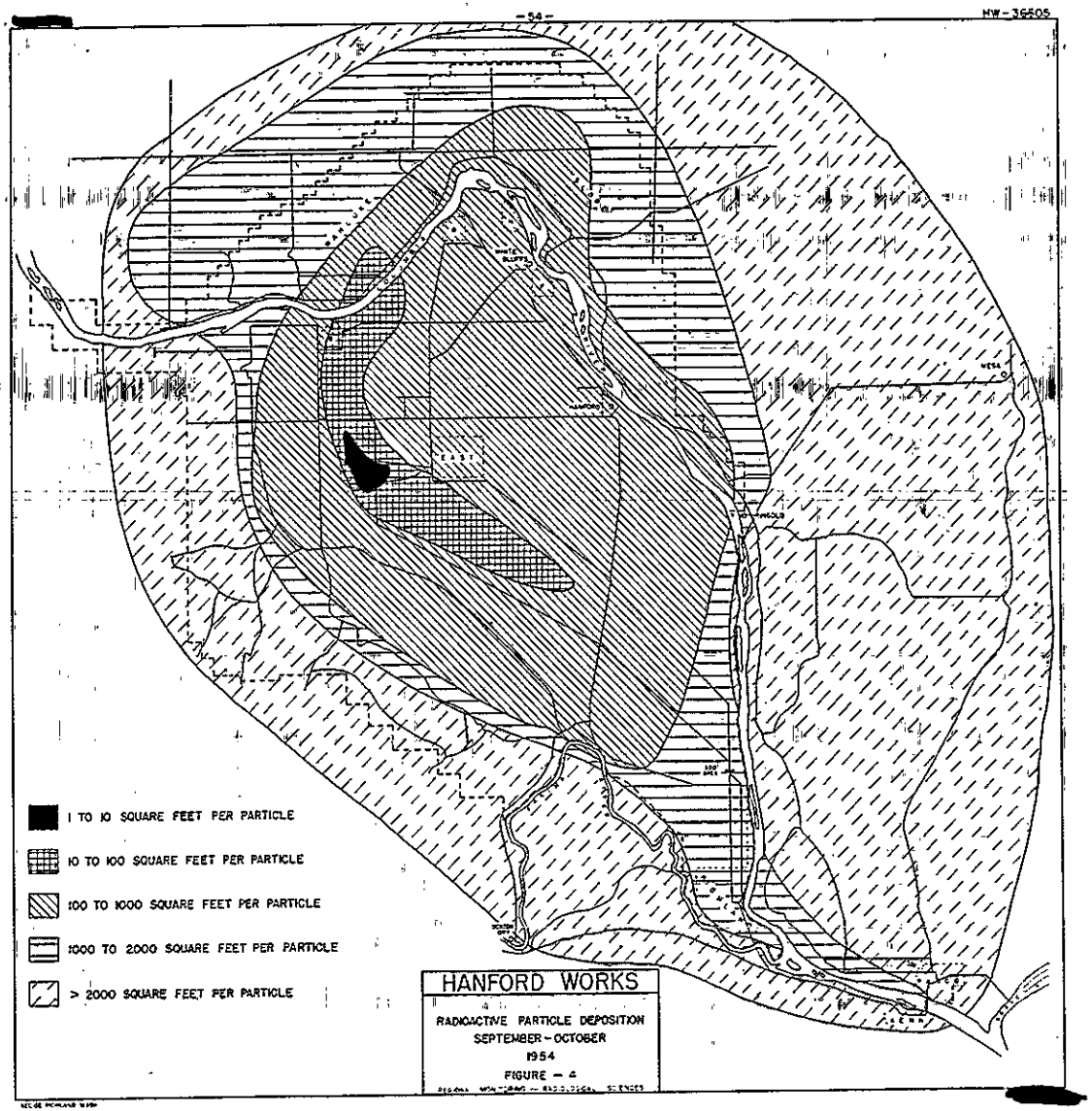
Unusually high concentrations of radioactive particles continued to be present on the ground in the project and local environs during the quarter. These particles were those described in an earlier report[9] as well as new particles arising from the Redox process. Figures 4 and 5 give a picture of particle concentrations near the first part of the quarter and during December, respectively. A comparison of weekly particle concentrations on control plots near the 200-W Area is shown in Figure 6. Particle concentrations illustrated in all three figures represent those particles detectable at ground level using a portable GM instrument.

The data illustrated in Figure 6 were obtained by comparing the number of particles found on a particular plot during the week in question with the average number found during the period from November 1 to November 26, which was a relatively stable period. The numbers reported in Figure 6 are average values of the ratio based on all plots.

Significant increases in the number of particles found on ground areas in the Redox Area were noted during early November and early December. Analyses of five particles emitted from the Redox stack during the week ending November 7 revealed that more than 95 per cent of the beta particle emitter activity associated with these additional particles was from ruthenium-rhodium isotopes with the ratio of the

activity of Ru^{103} to that of Ru^{106} being less than 0.05. Trace activities of strontium, zirconium and rare earths were also found. Plutonium was found in the only two particles tested for this element with one particle having 270,000 d/m of plutonium. Four of the particles were agglomerates of smaller white crystals with a yellow discoloration on some surfaces and both ammonium nitrate and iron were found in these particles. One apparently different particle was bright yellow without the crystalline appearance of the others and results from spectrographic analyses of this particle indicated major inert components to be calcium and iron.

Measurements of low-activity particles not detectable by portable monitoring instruments were initiated during the quarter through the exposure of film in lightproof envelopes to ground surfaces in the area. Concentrations of these low level particles were found to be on the order of 200 particles per square foot at locations adjacent to the 200-W perimeter fence southeast of Redox compared to concentrations of less than 10 in the 300 Area.



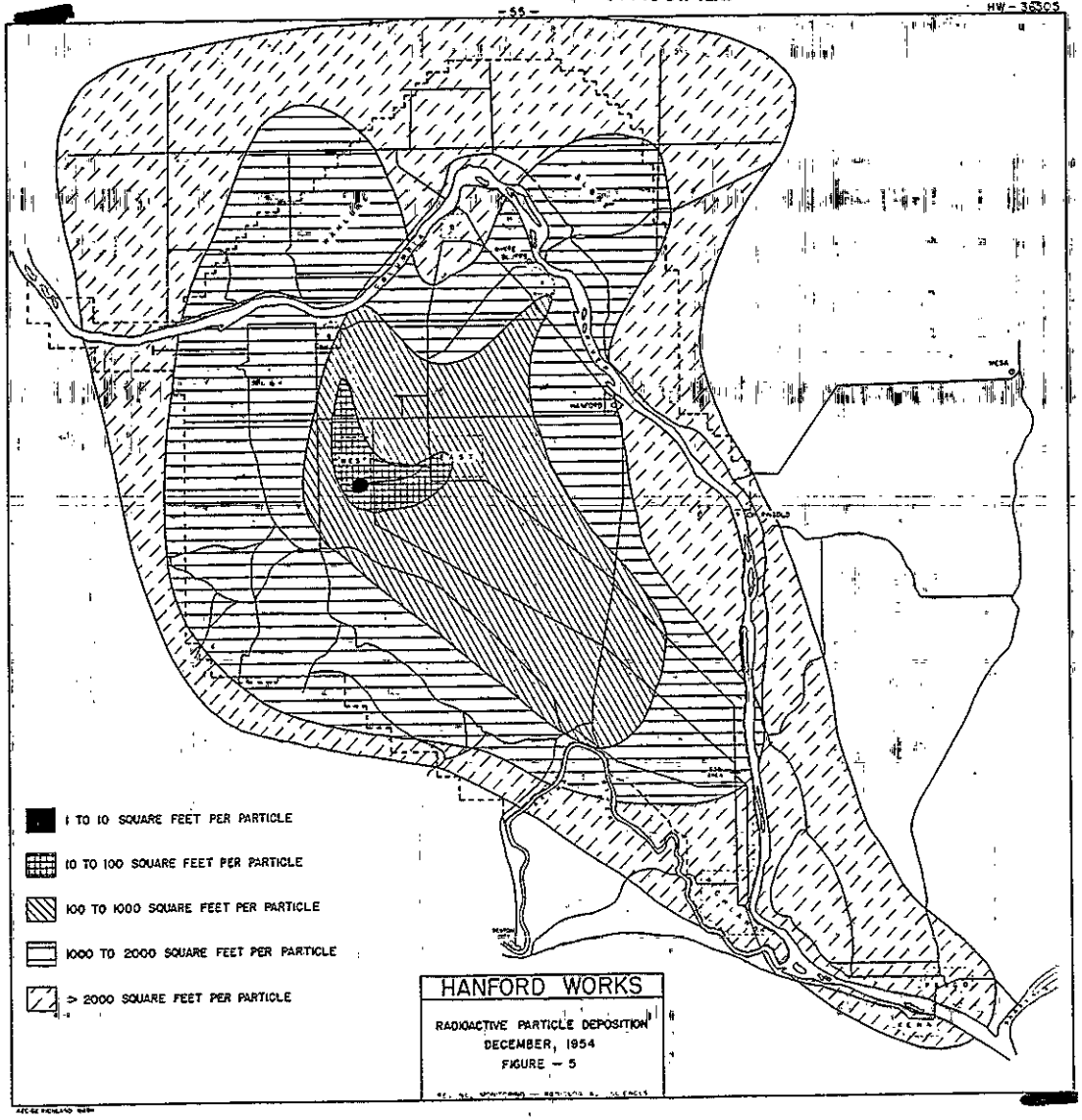
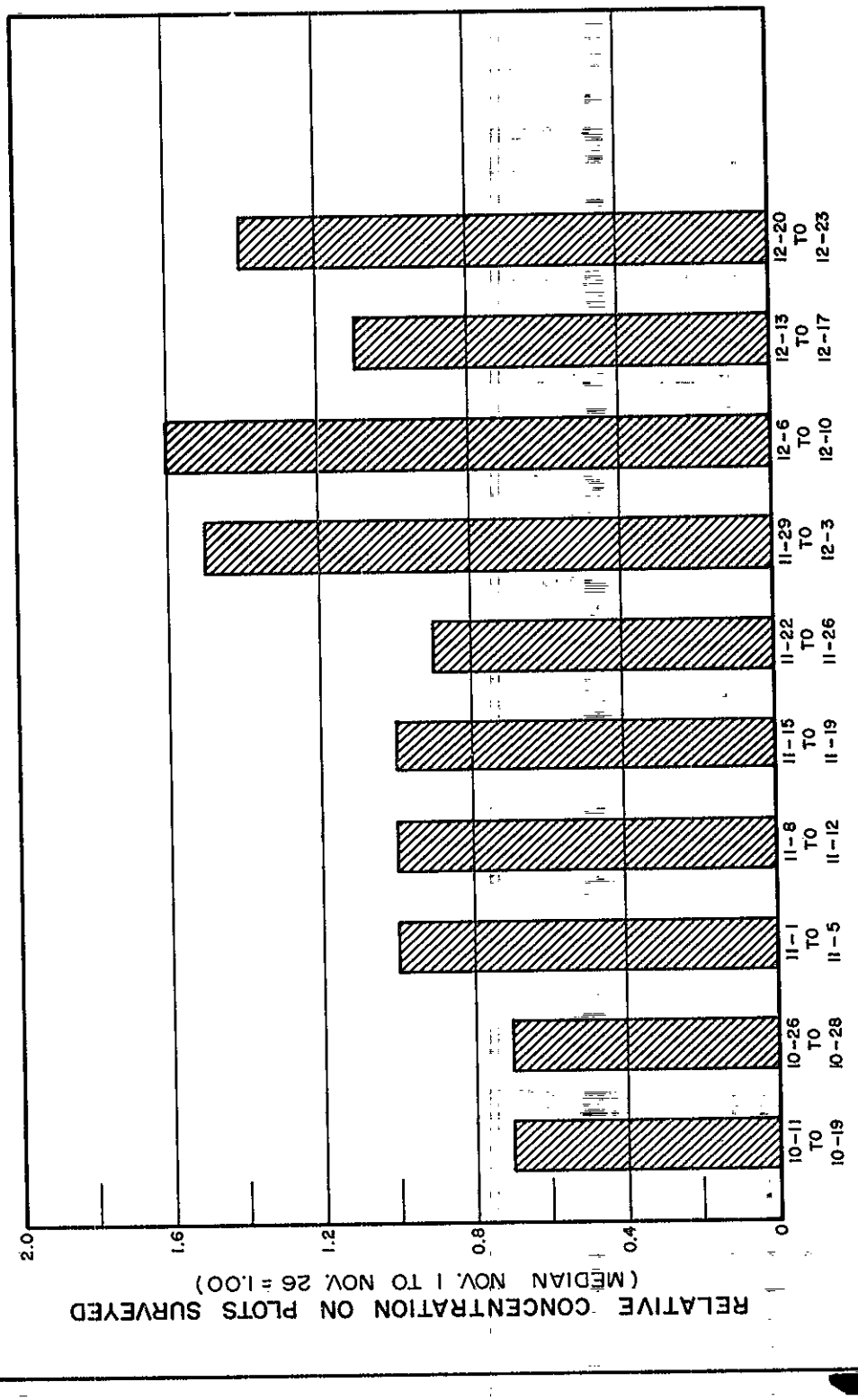


FIGURE — 6
CONCENTRATIONS OF PARTICLES ON 200-W CONTROL PLOTS



AEC-GE RICHLAND, WN.

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER AND RELATED WATERS

By

J. K. Soldat

Radioactive contamination in the Columbia River and related waters resulting from the discharge of reactor effluent water at HAPO was determined by analyzing 1600 samples of liquid and solid material. Sampling frequencies varied from daily to weekly at locations between the reactor areas and McNary Dam; monthly samples were collected from the Columbia River between McNary Dam and Portland. Liquid sample volumes were 500 ml from locations above McNary Dam and 1 gallon from locations below the dam. These samples were analyzed for beta and alpha particle emitters, and, in isolated cases, specific analyses for uranium were performed. No corrections were applied for the activity density of naturally occurring emitters present in the waters upstream of the HAPO environs.

Results obtained from analyzing samples of the Columbia River water in the immediate environs of HAPO for gross beta particle emitters are summarized in Table I.

TABLE I

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RIVER WATER
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-8} μc/ml

Location	Oct. Avg.	Nov. Avg.	Dec. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch	<5	<5	<5	<5	9	<5
181-B Area	8	16	<5	9	7	52
181-C Area	9	<5	6	7	<5	24
Allard Station	13	5	7	8	74	23
181-D Area	840	800	540	710	170	1800
181-H Area	1100	850	630	820	260	2200
Below 100-H Area	930	1900	1100	1300	330	3100
181-F Area	1600	1400	1300	1400	460	3200
Below 100-F Area	950	1900	1200	1400	360	3100
Hanford South Bank	1500	2100	2100	2000	510	3800
Hanford Middle	820	1300	1300	1200	420	3000
Hanford North Bank	730	630	770	720	180	1300
300 Area	610	910	480	670	280	1300
Byers Landing	--	440	73	260	300	440
Richland	400	720	400	510	140	800
Kennewick Highlands Pumping Station	260	330	300	290	140	390
Pasco Bridge (Kenn. Side)	220	230	390	290	97	1400
Pasco Bridge (Pasco Side)	220	270	280	260	130	460
Pasco Pumping Plant	300	350	250	300	110	530
Sacajawea Park	200	140	150	160	74	330
McNary Pool	46	55	64	55	32	84
McNary Dam	56	46	64	54	27	130
Paterson	33	44	29	36	20	62
Snake River at Mouth	22	25	8	18	31	56
Yakima River at Mouth	<5	<5	16	6	<5	43
Yakima River - Horn	<5	7	<5	<5	<5	12
Yakima River at Prosser	6	<5	<5	<5	<5	22
3000 Area Pont Inlet	<5	--	<5	<5	<5	<5

Seasonal decreases in the flow rate of the Columbia River and increases in the concentration of beta particle emitters in the reactor effluent at all but two reactors, (Section IV), resulted in two to four-fold increases in the activity density of beta particle emitters in the Columbia River between the reactor areas and McNary Dam. Average and maximum river flow rates for this quarter were 6.0×10^6 and 7.5×10^5 gps respectively, compared to values of 1.8×10^6 and 3.0×10^6 gps during the previous quarter; minimum flow during this quarter was 4.9×10^5 gps on December 15, 1954. Figure 7 illustrates the river flow rates for the period July to December, 1954.

Special river studies aimed at evaluating the effect of McNary Dam pool on contamination in the Columbia River and at establishing background data for evaluating the effects of the operation of additional reactors at HAPO, were expanded this quarter to include 800 measurements of surface velocity, 800 surface water samples for measurement of beta particle emitter concentration and temperature measurements and soundings at twenty selected locations between the reactor areas and McNary Dam. Results of measurements on the samples collected each month from the cross section at McNary Dam will be used to record values of beta particle emitter activity density at McNary pool in place of data formerly obtained by analyzing samples collected by Biology Section personnel.

All monthly samples collected from two locations in the Columbia River between McNary Dam and Portland, Oregon, showed detectable quantities of beta particle emitters. The activity density of these emitters ranged from 1.0×10^{-8} to 1.6×10^{-7} μc/ml during the quarter with the maximum results each month occurring in the Maryhill-Arlington region. These results were consistent with those obtained in previous periods for this section of the Columbia River.

The activity density of alpha particle emitters averaged near the detection limit of 5×10^{-9} μc/ml at all locations given in Table I except near 300 Area. Average and maximum results for the 300 Area location were 3.0×10^{-8} and 1.3×10^{-7} μc/ml this quarter, figures which are consistent with previous measurements from this location. Occasional significant alpha particle emitter concentrations were observed this quarter at other locations between the reactor areas and Richland. The highest alpha particle emitter activity density measured, other than at the 300 Area location, was 6.9×10^{-8} μc/ml at Wills Ranch, upstream of the reactor areas.

Twenty-six samples of Columbia River water were collected from the south bank at Hanford for I^{131} activity density measurements. The I^{131} results from the discharge of animal wastes to the river from the Biology Farm at 100-F Area as well as from the discharge of reactor effluent water into the river. The samples averaged 1.5×10^{-7} μc of I^{131} per ml of river water, including a maximum of 2.9×10^{-7} μc/ml. The average value was one-half that during the period of similar river flow rates during the fourth quarter of 1953.

Samples of the river mud at the shoreline and five feet out from the shore were collected at several locations between the reactor areas and Paterson, Washington, to determine the magnitude of the deposition of radioactive materials from the Columbia River. Samples were collected from above the reactor areas and from the Yakima and Snake Rivers to evaluate the contributions from naturally occurring emitters. The results of the analysis of these samples for beta particle emitters are summarized in Table II.

[redacted]

TABLE II

CONCENTRATIONS OF BETA PARTICLE EMITTERS
IN RIVER MUD SAMPLES
OCTOBER, NOVEMBER, DECEMBER
1954

Units of 10^{-5} μc/g

Location	Oct. Avg.	Nov. Avg.	Dec. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch						
Shore	2.7	4.4	3.4	3.3	2.9	5.8
5' Out	3.3	3.7	1.8	2.7	3.9	4.3
Allard Station						
Shore	3.0	1.7	2.2	2.4	4.5	3.4
5' Out	2.8	3.4	2.3	2.7	3.1	4.4
100-H Area						
Shore	7.1	15	8.0	9.5	9.6	24
5' Out	7.1	13	14	11	9.7	22
Below 100-F						
Shore	13	20	9.1	13	7.1	36
5' Out	20	9.8	10	13	7.9	29
Hanford Ferry						
Shore	8.9	10	4.7	7.5	4.5	13
5' Out	11	16	4.1	9.7	6.2	33
300 Area						
Shore	7.5	6.5	12	9.5	7.6	28
5' Out	10	8.0	18	13	4.8	33
Byers Landing Pumping Plant						
Shore	--	11	5.8	8.2	5.0	11
Richland Dock						
Shore	4.7	7.6	8.8	7.2	4.6	12
5' Out	9.9	54	9.4	19	4.7	94
Kennewick Highlands Pumping Plant						
Shore	3.6	3.3	3.5	3.4	3.6	4.5
5' Out	5.2	3.3	6.0	4.8	2.9	10
P. K. Bridge (Kenn. Side)						
Shore	4.0	2.4	5.7	4.4	3.1	9.8
5' Out	4.6	5.7	5.3	5.2	3.6	8.1
Sacajawea Park						
5' Out	5.0	4.6	3.8	4.5	3.4	7.3

TABLE II (contd.)

Location	Oct. Avg.	Nov. Avg.	Dec. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
McNary Cold Springs - South Shore	4.6	9.8	7.3	7.3	9.8	9.8
McNary Cold Springs - Middle	14	7.1	10	11	11	14
McNary Cold Springs - North Shore	5.6	6.8	12	8.2	17	12
McNary Dam 5' Out	5.2	2.6	3.0	3.5	2.0	9.5
Paterson Shore	4.2	2.2	4.2	3.5	2.8	5.8
Snake River Mouth 5' Out	3.8	2.6	2.4	2.9	2.6	7.4
Yakima River Horn Shore	1.8	1.8	2.3	1.9	2.0	3.2
5' Out	2.2	2.0	3.6	2.6	2.4	8.4
Yakima River Prosser 5' Out	1.7	2.0	2.0	1.9	1.8	3.3

Samples collected at locations between 100-H and Richland showed significantly higher concentrations of beta particle emitters than those collected from Wills Ranch and the Yakima and Snake Rivers. One unusually high measurement of 9.4×10^{-4} μc/g was observed 5 feet out from the Richland Dock during November, resulting in the highest monthly average for any location listed in Table II for 1954. Outside of this one sample, there were only small seasonal increases in the activity density of these emitters between 100-H Area and McNary Dam, and no significant changes in the natural emitter activity density measured at Wills Ranch and the Snake and Yakima Rivers.

Analysis of the solid samples collected from locations listed in Table II for alpha particle emitters revealed three locations where the activity density occasionally exceeded the detection limit of 3×10^{-6} μc/g. The alpha particle emitter activity density below the 300 Area averaged 3.7×10^{-6} μc/g during December including a maximum of 7.3×10^{-6} μc/g;

the averages for October and November and for the quarter were less than 3×10^{-6} μc/g. All samples collected from the Richland location were below the detection limit except one which was collected 5 feet out from shore and had an activity density of 3.3×10^{-6} μc/g. One sample with an activity density of 4.2×10^{-6} μc/g was obtained in December from the shoreline at the Yakima River horn; the monthly and quarterly averages for this location were all less than 3×10^{-6} μc/g. The detection of alpha particle emitter activity at these three locations does not represent a significant departure from past results, as occasional detectable concentrations have been observed at these and other locations in the past.

Approximately 100 samples of raw water were collected from the 183 and 283 Buildings in the reactor and separation areas. These samples represent river water prior to chlorination, filtration, and use as sanitary water. The results of the analysis of these samples for gross beta particle emitter activity density are summarized in Table III.

TABLE III

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RAW WATER

RIVER EXPORT LINE

OCTOBER, NOVEMBER, DECEMBER

1954

Units of 10^{-8} μc/ml

Location	Oct. Avg.	Nov. Avg.	Dec. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
183 Bldg., 100-B Area	<5	<5	5	<5	<5	14
183 Bldg., 100-C Area	<5	26	<5	10	<5	81
183 Bldg., 100-D Area	120	160	110	130	29	360
183 Bldg., 100-DR Area	130	120	160	140	30	240
183 Bldg., 100-F Area	200	190	140	180	64	280
183 Bldg., 100-H Area	190	190	140	180	46	360
283 Bldg., 200 East Area	130	57	63	86	6	360
283 Bldg., 200 West Area	100	170	69	120	10	240

[redacted]

Increases in the activity density of beta particle emitters in raw water are expected during this period of the year when the river flow rate is at its lowest value, resulting in the lowest dilutions of upstream reactor effluent. Small increases over similar measurements made during the fourth quarter of 1953 (HW-30744) are not unusual when increases in power levels at all reactors since that period are taken into consideration.

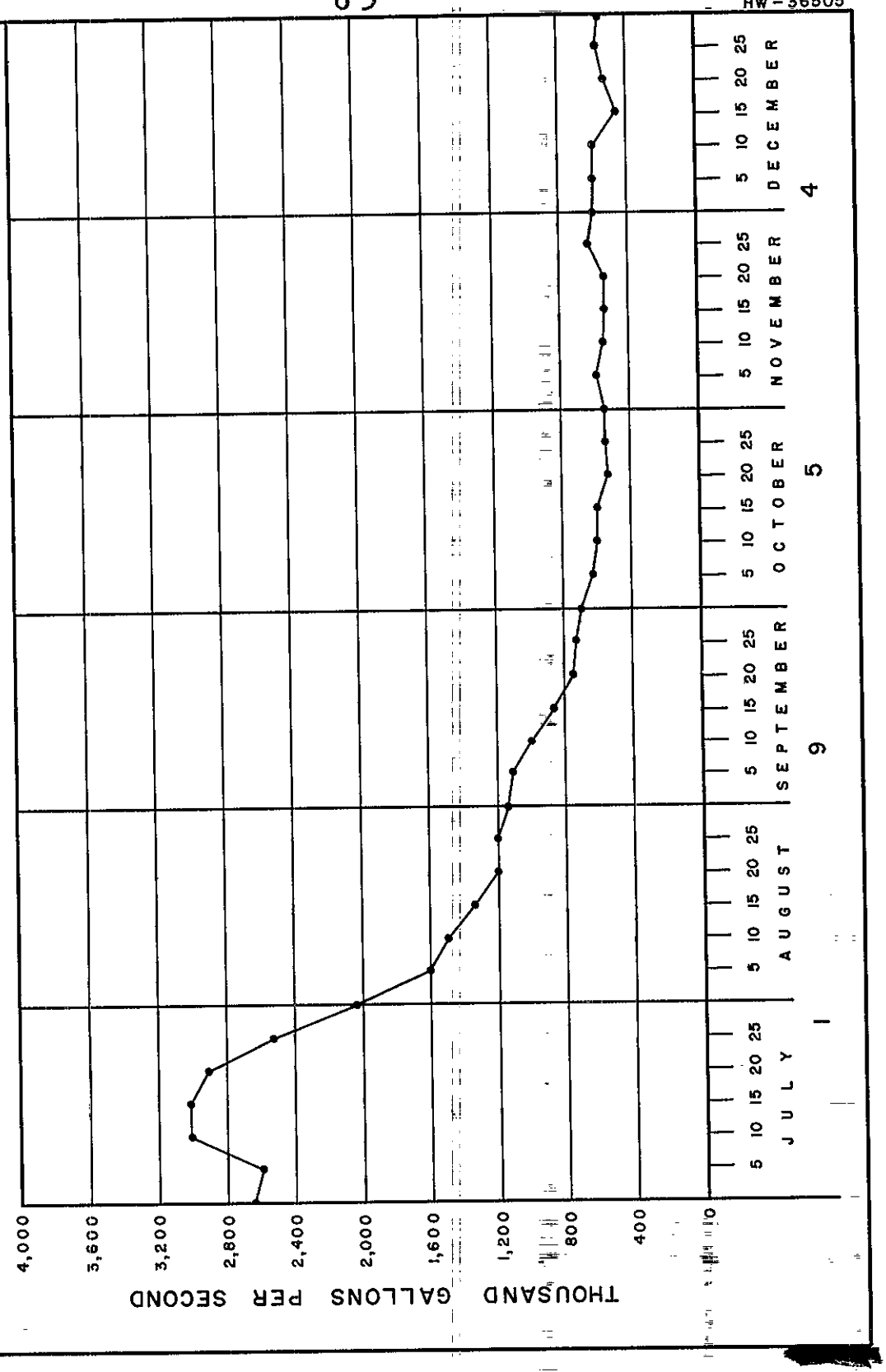
Analysis of raw water samples for alpha particle emitters revealed that the activity density averaged less than 5×10^{-9} μc/ml in all cases. One or two samples above this detection limit were obtained from each of the 183-D, 283-E, and 283-W locations. The maximum measurement was 9.1×10^{-9} μc/ml at 283-W during October. These later values do not represent any significant changes over previous measurements.

[redacted]

FIGURE — 7

COLUMBIA RIVER FLOW

OCTOBER — NOVEMBER — DECEMBER



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SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

By

D. L. Reid

A total of 140 rain samples was collected from 25 locations in the HAPO environs and analyzed for the gross beta particle emitter activity density. Approximately fifty per cent of the samples were collected during November when approximately fifty per cent of the precipitation occurred. Table I summarizes the precipitation measurements made by Synoptic Meteorology personnel at the Meteorology Tower near 200 West Area; measurements for the three previous years are included for comparison.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS
OCTOBER, NOVEMBER, DECEMBER
1954

Units - Inches

Year	October	November	December	Quarterly Total
1951	0.71	0.82	0.70	2.23
1952	0.04	0.20	0.77	1.01
1953	0.20	0.96	0.49	1.65
1954	0.42	0.86	0.35	1.63

The results obtained from radiochemical analysis of the rain samples are given in Table II.

[redacted]

TABLE II

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RAIN

OCTOBER, NOVEMBER, DECEMBER

1954

Location	Number Samples	Units of 10^{-6} µc/ml Maximum	Average
In 200 East Area	16	5	<1
250' E of stack	6	5	1
2000' E of stack	4	<1	<1
3500' SE of stack	6	1	<1
In 200 West Area	28	32	5
1000' E of stack	5	5	2
7000' E of stack	6	4	2
8000' SE of stack	5	3	2
4900' SE of Stack	6	4	2
Redox Area	6	32	17
100 Area Environs	33	3	<1
100-B SE	6	<1	<1
100-D SW	6	3	<1
100-F SW	5	1	<1
Hanford 614	6	2	<1
White Bluffs	5	1	<1
100-H Area SE	5	2	<1
Perimeter Locations	26	5	<1
700 Area 614	6	2	<1
Pasco H and R	3	1	<1
Benton City	6	5	1
Riverland	4	<1	<1
300 Area North	7	<1	<1
Intermediate Locations	37	8	<1
Route 4S, Mile 6	4	<1	<1
300 Area 614	3	<1	<1
200 North Area 614	5	2	<1
Gable Mountain	5	1	<1
Batch Plant	1	<1	<1
622 Building	19	8	<1

[redacted]

The average activity density of beta particle emitters in rainfall was below the detection limit of 1×10^{-6} μc/ml for most of the stations except those located in the 200 West Area. The maximum concentration of 3.2×10^{-5} μc/ml obtained at the Redox station was approximately 1.5 times that obtained during the previous quarter with no significant increase in the average concentration over the previous quarter.

[redacted]

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

By

Z. E. Carey

Nearly 900 samples were collected from sources of drinking water in the HAPO environs during the quarter and 60 additional samples were collected from test wells to determine any contamination in the water table underlying the project. Most samples were of 500 ml volume although 11.7 liter samples were collected from those sources where greater sensitivity was needed. Special samples were collected from various stages of the purification system at the Pasco Water Plant to supplement measurements made on drinking water at that location.

Table I summarizes the results of measurements made at all locations where the activity density of alpha particle emitters in drinking water averaged greater than the detection limit of 5×10^{-9} μc/ml during the quarter.

TABLE I

CONCENTRATIONS OF ALPHA PARTICLE EMITTERS IN DRINKING WATER
OCTOBER, NOVEMBER, DECEMBER
1954

500 ml samples

Location	Uranium and Plutonium			Uranium		
	No. Samples	Units of 10^{-9} µc/ml Max.	Avg.	No. Samples	Units of 10^{-9} µc/ml Max.	Avg.
Richland Well #4	39	28	6	37	4	3
Richland Well #12	9	10	6	9	7	7
3000 Area Well #F	9	18	6	9	2	<2
Sacajawea Park	12	9	6	12	7	6
Paterson	3	8	5	10	9	6
Benton City Water Co. Well	13	16	12	13	15	11
Benton City Store	13	18	12	13	13	9

Similar concentrations have been observed at the Richland and Benton City sources and at Sacajawea Park during previous quarters. While the values reported for the water collected at 3000 Area Well #F and Paterson do represent increases, they are considerably below the maximum permissible concentrations of any isotope of concern. (10)

Table II summarizes the results of radiochemical analysis of 500 ml samples of drinking water collected in the immediate HAPO environs. While individual samples at many of these locations do show concentrations above the limits of detection for alpha particle emitters, these concentrations were generally not confirmed by resampling.

TABLE II

CONCENTRATIONS OF ALPHA AND BETA PARTICLE EMITTERS IN WATER SUPPLIES OCTOBER, NOVEMBER, DECEMBER 1954

500 ml samples

Location	No. Samples	Uranium and Plutonium Units of 10^{-9} µc/ml Max.	Uranium and Plutonium Units of 10^{-9} µc/ml Avg.	Beta Particle Emitters Units of 10^{-8} µc/ml Max.	Beta Particle Emitters Units of 10^{-8} µc/ml Avg.
Richland Well #2	9	5	<5	23	6
Richland Well #4	39	28	6	24	<5
Richland Well #5	8	<5	<5	19	7
Richland Well #12	9	10	6	28	<5
Richland Well #13	9	5	<5	11	4
Richland Well #14	9	10	<5	<5	<5
Richland Well #15	5	8	<5	<5	<5
Richland Well #18	11	10	<5	13	<5
Tract House J-685	11	<5	<5	<5	<5
3000 Area Well "A"	12	10	<5	<5	<5
3000 Area Well "B"	3	<5	<5	<5	<5
3000 Area Well "C"	13	7	<5	290	38
3000 Area Well "D"	0				
3000 Area Well "E"	7	16	<5	<5	<5
3000 Area Well "F"	9	18	6	<5	<5
3000 Area Well "H"	10	10	<5	11	<5
3000 Area Well "J"	11	10	<5	11	<5
3000 Area Well "K"	6	10	<5	6	<5
3000 Area Well "L"	4	16	<5	6	<5
Durand Well #5	11	6	<5	7	<5
Columbia Field Well "A"	14	14	<5	17	<5
Columbia Field Well "B"	12	12	<5	250	22
Columbia Field Well "C"	13	15	<5	<5	<5
Headgate Well	13	<5	<5	<5	<5
1100 Area Well #8	19	10	<5	8	<5
Midway	9	5	<5	140	20
Riverland	7	<5	<5	10	<5
Lower Knob	13	<5	<5	16	<5
Wills Ranch	13	<5	<5	11	<5
Pistol Range	12	6	<5	45	10
White Bluffs Fire Hall	13	6	<5	170	82
White Bluffs Telephone Exchange	11	9	<5	68	15

TABLE II (contd.)

500 ml samples

Location	No. Samples	Uranium and Plutonium Units of 10^{-9} µc/ml Max.	Uranium and Plutonium Units of 10^{-9} µc/ml Avg.	Beta Particle Emitters Units of 10^{-8} µc/ml Max.	Beta Particle Emitters Units of 10^{-8} µc/ml Avg.
Benton City Water Co. Well	13	16	12	7	<5
Benton City Store	13	18	12	27	5
Kiona	13	6	<5	8	<5
Enterprise	13	<5	<5	28	<5
Kennewick Standard Station	13	8	<5	68	26
McGee Well	13	10	<5	43	10
Ford Well	13	9	<5	17	<5
Meeker Well	13	7	<5	78	12
100-B (San)	12	<5	<5	24	<5
100-C (San)	12	<5	<5	6	<5
100-D (San)	12	<5	<5	75	40
100-DR (San)	12	<5	<5	77	37
100-H (San)	14	6	<5	88	46
100-F (San)	14	6	<5	240	87
100-K Well #1 (San)	12	<5	<5	26	<5
200 East (San)	12	<5	<5	190	44
200 West (San)	12	<5	<5	270	68
300 Area (San)	13	<5	<5	13	<5
251 Building (San)	13	<5	<5	110	17
Redox Ad. Bldg. (San)	11	<5	<5	59	40
Sacajawea Park (San)	12	9	6	<5	<5
McNary Dam (San)	11	<5	<5	9	<5
Paterson (San)	3	8	5	17	8
Plymouth (San)	11	<5	<5	8	<5
Prosser (San)	11	<5	<5	54	7
Byers Landing Pump Plant	2	<5	<5	<5	<5
Kennewick Reservoir	11	<5	<5	53	23
Pasco Improvement Farm	2	<5	<5	6	<5
Pasco H and R Depot	13	5	<5	28	16

A noticeable increase in maximum concentrations of beta particle emitters was recorded at many of the locations during the quarter. Many of these unusual values were not confirmed by resampling and the average concentrations at such locations show nothing unusual. However, average concentrations of beta particle emitters did increase significantly in sanitary supplies of the downstream 100 Areas and in the supplies at White Bluffs which originate from the same source. These water supplies all consist of purified river water and the lower flow of the Columbia River during this period of the year results in higher concentrations of these emitters in river water through decreased dilution of upstream reactor effluent water.

Approximately two hundred 11.7 liter samples of water were analyzed for alpha particle emitters to obtain the greater sensitvity of measurement afforded by the larger sample. Results of these analyses are given in Table III. The only significant deviation from past values occurred in those measurements at Headgate where one measurement of 82×10^{-10} μc/ml on October 11 was not confirmed by resampling.

TABLE III

CONCENTRATIONS OF ALPHA PARTICLE EMITTERS IN DRINKING WATER OCTOBER, NOVEMBER, DECEMBER 1954

11.7 liters sample

Location	No. Samples	Units of 10^{-10} µc/ml Maximum	Average
Richland Well #2	3	21	13
Richland Well #4	4	31	25
Richland Well #5	4	37	24
Richland Well #12	4	66	45
Richland Well #13	3	27	20
Richland Well #14	5	25	18
Richland Well #18	3	20	17
Tract House J-685	7	27	14
Columbia Field Well "A"	7	33	17
Columbia Field Well "B"	7	15	12
Columbia Field Well "C"	7	29	17
1100 Area Well #8	7	25	22
3000 Area Well "A"	7	12	11
3000 Area Well "B"	1	20	20
3000 Area Well "C"	6	17	14
3000 Area Well "D"	0		
3000 Area Well "E"	1	10	10
3000 Area Well "F"	4	11	8
3000 Area Well "H"	5	11	10
3000 Area Well "K"	5	15	9
3000 Area Well "L"	3	22	18
3000 Area Well "J"	5	18	13
3000 Area Durand #5	5	18	14
Benton City Store	6	150	80
Benton City Water Co. Well	6	130	73
Kiona	6	14	9
Enterprise Well	6	11	8
Headgate Well	6	82	20
Kennewick Reservoir	4	8	6
Kennewick Standard Station	6	12	8
Riverland	2	5	5
Midway	5	52	15
Lower Knob	7	47	8

TABLE III (contd.)

11.7 liter samples

Location	No. Samples	Units of 10^{-10} µc/ml Maximum	Average
Wills Ranch	5	6	4
McGee Well	6	55	11
Ford Well	6	3	<2
Meeker Well	5	2	<2
White Bluffs Fire Hall	7	8	4
Pistol Range	6	26	18
B-Y Well	7	29	22
251 Bldg. (San)	6	6	4
Clover Island Pump Station	5	18	10
3000 Area Pond Inlet	1	9	9

Table IV summarizes the results of measurements made at the Pasco Filter Plant.

TABLE IV

CONCENTRATIONS OF BETA PARTICLE EMITTERS AT THE PASCO FILTER PLANT OCTOBER, NOVEMBER, DECEMBER 1954

Type Sample	No. Samples	Maximum	Average
Water Entering Plant from River	12	5.3×10^{-6} µc/ml	3.0×10^{-6} µc/ml
Sand (Surface of Sand Filter)	10	3.1×10^{-4} µc/gm	1.8×10^{-4} µc/gm
First Backwash Material (liquid)	8	1.2×10^{-6} µc/ml	4.7×10^{-7} µc/ml
First Backwash Material (solid)	5	3.0×10^{-2} µc/gm	1.9×10^{-2} µc/gm
Coal (Surface of Coal Filter)	9	3.4×10^{-4} µc/gm	2.0×10^{-4} µc/gm
First Backwash Material (liquid)	10	6.5×10^{-7} µc/ml	4.0×10^{-7} µc/ml
First Backwash Material (solid)	8	5.6×10^{-2} µc/gm	2.8×10^{-2} µc/gm
Water Leaving Plant	13	8.0×10^{-7} µc/ml	4.3×10^{-7} µc/ml

The concentrations of beta particle emitters in the water entering the plant increased by a factor of over 2 from the previous quarter due to the lower flow of the Columbia River during this season causing decreased dilution of reactor effluent water entering the river upstream. However, the water leaving the plant averaged about the same as the previous quarter reflecting an increase in efficiency of the filtration plant. The average filter plant efficiency during this quarter was comparable to that observed in the first two quarters of 1954 but reflects a significant increase over that of the previous quarter when efficiency was the lowest in over a year. The concentration in the water leaving the plant was less than one per cent of a calculated maximum permissible concentration using Handbook 52 values for isotopes in the radioactive material arising from reactor effluent water entering the river.(10, 11)

A summary of the results of measurements made on the test wells is given in Table V.

TABLE V

CONCENTRATIONS OF ALPHA AND BETA PARTICLE EMITTERS IN TEST WELLS

OCTOBER, NOVEMBER, DECEMBER

1954

500 ml samples

Location	No. Samples	Uranium and Plutonium Units of 10^{-9} µc/ml Maximum	Uranium and Plutonium Units of 10^{-9} µc/ml Average	Beta Particle Emitters Units of 10^{-8} µc/ml Maximum	Beta Particle Emitters Units of 10^{-8} µc/ml Average
300 Area Well #1	6	.11	6	<5	<5
300 Area Well North	2	840	800	<5	<5
B-Y Well	13	6	<5	49	5
32-77	1	<5	<5	26	26
36.5-60.5	1	<5	<5	370	370
39-79	1	<5	<5	25	25
50-30	1	7	7	19	19
70-68	1	<5	<5	11	11
303-1	12	580	270	13	7
303-2	12	780	230	8	<5
303-4	12	930	270	54	8
303-6	12	1000	570	170	32
303-7	2	150	130	<5	<5
303-9	3	88	54	19	8
303-10	2	270	250	<5	<5
303-11	3	81	36	12	5
303-12	3	230	130	<5	<5
3000-7	2	24	18	24	13

Measurements of beta particle emitters were unusually high in one sample collected from each of wells 36.5-60.5, 39-79, 50-30, 71-52, 70-68, 303-11 and 3000-7. The exact cause of these high measurements was not determined but later measurements have shown concentrations on the order of past values.

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