BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS

FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1954

April 20, 1955

GENERAL ELECTRIC
HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1954

By

G. E. Pilcher, J. K. Soldat and Z. E. Carey

April 20, 1955

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Operated for the Atomic Energy Commission by the
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ABSTRACT

SECTION I: RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

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Combined emission rates of I^{131} from the two separation facilities averaged 1.4 curies per day; maximum emission was 12 curies per day on August 27 from the S-Plant stack. Average ruthenium emission from S-Plant was 0.23 curie per day, with a maximum of 1.9 curie per day on July 19. Combined average tritium oxide emission from the 6 reactor area stacks was 0.8 curie per day with the maximum daily emission of 0.84 curie occurring at 105-D on July 9. Average activity density of S^{35} in 105-F effluent gas decreased this quarter from the previous quarter's average of 1.5×10^{-2} curie per day to the more nearly normal value of 3.5×10^{-3} curie per day. General decreases in the activity density of gross alpha and gross beta particle emitters and in the numbers of radioactive particles were noted at the reactor area stacks during the quarter.

SECTION II: RADIOACTIVE CONTAMINATION IN VEGETATION

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The concentrations of iodine on vegetation were reduced at nearly all sampling locations with the activity density of only seven out of over 2300 samples exceeding 1×10^{-5} μc/g, the maximum concentration acceptable at Hanford. Average concentrations of non-volatile beta particle emitters on vegetation were lower in most cases than during the previous quarter, reflecting a decreasing trend from the high concentrations observed during the first two months of last quarter. Maximum and average concentrations were significantly higher in on-site vegetation samples than on off-site vegetation possibly from the same source as that causing high contamination of ground surfaces on the project. There was a general decrease in concentrations of alpha particle emitters on vegetation.

SECTION III: RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

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Dose rates measured by Victoreen Integrons remained at values from 1.0 to 4.1 mrad/day at 200 West Area and Redox. Increases to 1.1 and 2.0 mrad/day were noted at 100-F and 100-H Area; all other location measurements remained less than 0.8 mrad/day. A significant decrease in dose rates at locations within a radius of 5 miles from the separation areas was measured by detachable ionization chambers. Maximum values were obtained at the perimeter of Redox where the average dose rate was 12 mrad/day during the quarter. General decreases were measured in the

[redacted]

activity density of filterable beta particle emitters in the atmosphere; concentrations averaged between 1.9×10^{-13} μc/ml and 5.2×10^{-13} μc/ml at all sampling locations including those on-site and in residential areas. A continuation of higher than normal radioactive particle concentrations in air were noted at nearly all locations both near the separation areas and at remote locations. The average concentrations measured on the project did not exceed 0.22 ptle/m^3; the average concentrations measured at locations off-site ranged from 0.02 to 0.15 ptle/m^3. Airborne I^{131} concentrations averaged less than 1×10^{-13} μc/ml in residential areas and less than 5×10^{-13} μc/ml at all locations near manufacturing areas. No significant changes were noted in the average activity density of alpha particle emitters in the atmosphere during the quarter.

SECTION IV: RADIOACTIVE CONTAMINATION IN HANFORD WASTES

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The activity of beta particle emitters in effluent water discharged to the Columbia River from reactor coolant water retention basins averaged between 12,000 μc/sec and 20,000 μc/sec from each area, a significant decrease from the preceding period. Trace quantities of alpha particle emitters, plutonium, and polonium continued to be found in individual samples from the retention basins in each area. I^{131} discharged to the river from the Animal Farm averaged 27 μc/day. Large fluctuations noted in contamination measured in 200 Area and 300 Area waste sources were consistent with previous observations; a single significant change was noted in an increase by a factor of 10 in the concentration of beta particle emitters in U swamp liquid samples. Generally high ground contamination in the 200 W Area was found to consist of radioactive particles with maximum dimensions ranging from a few microns to on the order of 1000 microns. The radioactive material present was nearly all ruthenium-rhodium isotopes with dose rates from individual particles being as high as 10 to 20 rad per hour. Ground contamination similar in nature but of lesser magnitude was noted throughout the project and local environs.

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

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Decreased total activity discharged to the Columbia River in reactor effluent water and increased average flow rate of the river caused decreased activity density of beta particle emitters at nearly all locations. Maximum measurements were found in the Hanford areas where individual samples showed values of 1.2×10^{-5} μc/ml and 1.4×10^{-5} μc/ml and average values were on the order of 5×10^{-6} μc/ml. Trace concentrations

of beta particle emitters measured between McNary Dam and Portland, Oregon, ranged from 3.4×10^{-8} μc/ml to 1.4×10^{-7} μc/ml. Alpha particle emitters in river water averaged less than 5×10^{-9} μc/ml at all locations. I^{131} in the Columbia River at Hanford averaged 1.3×10^{-7} μc/ml. No significant changes were noted in radioactive contamination measured in mud samples. Decreases were measured in the activity density of beta particle emitters in raw water associated with the average increased flow of the river; maximum concentrations of 1.7×10^{-6} μc/ml were measured in samples from 100-F Area.

SECTION VI: RADIOACTIVE CONTAMINATION IN RAIN

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The activity density of beta particle emitters in rain decreased significantly at all sampling locations. Concentrations were highest in the vicinity of the Redox Plant where an average concentration of 1.6×10^{-5} μc/ml included a maximum of 2×10^{-5} μc/ml. Concentrations at all other locations were in the range <1 to 7×10^{-6} μc/ml.

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

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Average concentrations of alpha particle emitters exceeded 5×10^{-9} μc/ml at three Richland wells, two Benton City wells, and at Sacajawea Park, with all averages less than 3×10^{-8} μc/ml. Trace uranium was detected in all of these wells. Concentrations of beta particle emitters in 100 Area sanitary water decreased significantly during the quarter. Average concentrations of beta particle emitters in Kennewick and Pasco sanitary water were 1.7×10^{-7} and 5.8×10^{-7} μc/ml respectively.

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INTRODUCTION

This publication summarizes the results obtained from monitoring the Hanford environs for radioactive contamination during the period July, August, and September 1954. Samples were collected by Regional Survey forces according to procedures previously outlined in documents of this series (HW-30174, HW-31818 and HW-29514). These samples were analyzed by the Control Laboratory of the Control Unit according to procedures and techniques described in HW-20136. Counting rates obtained from these analyses were corrected for geometry, back-scatter, air-window absorption, source size, self-absorption, chemical yield, and collection efficiency by the Control Services group using factors shown in HW-22682, HW-23769, HW-27854, and HW-30492. 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 results obtained from the described efforts are presented in Sections I through VII which discuss the amounts of active material discharged from plant facilities and its effect on the contamination of vegetation, air, soil and water.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

Samples of the effluent gases from the separation and reactor area stacks were collected at frequencies ranging from daily to weekly. Samples of the separation plant stack effluents were collected daily on filters and in scrubbers and these were analyzed for I^{131} and ruthenium. Samples collected from the reactor area stack effluents were analyzed for C^{14}, S^{35}, tritium oxide, and gross alpha and beta particle emitters. The results obtained from these samples follow.

SEPARATION AREAS

200 EAST AREA SEMI-WORKS

Results from periodic measurements of the activity density of gross beta particle emitters in the effluent gases from the Semi-Works Plant stacks are summarized in Table I.

TABLE I

SUMMARY OF RESULTS FROM STACK MONITORING
SEMI-WORKS STACK
JULY, AUGUST, SEPTEMBER
1954

Month	Curie of Gross Beta Particle Emitters Emitted Daily	
	Maximum	Average
July	$<2.0 \times 10^{-5}$	$<1.2 \times 10^{-5}$
August	8.3×10^{-7}	8.3×10^{-7}
September	---	---
Quarter	$<2.0 \times 10^{-5}$	$<7.6 \times 10^{-6}$
Last Quarter	3.2×10^{-5}	5.4×10^{-6}

The Semi-Works facility was still shut down during this quarter and no significant difference was noted between the measurements made during this and the previous quarter when the plant was also shut down.

200 WEST AREA T-PLANT

A summary of the results obtained from monitoring for I^{131} at the 50-foot level of the T-Plant stack is given in Table II.

TABLE II

SUMMARY OF RESULTS FROM I^{131} MONITORING

T-PLANT STACK

JULY, AUGUST, SEPTEMBER

1954

Month	Curies of I^{131} Emitted Daily	
	Maximum	Average
July	4.4	0.44
August	1.5	0.31
September	9.7	0.78
Quarter	9.7	0.49
Last Quarter	2.2	0.26

The average I^{131} emission from this facility for the quarter was weighted by two isolated instances of high emission; one of 4.4 curies per day on July 12 and the other of 9.7 curies per day on September 21, 1954. Following both of these incidents, the emission rate returned to the order of 0.1 curie per day within 24 hours.

No change was noted in the cooling period of the dissolved metal. The average amount of I^{131} dissolved this quarter was 70 curies per day compared to an average of 100 curies per day during the last quarter.

200 WEST AREA S-PLANT

The results obtained from I^{131} monitoring of the twenty-foot level of the S Plant stack are summarized in Table III.

TABLE III

SUMMARY OF RESULTS OF I^{131} MONITORING

S-PLANT STACK

JULY, AUGUST, SEPTEMBER

1954

Month	Curies of I^{131} Emitted Daily	
	Maximum	Average
July	0.23	0.02
August	12	1.1
September	12	1.6
Quarter	12	0.96
Last Quarter	15	1.0

A significant decrease was noted in the average and maximum I^{131} emission rates from the S-Plant facility during July, when the dissolving operations were curtailed for extensive maintenance. When dissolving was resumed, the emission rates returned to the order of magnitude noted for the previous two quarters. The fact that metal with a longer cooling period (an average of 117 days this quarter compared to 83 days last quarter) and therefore containing less I^{131}, was dissolved this quarter without any noticeable decrease in I^{131} emission rate, indicated that a higher percentage of the available I^{131} was emitted from the stack.

A summary of the results obtained from ruthenium monitoring at the fifty-foot level of the S-Plant stack is presented in Table IV.

TABLE IV

SUMMARY OF RESULTS FROM RUTHENIUM MONITORING

S-PLANT STACK

JULY, AUGUST, SEPTEMBER

1954

Month	Ruthenium Emission Units of Curies Per Day	
	Maximum	Average
July	1.9	0.36
August	1.6	0.39
September	0.50	0.06
Quarter	1.9	0.23
Last Quarter	5.3	0.69

A slight decrease of doubtful significance was noted in the average ruthenium emission rate during the first two months of the quarter, while a significant decrease was noted during the third month. These decreases were partly attributed to the equipment changes made during June and July to route off-gases from the ruthenium processing vessels through the sand filter.

Radiation Monitoring Sub-Section at S-Plant assumed the responsibility for monitoring the inlet and outlet of the S-Plant sand filter during the first week of July. Results of monitoring at these locations and those from monitoring at other exclusion area sand filters will no longer be summarized in these quarterly reports.

200 WEST AREA U-PLANT

Table V is a summary of the results obtained from monitoring for particulates at the U-Plant stack.

TABLE V

SUMMARY OF PARTICULATE MEASUREMENTS

U-PLANT STACK

JULY, AUGUST, SEPTEMBER

1954

	Curie Emitted Per Day				Radioactive Particles	
	Gross Alpha Particle Emitters		Gross Beta Particle Emitters			
	Units of 10^{-8} Curie		Units of 10^{-5} Curie		Units of 10^{4} Particles/Day*	
Month	Maximum	Average	Maximum	Average	Maximum	Average
July	21	2.4	11	2.5	25	9.3
August	4.5	1.7	28	10	--	---
September	0.73	0.32	0.41	0.042	46	23
Quarter	21	1.5	28	4.4	--	---
Last Quarter	23	0.53	45	7.3	17	3.5

*(The majority of the autoradiographs of the filters collected during August were too dark to permit accurate estimation of the number of radioactive particles.)

The average and maximum values of activity density of gross alpha and gross beta activity density are within the range of previous fluctuations and do not represent significant changes over previously reported values.

During August the majority of the autoradiographs of the filters from this location were too dense to permit accurate estimation of radioactive particle concentrations. This darkening of the films was again caused by either a finely divided material or a radioactive gas retained by the filter paper. The values for July and September indicate a probable quarterly average concentration of about 2×10^{5} particles per day, a not unusually high value.

REACTOR AREAS

Specific analyses of gas samples collected from sampling points near the stack breeching of the reactor area stacks, were performed to determine the activity density of C^{14}, S^{35}, tritium oxide and gross alpha and beta particle emitters in these effluent gases. The results of these analyses are summarized in Tables VI through XI for each reactor area.

TABLE VI

SUMMARY OF STACK MONITORING RESULTS

105-B STACK

JULY, AUGUST, SEPTEMBER

1954

Curie Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
July						
Maximum	0.21	<4.5	9.6	1.4	41	7.4
Average	0.08	<4.5	4.9	0.63	22	3.1
August						
Maximum	0.24	<4.5	<4.5	1.4	8.0	<0.76
Average	0.24	<4.5	<4.5	0.78	5.4	0.27
September						
Maximum	0.34	<4.5	<4.5	1.4	10.0	<0.49
Average	0.14	<4.5	<4.5	0.48	7.2	<0.15
Quarter						
Maximum	0.34	<4.5	9.6	1.4	41	7.4
Average	0.12	<4.5	<4.5	0.61	10	0.78
Last Quarter						
Maximum	1.0	<4.5	20	22	660	6.0
Average	0.22	<4.5	5.6	1.9	130	2.0

TABLE VII

SUMMARY OF STACK MONITORING RESULTS

105-C STACK

JULY, AUGUST, SEPTEMBER

1954

Curie Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
July						
Maximum	0.26	<4.5	<4.5	1.4	14	100
Average	0.05	<4.5	<4.5	0.78	10	49
August						
Maximum	0.03	<4.5	10	0.88	4.5	44
Average	0.02	<4.5	4.5	0.66	3.3	34
September						
Maximum	0.12	4.5	8.1	2.1	5.9	32
Average	0.04	<4.5	<4.5	0.89	3.8	28
Quarter						
Maximum	0.26	4.5	10	2.1	14	100
Average	0.04	<4.5	<4.5	0.79	5.5	36
Last Quarter						
Maximum	1.1	5.2	21	11	260	99
Average	0.10	<4.5	5.3	2.2	63	>52

TABLE VIII

SUMMARY OF STACK MONITORING RESULTS

105-D STACK

JULY, AUGUST, SEPTEMBER

1954

Curie Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day*
July						
Maximum	0.84	6.1	23	0.55	150	1.9
Average	0.62	<4.5	15	0.52	100	1.2
August						
Maximum	0.59	<4.5	23	0.65	160	1.4
Average	0.59	<4.5	9.0	0.58	72	0.7
September						
Maximum	0.67	<4.5	120	5.2	660	---
Average	0.24	<4.5	51	1.1	250	---
Quarter						
Maximum	0.84	6.1	120	5.2	660	---
Average	0.42	<4.5	25	0.84	180	---
Last Quarter						
Maximum	0.58	20	16	7.3	1200	7.3
Average	0.27	6.0	6.1	0.84	160	1.8

*The majority of the autoradiographs of the filters collected during September were too dark to permit accurate estimation of the number of radioactive particles.

TABLE IX

SUMMARY OF STACK MONITORING RESULTS

105-DR STACK

JULY, AUGUST, SEPTEMBER

1954

Curie Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
July						
Maximum	0.44	<4.5	4.6	1.1	2.2	<0.72
Average	0.13	<4.5	<4.5	0.64	1.6	0.13
August						
Maximum	0.08	6.7	38	0.71	0.44	<0.60
Average	0.05	<4.5	25	0.48	0.36	<0.09
September						
Maximum	0.17	18	23	2.5	0.42	0.38
Average	0.08	8	14	0.79	0.28	0.11
Quarter						
Maximum	0.44	18	38	2.5	2.2	<0.72
Average	0.09	<4.5	12	0.66	0.65	0.07
Last Quarter						
Maximum	0.48	8.9	32	1.1	2.0	4.4
Average	0.11	<4.5	10	0.66	0.61	0.67

TABLE X

SUMMARY OF STACK MONITORING RESULTS

105-F STACK

JULY, AUGUST, SEPTEMBER

1954

Curie Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day*
July						
Maximum	0.22	<4.5	30	36	110	71
Average	0.11	<4.5	14	0.14	63	26
August						
Maximum	0.10	<4.5	20	4.8	210	--
Average	0.10	<4.5	9.8	1.0	84	--
September						
Maximum	0.19	<4.5	160	5.4	290	--
Average	0.10	<4.5	100	2.6	160	--
Quarter						
Maximum	0.22	<4.5	160	5.4	300	--
Average	0.11	<4.5	35	1.4	110	--
Last Quarter						
Maximum	0.59	11	900	130	3000	210
Average	0.17	<4.5	150	17	250	12

*The majority of the autoradiographs of the filters collected during August and September were too dark to permit accurate estimation of the number of radioactive particles.

TABLE XI

SUMMARY OF STACK MONITORING RESULTS

105-H STACK

JULY, AUGUST, SEPTEMBER

1954

Curie Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
July						
Maximum	0.30	<4.5	16	1.6	3.4	<2.4
Average	0.08	<4.5	7.8	0.93	2.0	0.30
August						
Maximum	0.09	<4.5	<4.5	3.3	3.3	<0.51
Average	0.06	<4.5	<4.5	1.5	1.9	0.09
September						
Maximum	0.14	<4.5	6.2	5.3	3.7	<0.49
Average	0.05	<4.5	<4.5	1.6	2.0	0.21
Quarter						
Maximum	0.30	<4.5	16	5.3	3.7	<2.4
Average	0.07	<4.5	<4.5	1.4	2.0	0.18
Last Quarter						
Maximum	0.37	5.5	6.2	6.1	89	>66
Average	0.13	<4.5	<4.5	1.2	15	>14

Tritium oxide emission rates from individual reactor areas for this quarter averaged within a factor of two of those noted during the previous quarter, within the normal variation of these values. Total average emission from all 6 reactor stacks combined was 0.8 curie per day compared to 1.0 curie per day during the previous quarter; a statistically non-significant change. The maximum tritium oxide emission rate was noted at 105-D Area this quarter where several values over 0.5 curie per day were recorded throughout the quarter; the maximum value of 0.84 curie per day was obtained on July 9.

Occasional C^{14} measurements, obtained at 105-C, 105-D, and 105-DR, do not represent any significant changes over values reported for these areas in previous quarters. The average C^{14} emission rate for all of the reactor areas was below the detection limit of 4.5×10^{-3} curie per day during the present quarter.

Significant S^{35} measurements were obtained at all reactor area stacks this quarter, although the average emission rate was below the detection limit of 4.5×10^{-4} curie per day at three of the areas (105-B, 105-C, and 105-H). The maximum value measured this quarter was at 105-F where 1.6×10^{-2} curie per day was emitted on September 23, 1954. This value was one-fifth of the maximum of 9.0×10^{-2} reported last quarter, also from 105-F. An increase by a factor of four over the previous quarterly average was noted in the average emission rate of 105-D this quarter.

The only significant change in the activity density of gross alpha particle emitters during the present quarter occurred at 105-F where the average emission decreased from the high of 1.7×10^{-6} curie per day noted last quarter to the more normal value of 1.4×10^{-7} curie per day. There were slight decreases of questionable significance in the gross alpha particle emitter activity density at 105-B and 105-C Area stacks.

[redacted]

There were general decreases in the average activity density of gross beta particle emitters in the reactor area effluent gases this quarter; these decreases were accompanied by decreases in the radioactive particle concentrations.

Some autoradiographs of filters obtained from the 105-D and 105-F Areas were too dense to permit accurate estimation of the radioactive particle concentrations. However, there were decreases in the average gross beta measurements as mentioned previously and autoradiographs of filters from these two areas have been too dense to count on several occasions in the past.

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SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Nearly 2400 vegetation samples were taken and analyzed to determine the deposition of radioactive contamination in the Hanford environs. Approximately 1800 of these were collected from locations in the nearby environs and the remaining samples were obtained from remote locations in eastern Washington, southern Washington, and northern Oregon. The samples were analyzed for the activity of I^{131} and non-volatile beta particle emitters; selected samples from several locations 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, respectively.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

JULY, AUGUST, SEPTEMBER

1954

Location	I^{131} Units of 10^{-6} µc/g			Non-Volatile Beta Emitters Units of 10^{-6} µc/g		
	No. Samples	Max.	Avg.	Avg. Last Qtr.	Max.	Avg.	Avg. Last Qtr.
North of 200 Areas	199	3	<3	10	310	77	600
Near the 200 Area	187	6	<3	10	520	68	750
Route 3	11	11	3	5	170	92	4600
200 West Gate	53	10	4	30	320	73	630
Batch Plant	26	8	<3	16	760	130	3400
Meteorology Tower	13	4	<3	13	120	61	340
South of 200 Areas	330	3	<3	9	330000*	3900*	300
Richland	176	6	<3	6	140	46	200
Pasco Environs	135	4	<3	6	88	33	230
Kennewick Environs	174	5	<3	6	280	36	220
Benton City - Kiona	39	<3	<3	4	94	41	170
Richland Y	13	<3	<3	4			
Hanford	13	<3	<3	5			
200 East Area	64	6	<3	34	370	85	840
200 West Area Redox Area	45	17	4	5	2200	130	6500
Wahluke Slope	118	3	<3	23	130	52	510
Goose Egg Hill	20	5	<3	3	2200	180	150
Rattlesnake Mountain	58	4	<3	3	180	51	85
PSN-300-310-330	33	4	<3	12	70	41	350
Redox Construction	73	8	<3		1500	110	1200
Off Area Sampling							
Pasco to Ringold	38	<3	<3	20	110	44	620
Prosser to Paterson-McNary	207	3	<3	3	140	39	170
Eastern Washington	136	<3	<3	<3	100	33	39
So. Washington and No. Oregon	187	<3	<3	<3	110	28	52

* If this maximum is omitted, the average becomes 58.0 and the new maximum is 210.

TABLE II

RADIOACTIVE CONTAMINATION ON VEGETATION

OFF-AREA LOCATIONS

JULY, AUGUST, SEPTEMBER

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	4	<3	<3	4	60	38
Touchet	4	<3	<3	4	46	31
Lowden	4	<3	<3	4	36	19
Walla Walla	8	<3	<3	8	51	27
Dixie	4	<3	<3	4	44	36
Waitsburg	8	<3	<3	8	40	23
Dayton	8	<3	<3	8	97	38
Pomeroy	8	<3	<3	8	40	25
Lewiston	8	<3	<3	8	41	31
Uniontown	4	<3	<3	4	51	29
Pullman	8	<3	<3	8	51	22
Colfax	4	<3	<3	4	52	32
Steptoe	4	<3	<3	4	88	44
Rosalia	4	<3	<3	4	53	36
Spangle	4	<3	<3	4	52	34
Spokane	8	<3	<3	8	92	36
Cheney	0			0		
Reardon	4	<3	<3	4	86	45
Davenport	4	<3	<3	4	49	34
Harrington	4	<3	<3	4	58	29
Sprague	8	<3	<3	8	100	57
Ritzville	8	<3	<3	8	100	50
Lind	8	<3	<3	8	44	30
Connell	8	<3	<3	8	37	25
Moxee	10	<3	<3	12	57	56
Union Gap	6	<3	<3	6	40.0	23
Wapato	10	<3	<3	12	26	16
Toppenish	10	<3	<3	12	74	32
Toppenish to Goldendale	12	<3	<3	16	55	33
Goldendale	10	<3	<3	12	92	29

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	5	<3	<3	7	75	37
Lyle	5	<3	<3	6	45	26
Bingen	5	<3	<3	6	42	28
Camas	10	<3	<3	12	52	23
Vancouver	9	<3	<3	11	40	26
Portland	8	<3	<3	11	52	32
Troutdale	5	<3	<3	6	26	15
Bonneville	5	<3	<3	6	43	27
Hood River	5	<3	<3	6	63	29
Dalles	9	<3	<3	12	62	25
Moody	3	<3	<3	4	40	26
Rufus	5	<3	<3	6	38	28
Blalock	5	<3	<3	6	54	33
Arlington	5	<3	<3	6	45	34
Heppner Jct.	5	<3	<3	6	110	51
Boardman	5	<3	<3	6	38	23

The concentrations of iodine on vegetation were reduced at nearly all sampling locations during the quarter with only seven samples at three locations exceeding the maximum concentration acceptable at Hanford of 1 x 10^{-5} µc/g (HW-25239). There were no significant trends during the quarter and iodine from bomb fallout was not significant even though particulate fallout was noted on air filters during the month of September. Significant iodine concentrations were confined to a very small area near the plant. Figure I describes the area surveyed. Table III summarizes monthly average concentrations of iodine on vegetation.

TABLE III

ACTIVITY DENSITY FROM I-131 ON VEGETATION

JULY, AUGUST, SEPTEMBER

1954

Units of 10^{-6} µc/g

Location	July		August		September	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	3	<3	4	3	3	<3
Near the 200 Areas	3	<3	6	<3	3	<3
Route 3	<3	<3	5	<3	11	4
200 West Gate	9	3	6	<3	10	5
Batch Plant	8	<3	<3	<3	3	<3
Meteorology Tower	4	<3	4	<3	3	<3
South of 200 Areas	3	<3	<3	<3	<3	<3
Richland	3	<3	5	<3	6	<3
Pasco Environs	<3	<3	<3	<3	4	<3
Kennewick Environs	3	<3	4	<3	5	<3
Benton City - Kiona	<3	<3	<3	<3	<3	<3
Richland Y	<3	<3	<3	<3	<3	<3
Hanford	<3	<3	<3	<3	<3	<3
200 East Area	6	<3	<3	<3	<3	<3
200 West Area Redox Area			<3	<3	17	6
Wahluke Slope	<3	<3	<3	<3	3	<3
Goose Egg Hill					5	<3
Rattlesnake Mountain	<3	<3	4	<3	<3	<3
PSN-300-310-330	<3	<3	<3	<3	4	<3
Redox	5	<3	7	<3	8	<3
Off-Area Sampling						
Pasco to Ringold	<3	<3			<3	<3
Prosser to Paterson-McNary	3	<3	<3	<3	<3	<3
Eastern Washington			<3	<3	<3	<3
So. Washington and No. Oregon	<3	<3	<3	<3	<3	<3

[redacted]

Average concentrations of non-volatile beta particle emitters were considerably lower in most all cases than those measured during the last quarter. Averages during July were on the same order as those during June with the difference in quarterly averages arising from the high concentrations of these emitters noted during the early months of last quarter. Maximum and average concentrations were significantly higher in on-site vegetation samples than in off-site vegetation possibly from the same source as that causing the higher ground contamination within the project. The maximum measurement of 0.33 μc/g was found at Rt. 10, mile 8 and was found to consist of ruthenium-rhodium isotopes. This measurement is believed to be the result of the inclusion of one of the highly radioactive particles also found on the ground in that locale. Table IV summarizes average concentrations of non-volatile beta particle emitters on a month-to-month basis for the various locations.

TABLE IV

ACTIVITY DENSITY FROM NON-VOLATILE BETA PARTICLE EMITTERS ON VEGETATION JULY, AUGUST, SEPTEMBER 1954

Units of 10^{-6} μc/g

Location	July		August		September	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	310	120	110	62	110	53
Near the 200 Areas	520	93	150	59	150	61
Route 3	54	49	170	130	110	82
200 West Gate	320	92	140	66	110	60
Batch Plant	610	140	110	86	760	150
Meteorology Tower	120	81	87	57	75	47
South of 200 Areas	180	86	210	52	330000*	110000*
Richland	120	53	87	39	140	46
Pasco Environs	81	39	54	27	88	34
Kennewick Environs	280	44	56	27	70	36
Benton City - Kiona	94	51	57	27	92	50
Richland Y						
Hanford						
200 East Area	370	120	75	42	91	53
200 West Area Redox Area			2200	150	300	96
Wahluke Slope	130	56	120	45	120	56
Goose Egg Hill					2200	180
Rattlesnake Mountain	180	93	85	45	65	27
PSN-300-310-330	62	42	69	40	70	42
Redox Construction	1500	180	220	60	450	86
Off-Area Sampling						
Pasco to Ringold	110	47			75	43
Prosser to Paterson-McNary	82	43	98	34	100	38
Eastern Washington			103	24	100	43
So. Washington and No. Oregon	54	22	92	28	110	35

* If this maximum is omitted the average becomes 31.0 and the new maximum is 62.0.

Table V summarizes the results from measurements on alpha particle emitters on vegetation.

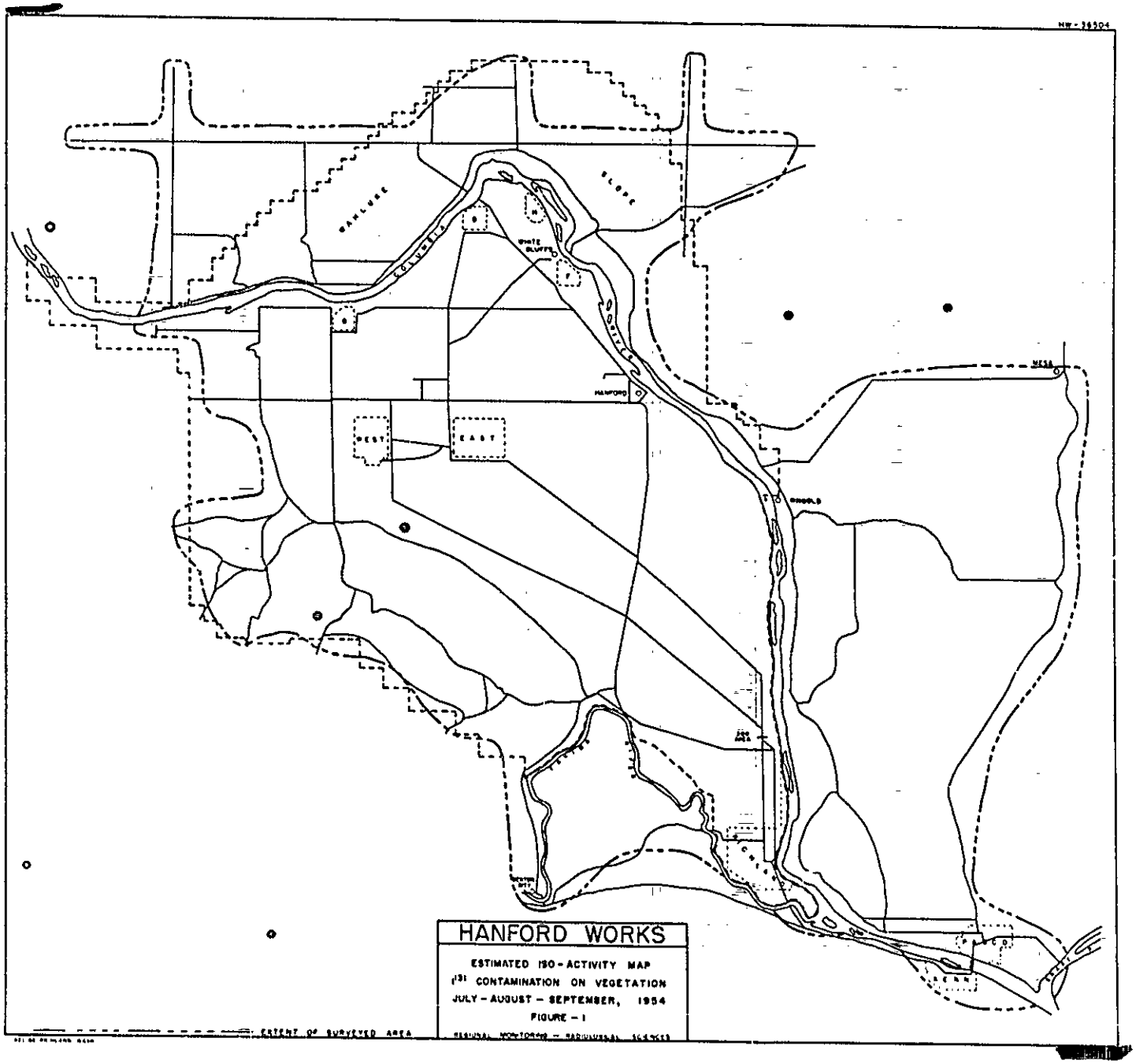
TABLE V

ACTIVITY DENSITY OF GROSS ALPHA PARTICLE EMITTERS ON VEGETATION JULY, AUGUST, SEPTEMBER 1954

Location	Units of 10^{-8} µc/g				
	July	August	September	Quarterly Avg.	Max. Results
Near 200 Areas					
200 West Gatehouse	16	25	13	18	40
Batch Plant	<10	<10	17	<10	20
Rt. 4-S Mile 4	<10	<10	<10	<10	<10
Meteorology Tower	10	<10	13	10	18
Rt. 4-S Mile 6	<10	<10	<10	<10	<10
300 Area	<10	<10	<10	<10	10
Outlying					
Richland	<10	<10	<10	<10	<10
Pasco	<10	<10	<10	<10	14
Benton City	<10	<10	<10	<10	<10

Alpha particle emitters on vegetation were lower this quarter than the previous quarter with all but one average below detectable limits.

HW-36504



SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

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 following tables summarize the results obtained by measurements made by each of the monitoring methods during the quarter.

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 dose rates for the three month period is given in Table I.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JULY, AUGUST, SEPTEMBER

1954

Units of mrad per 24 Hours

Location	No. of Units	July	August	September	Quarterly Average
100-B Area	3	0.1	0.2	0.2	0.2
100-D Area	3	0.8	0.2	0.1	0.4
100-H Area	3	3.1	0.6	2.6	2.1
100-F Area	3	3.0	0.2	0.1	1.1
200-West Area	2	1.1	0.2	1.6	1.0
200-East Area	2	0.2	0.4	1.0	0.5
Riverland	1	0.5	0.5	0.4	0.5
300 Area	1	0.7	0.1	0.3	0.4
Richland	1	0.4	0.2	0.4	0.3
Pasco	1	0.3	<0.1	1.6	<0.7
Benton City	1	0.4	0.5	0.1	0.3
North Richland North	1	<0.1	<0.1	0.1	<0.1
Hanford	1	<0.1	0.1	<0.1	<0.1
Kennewick	1	1.7	0.5	<0.1	<0.8
Redox	1	5.3	2.8	4.2	4.1
200-East Semi-Works	1	<0.1	1.6	0.1	<0.6

[redacted]

Unusually variable results were recorded during the current reporting period. Increases in measured dose rates were reported at 100-F Area, 100-H Area, Pasco, and Kennewick; decreases were noted at 200 West Area. No measurable trends were present in the data.

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 dose rate measurements is given in Table II.

TABLE II

DOSAGE RATES

MEASURED WITH "C" TYPE DETACHABLE IONIZATION CHAMBERS

JULY, AUGUST, SEPTEMBER

1954

Units of mrad per 24 hours

Location	July	August	September	Quarterly Average
100-B Area	0.9	0.6	0.5	0.7
100-D Area	0.7	0.7	0.9	0.8
100-F Area	0.3	0.4	0.4	0.4
100-H Area	0.3	0.3	0.7	0.4
200-W Area	0.6	0.5	0.5	0.5
200-E Area	0.8	0.6	0.6	0.7
200-E Semi-Works	0.8	0.7	0.5	0.7

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

The dose 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 dose 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

RADIATION LEVELS OBSERVED WITH "M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS JULY, AUGUST, SEPTEMBER 1954

Units of mrad/24 hours

Location	July	August	September	Quarterly Average	Group Average
100 Areas and Environs					
Route 1, Mile 8	0.84	0.48	0.75	0.69	
Route 2N, Mile 10	0.59	0.47	0.88	0.65	
Route 2N, Mile 5	0.63	0.52	0.73	0.63	
White Bluffs	0.52	0.43	0.56	0.50	
Route 11A, Mile 1	1.88	1.07	1.44	1.46	
Hanford 614 Bldg.	0.50	0.32	0.46	0.43	0.66
Intersection Rt. 1 and Rt. 4N	0.45	0.48	0.49	0.47	
P-11 Area	0.48	0.52	0.31	0.44	
Within 5 Miles of 200 East Area					
Route 4S, Mile 6	0.66	1.04	1.22	0.97	
Batch Plant	5.06	1.30	3.52	3.29	
Route 11-A, Mile 6	3.72	1.35	1.45	2.17	
Route 3, Mile 1	1.93	0.69	1.07	1.23	
Route 4S, Mile 2.5	0.89	0.67	1.27	0.94	
Redox Area	2.06	1.95	2.77	2.26	2.46

TABLE III (contd.)

Units of mrad/24 hours

Location	July	August	September	Quarterly Average	Group Average
Within 5 Miles of 200 East Area (contd.)					
Route 4S, Mile 4.5	1.11	1.33	2.08	1.51	
Military Camp PSN 61	1.77	0.58	1.35	1.23	
51	2.66	0.74	1.46	1.62	
50	1.35	1.13	1.69	1.39	
49	0.80	0.56	1.27	0.91	
Redox Perimeter	29.88	3.48	2.70	12.02	
Within 10 Miles of 200-East					
Route 4S, Mile 10	0.57	0.68	0.92	0.72	
Route 10, Mile 1	2.82		4.20	3.51	
Route 10, Mile 3	1.83	1.52	3.12	2.16	1.89
Route 2S, Mile 4	0.79	1.43	1.27	1.16	
300 Area and Environs					
Route 4S, Mile 16	1.09	0.50	0.79	0.79	
Route 4S, Mile 22	2.62	4.03	2.39	3.01	
North Richland North	1.54	0.65	0.66	0.95	1.39
300 Area	0.81	0.90	0.74	0.82	
Outlying					
Richland	1.04	0.67	0.84	0.85	
Benton City	0.52	0.28	0.42	0.41	
Pasco	0.31	0.56	0.47	0.45	
Kennewick	0.51	0.51	0.36	0.46	0.54

The average dose rates at grouped locations in the environs of the reactor areas, within a radius of 10 miles from the separation areas, in the immediate environs of the 300 Area, and in the outlying residential areas were not significantly different from those observed during the previous quarter. A significant decrease was noted at monitoring stations located within a radius of 5 miles of the separations areas. The largest difference was reported at the Redox perimeter location where a quarterly average dosage rate of 12 mrad/day was measured, a decrease of greater than one-half of the value of the previous quarter.

[redacted]

The activity density of beta particle emitters in the atmosphere was measured using filters through which flow rates of 2 to 2.5 cfm of air were passed 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

AIRBORNE BETA PARTICLE EMITTERS MEASURED ON AIR FILTERS

JULY, AUGUST, SEPTEMBER

1954

Activity Density - Units of 10^{-14} µc/ml

Location	July	August	September	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-D Area	19	34	33	28	40
100-H Area	40	47	69	52	160
Hanford 614 Bldg.	32	56	14	36	230
White Bluffs	44	51	55	50	74
200 Areas and Vicinity					
200-E Semi-Works	26	29	44	33	84
200-W, West Center	34	34	34	34	48
200-W, Redox Area	55	36	49	45	110
Gable Mountain	37	51	29	40	69
PSN 320		36	24	27	36
300 Area 614 Bldg.	20	16	27	21	40
Outlying Areas					
North Richland	32	45	37	38	54
Pasco	19	19	19	19	39
Benton City	26	20	27	24	38
Riverland	30	26	20	25	51

[redacted]

General decreases were noted in the activity density of beta particle emitters collected on air filter samples at nearly all stations during this period. This condition resulted largely from the fact that higher than normal measurements were reported during the previous quarter when particulate contamination, presumably from outside sources, was prevalent in the environs.

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 three locations. The results of these measurements are given in Table V.

TABLE V

AVERAGE BETA PARTICLE EMITTERS COLLECTED ON AIR FILTERS

DUAL UNIT AIR MONITORS

JULY, AUGUST, SEPTEMBER

1954

Activity Density - Units of 10^{-14} μc/ml

Location	July	August	September	Quarterly Average	Weekly Maximum
200 West Area #1	44	43	53	47	72
200 West Area #2	35	73	45	55	130
200 East Area #1	21	11	20	24	48
200 East Area #2	21	25	26	24	43
Richland #1	20	21	19	20	36
Richland #2	16	16	7	12	25

The quarterly averages shown in Table V reflect the same decreases noted in the results shown in Table IV. In these cases also, the concentrations measured in the current period were essentially normal following the higher activity densities reported during the previous quarter.

[redacted]

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 separations areas and at remote locations are given in Table VII.

TABLE VI

SUMMARY OF AIRBORNE
PARTICLE CONCENTRATIONS NEAR THE SEPARATIONS AREAS
JULY, AUGUST, SEPTEMBER
1954

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

Location	Air Volume Sampled m^3	July	August	September	Present Quarter Averages	Previous Quarter Averages
200-E and Vicinity						
2704 Outside	9180	60	170	90	110	140
BY - SE	9248	130	270	170	190	170
BY - NE	8559	80	140	63	100	99
"B" Gate	8853	92	130	78	100	170
2704 Inside	9252	41	98	40	63	110
200-W and Vicinity						
2701 Outside	8109	73	350	75	170	150
2722	8904	120	150	67	110	150
"T" Gate	9248	96	170	68	120	130
222-T Outside	9138	120	200	270	200	190
231	9248	330	210	110	220	160
Redox	9279	160	220	140	180	960
"W" Guard Tower	9222	110	190	98	140	210
2701 Inside	9210	100	300	110	180	160
272	9244	71	100	80	89	83
222-U Lab.	6953	53	120	39	81	230
"U" Plant Gate	7828	62	150	41	93	190
Meteorology Tower						
3'	36992	13	39	12	23	38
50'	36788	19	39	22	28	22
100'	29214	21	59	21	33	33
150'	25536	23	45	27	32	39
200'	23588	31	60	23	38	42
250'	23588	14	62	28	35	35
300'	21856	51	60	21	42	48
350'	21856	24	66	21	36	54
400'	11288	31	120	37	43	69

TABLE VII

SUMMARY OF AIRBORNE PARTICLE CONCENTRATIONS OUTSIDE THE SEPARATIONS AREAS JULY, AUGUST, SEPTEMBER 1954

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

Location	Air Volume Sampled m^3	July	August	September	Present Quarter Averages	Previous Quarter Averages
Area Locations						
100-B Area	6090	38	135	*	88	120
100-D Area	18870	11	33	5.6	23	23
White Bluffs	23001	11	56	16	19	38
100-F Area	28305	16	47	32	31	36
300 Area	37587	35	82	40	57	60
Off Area Locations						
Benton City, Wn.	37383	26	74	23	42	52
Pasco, Wn.	35464	37	42	16	32	43
Richland, Wn.	37587	37	76	24	48	83
Boise, Idaho	8713	160	160	130	150	130
Klamath Falls, Ore.	9197	110	140	70	110	130
Great Falls, Mont.	7290	14	110	30	53	62
Walla Walla, Wn.	9176	100	140	61	100	110
Meacham, Ore.	9206	46	95	58	68	66
Lewiston, Idaho	9223	100	140	78	110	190
Spokane, Wn.	36329	56	74	16	51	63
Kennewick, Wn.	9248	56	95	40	65	130
Yakima, Wn.	18543	9.1	37	24	20	65
Seattle, Wn.	7969	17	11	16	15	59

*Temporarily discontinued.

A continuation of higher than normal concentrations of particles during the quarter was noted at nearly all locations both near the separation areas and at remote locations. Exact sources of these concentrations were not established, but presumably the measurements were weighted markedly by contamination occurring from sources other than Hanford.

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

TABLE VIII

AVERAGE ACTIVITY DENSITY OF I^{131} DETECTED BY AIR SCRUBBERS

JULY, AUGUST, SEPTEMBER

1954

Units of 10^{-12} μc/ml

Location	July	August	September	Quarterly Average	Weekly Maximum
200 Area and Vicinity					
200 East - Southeast	<0.1	<0.1	<0.1	<0.1	<0.1
Gable Mountain	<0.1	<0.1	<0.1	<0.1	<0.1
200-W Gatehouse	0.2	0.7	0.3	0.4	1.3
200-W Scrubber	0.1	0.1	<0.1	0.1	0.5
200-E Semiworks	0.1	<0.1	0.1	<0.1	0.2
Redox Area	<0.1	<0.1	0.5	0.2	1.2
Outlying Areas					
100-H Area	0.2	<0.1	<0.1	<0.1	0.5
300 Area	<0.1	<0.1	<0.1	<0.1	<0.1
North Richland North	<0.1	<0.1	<0.1	<0.1	<0.1
Richland	<0.1	<0.1	<0.1	<0.1	0.1
Pasco	<0.1	<0.1	<0.1	<0.1	<0.1
Benton City	<0.1	<0.1	<0.1	<0.1	<0.1

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

CONCENTRATION OF AIRBORNE ALPHA PARTICLE EMITTERS

JULY, AUGUST, SEPTEMBER

1954

Activity Density - Units of 10^{-15} µc/ml

Location	Number Samples	Weekly Average Maximum	Quarterly Average
200-W, West Center	12	29	4
200-E Semiworks	13	7	<4
Gable Mountain	12	70	11
Pasco	13	51	8
300 Area	13	23	9
100-D Area	6	23	8
Benton City	13	4	<4
Hanford 614 Bldg.	12	11	<4
White Bluffs	13	13	6
North Richland	12	20	6
200-W Redox Area	12	22	5
100-H Area	12	47	10
Riverland	13	8	<4
PSN 320	4	8	4
Dual Unit Monitors			
200 WEC #1	9	22	4
200 WEC #2	11	23	6
200 ESE #1	12	6	<4
200 ESE #2	12	5	<4
Richland #1	12	30	5
Richland #2	10	12	5

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

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 AREA 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
JULY, AUGUST, SEPTEMBER
1954

Units of 10^3 µc/second

Location	No. Samples	July Max.	July Avg.	August Max.	August Avg.	September Max.	September Avg.	Quarter Max.	Quarter Avg.
100-B Area	86	16	14	14	12	26	14	26	13
100-C Area	86	31	21	27	20	26	19	31	20
100-D Area	108	15	13	18	13	16	13	18	13
100-DR Area	110	22	12	17	12	18	13	22	12
100-H Area	110	50	21	17	15	21	14	50	17
100-F Area	108	18	13	14	12	15	13	18	13

A comparison of the total activity of beta particle emitters discharged to the river during this period with the results of similar measurements obtained during the previous quarter showed that significant decreases in the activity admitted to the river occurred at all areas. These decreases ranged from 20% at 100-B Area and 100-H Area to 33% at 100-D Area and can be ascribed to the expected improvement in coolant water quality following the completion of the spring "run-off" season.

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 from 9×10^{-9} µc/ml to 6.9×10^{-8} µc/ml.

Radiochemical analyses of 154 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 and these trace amounts measured 2.1×10^{-9} µc/ml and 2.6×10^{-9} µc/ml at 100-B and 100-C Areas, respectively.

[redacted]

As in previous reporting periods, several samples analyzed for plutonium showed values above the detection limit of 3×10^{-9} μc/ml. These significant activity densities ranged from 5.9×10^{-9} μc/ml to 5.7×10^{-8} μc/ml and were present at all areas.

Significant quantities of polonium were found in samples of effluent water from each of the reactors. Except for one individual sample with a concentration of 3.8×10^{-8} μc/ml from 100-B Area, the measured concentrations varied from the detection limit of 6×10^{-10} μc/ml to 5.9×10^{-9} μc/ml.

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. On the average, 27 μc/day were admitted to the river during the quarter, a value comparing favorable with the discharge rates of the previous reporting periods.

200 AREA WASTES

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

[redacted]

TABLE II

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS

JULY, AUGUST, SEPTEMBER

1954

Liquid Samples

Location	No. Samples	Alpha Particle Emitters Units of 10^{-8} µc/ml Maximum	Alpha Particle Emitters 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	11	1.2	<0.5	27	10
T-Swamp	25	1.6	<0.5	34	8.4
U-Swamp	24	14	2.3	4000	590
Laundry Ditch	21	9.7	3.3	8.3	2.9
231 Ditch	23	34	3.0	9.1	1.5
200-E "B" Ditch	24	13	2.0	3.8	1.4
200-E "B" Swamp	12	6.9	0.8	5.0	1.3
234-5 Ditch	12	270	36	9.9	2.2

Solid Samples

		Units of 10^{-6} µc/g		Units of 10^{-5} µc/g	
T-Ditch	7	17	5.7	300	120
T-Swamp	13	14	3.6	1500	160
Laundry Ditch	12	47	24	57	20
200-E "B" Ditch	18	20	3.0	91	24
200-E "B" Swamp	12	19	3.2	150	23
234-5 Ditch	6	15000	3800	15	7.4

[redacted]

The concentration of beta particle emitters measured in liquid samples collected at the U swamp during the period showed significant increases by a factor of 10 over those normally recorded at this location. The results of liquid and solid samples analyzed at all remaining locations were comparable to values previously reported.

Samples from all waste sources indicated in Table II were analyzed specifically for the activity density of uranium. The average concentrations of uranium in liquid samples collected at the B, T, and U swamps ranged from 2×10^{-9} μc/ml to 3.8×10^{-8} μc/ml with a maximum of 3.6×10^{-7} μc/ml measured in the ditch which carries the laundry effluents to the U swamp. Solid samples collected from the edges of the swamps and from the ditches showed uranium deposition averaging between 2.2×10^{-6} and 6.0×10^{-5} μc/g. Again, the maximum concentrations were observed in the laundry effluent ditch where a value of 1.3×10^{-4} μc/g was recorded.

300 AREA WASTES

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

TABLE III

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
JULY, AUGUST, SEPTEMBER
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.	Alpha Particle Emitters Units of 10^{-8} µc/ml Max.	Alpha Particle Emitters 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	47	610	24	2900	210	18	1.6
New Pond Inlet	44	250	20	5900	390	55	2.4

Solid Samples

		Activity Density Units of 10^{-3} µc/g		Activity Density Units of 10^{-3} µc/g		Activity Density Units of 10^{-3} µc/g	
Old Pond Inlet	10	51	7.8	38	7.0	62	5.6
New Pond Inlet	10	10	4.5	32	5.2	31	10

The contamination measured in samples collected from 300 Area wastes was within the expected order of magnitude in all cases based upon results obtained in previous reporting periods. The considerable variation in activity densities found at these sources is associated with the varying amounts of material entering the waste ponds at the time the samples were collected.

Radiochemical analyses of approximately 100 samples obtained from the 300 Area old and new ponds 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.

[redacted]

ENVIRONS - GROUND CONTAMINATION

General ground contamination continued to be relatively high within the 200 W Area. The contamination was found to exist as small particles with individual particle dose rates, based on field measurements, being as high as 1-20 rad per hour at locations within several thousand feet of the Redox stack. Measured particle diameters ranged from a few microns to on the order of 1000 microns. Radiochemical analyses established the radioactive material in the particles to be a mixture of ruthenium-rhodium isotopes with the ratio of the activity of Ru^{103} to that of Ru^{106} being less than 1. The composition and location definitely established the source as Redox although the low percentage of Ru^{103} indicated that the source was not recently processed fission products.

Environmental surveys made during the quarter revealed particles of similar composition to be present throughout the environs as far away as Pendleton, Oregon, and Mesa, Washington. Particle concentrations in the Richland-Benton City areas were on the order of 1 particle per 3000 square feet although a somewhat higher concentration was noted on densely vegetated areas. Crop surveys revealed no contamination of fruit although particles were detected on the ground in some of the orchards adjacent to the project. Road surveys on the project showed contamination on most highways with particle frequencies varying from 2 per mile to 30 per mile near the 200 W Area. Most of these particles on the roadways were fixed.

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER AND RELATED WATERS

Radioactive contamination resulting from the discharge of reactor coolant water to the Columbia River was determined by analyzing over 800 liquid and solid samples collected from the river and related waters. The samples were analyzed for the activity density of gross alpha and gross beta particle emitters, and specific analyses for uranium and/or plutonium were performed in isolated cases. The sampling frequency at selected locations varied from daily to weekly in the immediate environs and was maintained on a monthly basis at remote downstream locations. The results of 500 ml samples collected at locations between the reactor areas and McNary Dam and analyzed for the concentration of gross beta particle emitters are summarized in Table I.

TABLE I

CONCENTRATION OF GROSS BETA PARTICLE EMITTERS
IN COLUMBIA RIVER WATER
JULY, AUGUST, SEPTEMBER
1954

Units of 10^{-8} μc/ml

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
181-B Area	<5	5	11	7	7	17
181-C Area	<5	<5	<5	<5	7	8
Allard Station	5	180	<5	74	80	680
181-D Area	44	80	280	170	160	390
181-H Area	74	190	450	260	320	640
Below 100-H Area	330	240	440	330	850	720
181-F Area	270	410	630	460	650	990
Below 100-F Area	150	250	620	360	1200	800
Hanford South Bank	330	400	900	510	1000	1200
Hanford Middle	250	400	750	420	1000	1400
Hanford North Bank	110	230	250	180	500	400
300 Area	220	200	360	280	470	470
Byers Landing	---	---	300	300	370	300
Richland	110	160	260	140	210	290
Kennewick Highlands Pumping Station	73	130	220	140	200	250
Pasco Bridge (Kenn. Side)	64	55	160	97	120	460
Pasco Bridge (Pasco Side)	76	82	240	130	150	490
Pasco Pumping Plant	62	110	130	110	210	230
Sacajawea Park	41	65	110	74	110	180
McNary Dam	30	92	28	27	27	74
McNary Pool	15	29	53	32	24	73
Paterson	17	19	27	20	20	35

A comparison of the quarterly average concentrations summarized in Table I with the results of similar measurements obtained during the last quarter showed that significant decreases in activity densities occurred at nearly all locations. Only those samples collected upstream from the plant area and at remote stations downstream did not show these changes. The general decreases in concentrations were expected based upon significant decreases in the activity of beta particle emitters discharged to the Columbia River in reactor effluent water and an increase in the average flow rate of the river for the current period. The flow rate over the present quarter averaged 1,800,000 gal/sec compared to an average flow of 1,590,000 gal/sec during the previous quarter. Further comparisons of the monthly average concentrations given showed that an increasing trend in the activity densities occurred during the three month period. This increase was consistent with similar trends observed during this period in previous years and was related to the decreasing dilution effect of the Columbia River on the reactor effluent water as the river flow rate declined during the quarter from the peak flow of 3,198,000 gal/sec on July 14, 1954. Average flow rates of the river for the months of July, August, and September were 2,820,000, 1,600,000, and 1,010,000 gal/sec, respectively. Figure II illustrates variation in flow rate during the quarter.

One gallon samples were collected monthly from ten locations between McNary Dam and Portland, Oregon. Trace concentrations of beta particle emitters were detected in all samples with values ranging from 3.4×10^{-8} μc/ml to 1.4×10^{-7} μc/ml, amounts which compare favorably with those previously found at these locations.

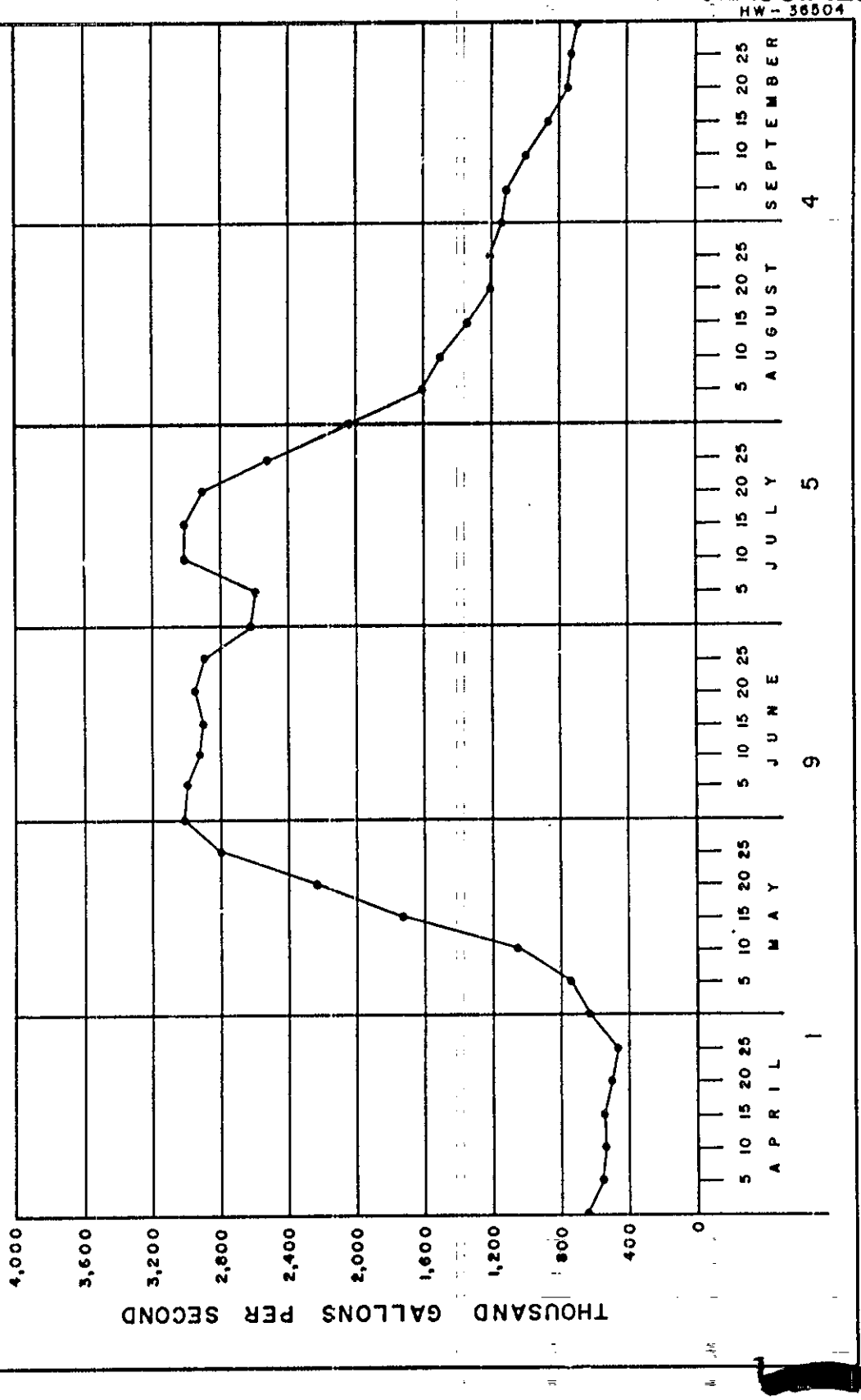
The activity density of alpha particle emitters in river water measured at all sampling locations below the reactor areas averaged less than 5×10^{-9} μc/ml during the quarter.

[redacted]

FIGURE — 2

COLUMBIA RIVER FLOW

JULY — AUGUST — SEPTEMBER



Evaluations of the activity density of naturally present beta and alpha particle emitters in the river water were made by analyzing samples of the Columbia River obtained from a location upstream from the reactor areas and from samples collected from the Yakima and Snake Rivers which enter the river above McNary Dam. The average concentrations measured in all cases were less than 5×10^{-8} μc/ml and 5×10^{-9} μc/ml for beta and alpha particle emitters, respectively.

Nineteen samples collected from the south shore of the Columbia River at the Hanford Ferry were analyzed specifically for the activity density of I^{131} which is discharged to the river in trace quantities at the Biology Farm in the 100-F Area. The average concentration measured in these samples was 1.3×10^{-7} μc/ml with a maximum of 3.4×10^{-7} μc/ml, values which are comparable with those previously reported.

Radioactive contamination deposited by the waters of the Columbia River was measured by analyzing mud samples for the activity density of alpha and beta particle emitters. Samples were collected from shore and off-shore locations at weekly frequencies. Comparisons with the concentrations found at background locations were made by analyzing similar shore and off-shore samples collected from a location upstream from the reactor areas and collected from stations on the Yakima and Snake Rivers. A summary of the measured beta particle emitter concentrations is given in Table II.

TABLE II

CONCENTRATION OF GROSS BETA PARTICLE EMITTERS IN RIVER MUD

JULY, AUGUST, SEPTEMBER

1954

Units of 10^{-5} μc/g

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch						
Shore	2.7	2.9	3.0	2.9	3.8	4.0
5' Out	3.1	2.4	6.2	3.9	3.1	16
Allard Station						
Shore	3.2	7.4	2.4	4.5	3.3	20
5' Out	2.4	4.0	2.7	3.1	3.7	5.6
100-H Area						
Shore	4.0	11	11	9.6	5.7	18
5' Out	2.6	11	13	9.7	5.3	22
Below 100-F						
Shore	3.0	5.0	13	7.1	12	25
5' Out	5.7	5.3	12	7.9	20	18
Hanford Ferry						
Shore	3.2	4.5	5.5	4.5	14	7.6
5' Out	5.6	6.9	6.2	6.2	10	12
300 Area						
Shore	15	4.2	5.5	7.6	6.6	31
5' Out	3.1	7.0	3.7	4.8	6.0	15
Byers Landing Pumping Plant						
Shore	---	---	5.0	5.0	4.4	5.0
Richland Dock						
Shore	5.5	4.8	3.5	4.6	4.2	14
5' Out	5.2	4.3	4.6	4.7	3.7	12
Kennewick Highlands Pumping Plant						
Shore	4.6	2.1	3.5	3.6	4.0	13
5' Out	2.0	3.0	4.0	2.9	4.1	9.1
P. K. Bridge (Kennewick)						
Shore	3.6	2.8	2.7	3.1	4.6	7.8
5' Out	3.3	4.1	3.5	3.6	6.2	6.0
Sacajawea Park						
5' Out	3.6	3.7	3.0	3.4	4.8	5.1

TABLE II (contd.)

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
McNary Dam						
5' Out	1.1	2.1	2.6	2.0	4.4	4.1
Paterson						
Shore	2.9	2.8	2.8	2.8	3.6	4.7
Snake River Mouth						
5' Out	---	3.1	2.3	2.6	2.8	3.8
Yakima River Horn						
Shore	2.8	1.7	1.5	2.0	3.0	5.5
5' Out	1.9	2.6	2.7	2.4	2.5	3.5
Yakima River - Prosser						
5' Out	1.8	2.0	1.6	1.8	2.0	3.6

The average activity density of beta particle emitters in mud samples continued to be significantly higher at near plant locations than that measured in background samples, and were found to be comparable to those values previously reported. Special samples collected at three points across the stream at a location several miles above McNary Dam averaged between 9.8×10^{-5} μc/g and 1.7×10^{-4} μc/g with a maximum individual value of 3.6×10^{-4} μc/g measured on August 24, 1954.

The activity density of alpha particle emitters in mud samples collected from all locations summarized in Table II as well as from the given background locations averaged less than 2×10^{-6} μc/g.

Weekly samples were collected directly from the raw water - river export lines at the 183 and 283 buildings in the reactor and separations areas. These samples represent river water prior to chlorination and filtration for operational and sanitary purposes in the manufacturing areas. The results of the analysis of these samples for the concentration of beta particle emitters are summarized in Table III.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER
RIVER EXPORT LINE
JULY, AUGUST, SEPTEMBER
1954

Beta Particle Emitters - Units of 10^{-8} μc/ml

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
183 Bldg. - 100-B Area	<5	5	6	<5	5	19
183 Bldg. - 100-C Area	<5	<5	<5	<5	<5	18
183 Bldg. - 100-D Area	12	26	45	29	60	83
183 Bldg. - 100-DR Area	<5	30	49	30	63	88
183 Bldg. - 100-F Area	31	61	100	64	98	170
183 Bldg. - 100-H Area	12	42	75	46	72	130
283 Bldg. - 200 East Area	6	10	<5	6	45	18
283 Bldg. - 200 West Area	8	13	11	10	68	40

Significant decreases in the average concentrations were observed during this period for the samples collected at all locations downstream from 100-C Area. The lower values were expected based upon the decrease in activity density of river water from which the raw water is pumped to the various operating areas.

The results obtained from analyzing all raw water samples for the activity density of alpha particle emitters showed average values below the detection limit of 5×10^{-9} μc/ml at each manufacturing area.

SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

A total of 64 rain samples was analyzed during the quarter to determine the activity density of beta particle emitters in rain. Rainfall during each month allowed representative sampling for each period. Table I summarizes the precipitation measurements made by Synoptic Meteorology personnel at the Meteorology Tower near 200-W Area.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS
JULY, AUGUST, SEPTEMBER
1954
Units - Inches

Year	July	August	September	Quarterly Total
1951	0.37	0.15	0.10	0.62
1952	T	0.08	0.08	0.16
1953	T	0.96	0.13	1.09
1954	0.22	0.42	0.51	1.15

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

TABLE II

ACTIVITY DENSITY OF GROSS BETA PARTICLE EMITTERS IN RAIN

JULY, AUGUST, SEPTEMBER

1954

Location	Number Samples	Units of 10^{-6} µc/ml Maximum	Average
In 200 East Area	4	2	1.5
250' E of Stack	2	2	2
3500' SE of Stack	2	2	1
In 200 West Area	10	20	5.8
1000' E of Stack	1	2	2
7000' E of Stack	2	3	2
8000' SE of Stack	2	<1	<1
4900' SE of Stack	2	2	<1
Redox Area	3	20	16
100 Area Environs	9	4	<1
100-B SE	4	<1	<1
100-D SW	2	<1	<1
100-F SW	2	<1	<1
White Bluffs	3	4	1
100-H SE	1	<1	<1
Perimeter Locations	15	5	<1.5
700A 614	3	5	2
Pasco H and R	4	1	<1
Benton City	2	<1	<1
Riverland	4	4	2
300 Area North	2	1	<1
Intermediate Locations	25	7	<1.2
Route 4S, Mile 6	4	3	2
300 Area 614	3	<1	<1
200 North 614	2	1	<1
Gable Mountain	3	<1	<1
Batch Plant	2	1	<1
622 Bldg.	11	7	1

[redacted]

Very significant decreases from average values for last quarter were noted in the average concentrations of beta particle emitters in rain at every sampling location. The absence of radioactive material from nuclear explosions in the air during any rainfall and the decreased contribution of airborne radioactive materials from the Separation plants were reflected in the lower concentrations of such material in rain.

[redacted]

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Approximately 1100 samples were collected during the quarter to determine the magnitude of radioactive contamination in drinking water supplies. An additional 100 samples were collected from test wells to determine the trends of movement of any contamination in the water table. Samples of 500 ml volume were collected at frequencies varying from daily to weekly; larger 11.7 liter samples were collected when greater sensitivity was desired. Special samples were collected from the various stages in the water purification process at the Pasco Filter Plant to supplement drinking water measurements made at that location.

Table I is a summary of all data from all locations at which the quarterly average activity density of alpha particle emitters exceeded the detection limit of 5×10^{-9} µc/ml.

TABLE I

CONTAMINATION FROM ALPHA PARTICLE EMITTERS

JULY, AUGUST, SEPTEMBER

1954

500 ml Samples

Location	Alpha Particle Emitters			Uranium		
	No. Samples	Units of 10^{-9} µc/ml Max.	Avg.	No. Samples	Units of 10^{-9} µc/ml Max.	Avg.
Richland Well #2	11	32	9	11	13	7
Richland Well #12	11	16	9	11	8	6
Richland Well #15	12	8	5	12	7	<5
Benton City Water Co. Well	12	17	11	11	13	10
Benton City Store	14	220	25	14	13	8
Sacajawea Park	11	8	6	10	12	7

The abnormally high concentration of alpha particle emitters in the sample of water collected from Benton City Store on September 20, 1955, was not identified as uranium and resample did not confirm the measurement. If this high concentration is omitted, the new maximum would be 1.7×10^{-8} μc/ml and the revised average 6×10^{-9} μc/ml well within the expected range of values at this location. As in the past, uranium was found at all locations which showed detectable alpha emission.

Table II gives a complete summary of all results obtained by analyzing 500 ml samples of drinking water in the immediate HAPO environs. While individual samples collected at many of these locations showed significant concentrations of alpha particle emitters, resampling did not confirm the high measurements to give an average below the detection level. Abnormally high concentrations of beta particle emitters in individual samples collected from Richland Well #4, Benton City Store, and Kiona were not confirmed by resampling. The maxima and averages of all other samples at these three locations were normal. The maximum concentrations of beta particle emitters decreased from last quarter figures at all 100 Area sanitary supplies, possibly due to the fact that minimum river flow was much lower for the second quarter. Since these supplies are essentially purified river water, any less dilution of the radioactive materials entering the river from upstream reactors will be reflected in the concentrations of these materials in the sanitary supply from a downstream source.

TABLE II

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN WATER SUPPLIES JULY, AUGUST, SEPTEMBER 1954

500 ml Samples

Location	Samples	Alpha Particle Emitters Units of 10^{-9} µc/ml Max.	Alpha Particle Emitters 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	11	32	9	<5	<5
Richland Well #4	50	25	<5	140	<5
Richland Well #5	9	11	<5	<5	<5
Richland Well #12	11	16	6	<5	<5
Richland Well #13	12	6	<5	9	<5
Richland Well #14	12	6	<5	<5	<5
Richland Well #15	12	8	5	<5	<5
Richland Well #18	5	<5	<5	<5	<5
Tract House J-685	13	<5	<5	5	<5
3000 Area Well "A"	13	<5	<5	20	<5
3000 Area Well "B"	13	7	<5	11	<5
3000 Area Well "C"	13	<5	<5	6	<5
3000 Area Well "D"	11	<5	<5	<5	<5
3000 Area Well "E"	13	<5	<5	<5	<5
3000 Area Well "F"	12	<5	<5	<5	<5
3000 Area Well "H"	13	<5	<5	<5	<5
3000 Area Well "J"	12	<5	<5	<5	<5
3000 Area Well "K"	13	<5	<5	<5	<5
3000 Area Well "L"	13	<5	<5	6	<5
Durand Well #5	14	<5	<5	12	<5
Columbia Field Well "A"	12	<5	<5	6	<5
Columbia Field Well "B"	12	7	<5	<5	<5
Columbia Field Well "C"	12	<5	<5	<5	<5
Headgate Well	13	<5	<5	46	<5
1100 Area Well #8	13	<5	<5	23	<5
Midway	13	<5	<5	7	<5
Riverland	14	6	<5	<5	<5
Lower Knob	12	<5	<5	27	<5
Wills Ranch	14	<5	<5	28	<5
Pistol Range	11	<5	<5	5	<5
White Bluffs Fire Hall	13	8	<5	9	<5
White Bluffs Telephone Exchange	8	<5	<5	13	<5
Benton City Water Co. Well	12	<5	<5	20	<5

TABLE II (contd.)

500 ml Samples

Location	Samples	Alpha Particle Emitters Units of 10^{-9} µc/ml Max.	Alpha Particle Emitters 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 Store	14	220	25	200	21
Kiona	14	<5	<5	180	27
Enterprise	13	6	<5	31	<5
Kennewick Standard Station	13	8	<5	36	17
McGee Well	13	<5	<5	7	<5
Ford Well	14	<5	<5	<5	<5
Meeker Well	13	10	<5	14	<5
100-B (Sanitary)	13	19	<5	5	<5
100-C (Sanitary)	13	<5	<5	<5	<5
100-D (Sanitary)	13	9	<5	59	12
100-DR (Sanitary)	13	<5	<5	19	18
100-H (Sanitary)	13	<5	<5	33	14
100-F (Sanitary)	13	9	<5	46	25
100-K Well #1 (Sanitary)	10	17	<5	<5	<5
200-East (Sanitary)	12	<5	<5	31	7
200-West (Sanitary)	12	<5	<5	140	17
300 Area (Sanitary)	12	13	<5	<5	<5
251 Bldg. (Sanitary)	13	<5	<5	12	<5
Redox Ad. Bldg. (Sanitary)	13	11	<5	9	<5
Sacajawea Park (Sanitary)	11	8	6	<5	<5
McNary Dam (Sanitary)	13	<5	5	37	<5
Paterson (Sanitary)	13	<5	<5	<5	<5
Plymouth (Sanitary)	13	<5	<5	<5	<5
Prosser (Sanitary)	13	<5	<5	<5	<5
Byers Landing Pumping Plant	1	<5	<5	<5	<5
Kennewick Reservoir	12	<5	<5	42	16
Pasco Improvement Farm	1	<5	<5	<5	<5
Pasco H and R Depot	13	<5	<5	98	16

Table III summarizes the results obtained from analyzing 11.7 liter samples of drinking water to achieve a sensitivity limit of 2×10^{-10} µc/ml for alpha particle emitters in those wells where the small sample indicated a value of questionable significance.

TABLE III

ACTIVITY DENSITY FROM ALPHA PARTICLE EMITTERS IN DRINKING WATER
JULY, AUGUST, SEPTEMBER
1954

11.7 liter Samples

Location	Number Samples	Units of 10^{-10} µc/ml Maximum	Average
Richland Well #2	6	46	29
Richland Well #4	7	32	16
Richland Well #5	5	19	<2
Richland Well #12	5	50	38
Richland Well #13	6	31	20
Richland Well #14	7	34	22
Richland Well #15	6	38	26
Tract House J-685	6	9	7
Columbia Field Well "A"	5	10	8
Columbia Field Well "B"	6	12	8
Columbia Field Well "C"	5	13	7
1100 Area Well #8	5	23	17
3000 Area Well "A"	7	12	8
3000 Area Well "B"	7	18	9
3000 Area Well "C"	9	17	8
3000 Area Well "D"	7	45	12
3000 Area Well "E"	6	14	11
3000 Area Well "F"	3	16	10
3000 Area Well "H"	6	17	8
3000 Area Well "K"	6	14	10
3000 Area Well "L"	6	16	11
3000 Area Durand #5	6	13	9
3000 Area Well "J"	6	18	7
Benton City Store	6	120	67
Benton City Water Co. Well	3	75	52
Kiona	5	14	10
Enterprise Well	4	10	8
Headgate Well	5	8	6

TABLE III (contd.)

11.7 Liter Samples

Location	Number Samples	Units of 10^{-10} μc/ml Maximum	Average
Kennewick Reservoir	4	5	3
Kennewick Standard Station	5	9	5
Riverland	7	7	4
Midway	6	8	5
Lower Knob	5	2	<2
Wills Ranch	3	9	7
McGee Well	7	<2	<2
Ford Well	7	<2	<2
Meeker Well	7	<2	<2
White Bluffs Fire Hall	5	18	14
Pistol Range	4	18	14
B-Y Well	6	36	23
251 Bldg. (Sanitary)	6	9	3
Clover Island Pumping Station	4	6	4
3000 Area Pond Inlet	5	12	7

The values in Table III also reflect the higher concentrations of uranium in the Richland-Benton City region.

Beta particle emitters were found in all drinking water supplies using the Columbia River, downstream of the reactors, as an initial source of water. Particular study has been given to effect on concentrations of these emitters by purification processes in the Pasco Filter Plant. Table IV summarizes these measurements to supplement the average concentrations in drinking water reported in Table II.

TABLE IV

RADIOACTIVE CONTAMINATION MEASURED AT PASCO FILTER PLANT

JULY, AUGUST, SEPTEMBER

1954

Type Sample	Samples	Activity Density Gross Beta Particle Emitters Maximum	Average
Water Entering Plant from River	11	2.3×10^{-6} μc/ml	1.1×10^{-6} μc/ml
Sand (surface of sand filter)	13	1.8×10^{-4} μc/g	4.6×10^{-5} μc/g
First Backwash Material (Liquid)	13	9.4×10^{-6} μc/ml	1.6×10^{-6} μc/ml
First Backwash Material (Solid)	10	1.6×10^{-2} μc/g	9.6×10^{-3} μc/g
Coal (surface of coal filter)	11	1.7×10^{-4} μc/g	5.4×10^{-5} μc/g
First Backwash Material (Liquid)	11	1.2×10^{-5} μc/ml	2.0×10^{-6} μc/ml
First Backwash Material (Solid)	8	2.5×10^{-2} μc/g	1.2×10^{-2} μc/g
Water Leaving Plant	12	3.8×10^{-6} μc/ml	5.8×10^{-7} μc/ml

The decreased efficiency noted by comparison of figures given in Table IV with similar figures for the second quarter of 1954 may be partially explained by the greater flow of water through the purification plant during the hot summer months. However, the efficiency was not as high as that observed during the summer months of 1953.

Alpha particle emitters were detected in 4 samples of Pasco sanitary water with the maximum concentration being 2.6×10^{-8} μc/ml. Concentrations of these emitters in the backwash solids varied from 4.8 to 18×10^{-6} μc/g and in the backwash liquids <5 to 18×10^{-9} μc/ml.

Table V summarizes the results of test well measurements.

TABLE V

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN TEST WELLS JULY, AUGUST, SEPTEMBER 1954

500 ml Samples

Location	Number Samples	Alpha Particle Emitters Units of 10^{-9} µc/ml Max.	Alpha Particle Emitters 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.
300 Area North Well	1	480	480	<5	<5
1.9 - 3.4	1	12	12	<5	<5
17.4 - 4.5	1	5	5	<5	<5
32 - 77	1	<5	<5	19	19
39 - 79	1	6	6	<5	<5
49 - 79	1	8	8	<5	<5
303 - 1	10	900	340	80	11
303 - 2	10	160	110	20	<5
303 - 3	3	110	110	<5	<5
303 - 4	10	440	250	32	<5
303 - 5	3	280	250	<5	<5
303 - 6	10	550	280	18	<5
303 - 7	2	510	490	<5	<5
303 - 8	4	50	30	<5	<5
303 - 9	2	150	120	<5	<5
303 - 10	2	270	230	6	<5
303 - 11	2	220	150	<5	<5
303 - 12	2	580	560	<5	<5
3000 - 7	2	14	8	<5	<5

While several of the wells show increases from the previous quarter's measurements, most increases have been within the ranges of past fluctuations. Concentrations in test wells 303-11 and 303-12 do represent significant increases over the averages of the past two quarters.

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