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RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS

FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1953

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HANFORD TECHNICAL REPORT

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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1953

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By

H. J. Paas

December 5, 1953

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Operated for the Atomic Energy Commission by the General Electric Company under Contract #W-31-109-Eng-52

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ABSTRACT

SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

An average of 2.5 curies of I^{131} per day were emitted to the atmosphere from the separation facilities during the quarter. Approximately 95 per cent of this I^{131} was emitted from the S-plant stack where the maximum emission was 27 curies of I^{131} per 24 hours on July 7, 1953. Average ruthenium emission of 2.7 curies per day was the highest quarterly average recorded to date; maximum emission was 84 curies per day on September 6, 1953. C^{14}, S^{35}, gross beta particle emitters and radioactive particle emission increased at several reactor area stacks. Maximum S^{35} emission was noted at 105-H on August 11, 1953 when 3.6×10^{-3} curie per day was discharged to the atmosphere. There was no significant change in the average tritium oxide emission from the five reactor stacks sampled.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION

Expected decreases in the amount of I^{131} deposited on vegetation occurred after the high deposition noted during the previous quarter when fallout from the Nevada tests influenced the contamination pattern. Average values were less than 3×10^{-6} $\mu c/g$ in residential areas surrounding the plant and ranged from 3×10^{-6} $\mu c/g$ to 1.6×10^{-5} $\mu c/g$ near the separation areas. Maximum deposition was 2.1×10^{-4} $\mu c/g$ south of the 200 West areas. Trace I^{131} was detected at many remote locations during September when reactor failures occurred at the Redox facility. The average activity density of non-volatile beta particle emitters decreased significantly from the previous quarter but the values remained higher than those normally found in the environs. Highly significant increases in this contaminant occurred during the middle and latter part of August and again during the last two weeks of September; these trends appeared coincident with the announcement that nuclear explosions had occurred at foreign locations. In general, non-volatile beta particle emitters averaged between 1 and 2 $\times 10^{-4}$ $\mu c/g$. Samples of crops and fruits showed activity densities comparable to those found on vegetation samples. Alpha particle emitters on vegetation were not significantly different from those measured during the previous quarter.

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SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dosage rates measured by detachable ionization chambers averaged less than 2 mrep/day in all locations except that near the Redox area where the three month average was 2.4 mrep/day. Values at residential areas around the plant ranged from 0.4 to 0.7 mrep/day. The activity density of filterable beta particle emitters in the atmosphere averaged between 1.2 and 9.9×10^{-12} μc/cc at environmental locations. The maximum measurement was 7.2×10^{-11} μc/cc; several values on the order of 3×10^{-11} μc/cc were observed at the same time that highly significant increases in concentrations of airborne radioactive particles were detected. Daily monitoring showed that particulate contamination was widespread and indicated the origin from a source other than Hanford; maximum values in excess of 1 ptle/m^3 were observed over 24 hour periods at locations in Oregon, Washington, and Idaho. A value of 8 ptles/m^3 was measured at Walla Walla on August 30. Increases in particulate contamination were apparently associated with the detonation of atomic bombs at foreign sources. A graph showing the trends of these measurements is included in the text. Airborne concentrations of I^{131} during this period were the highest measured during any quarter of 1953. Average values in the range of 1 to 2×10^{-12} μc/cc were observed near the separation areas and trace activity was detected in nearly all perimeter locations. Alpha particle emitters in the atmosphere remained unchanged from previous values.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES

Daily monitoring of reactor effluent showed that the activity density of beta particle emitters averaged between 3.1 and 4.5×10^{-3} μc/cc. The maximum measurement was 7.8×10^{-3} μc/cc in a sample collected from the 107-D basin. These values represented significant decreases from previous averages at all areas except the 100-D area where a small increase was not significant. Alpha particle emission in reactor effluent averaged less than 5×10^{-9} μc/cc at all areas except 100-DR where the average was 6×10^{-9} μc/cc; maximum measurements ranged from 1×10^{-8} μc/cc to 1.1×10^{-7} μc/cc. One hundred and forty-eight samples analyzed for uranium showed all values below the detection limit of 2×10^{-9} μc/cc. Trace plutonium was found at each reactor at some time during the period although the values barely exceeded the detection limit of 3×10^{-9} μc/cc. Positive polonium values ranged from 6×10^{-10} μc/cc to 1.9×10^{-9} μc/cc. I^{131} discharged to the river from the Biology Farm averaged 0.04 mc/day. Monitoring of 200 areas wastes showed no significant trends except for wide fluctuation noted at the Redox swamp and the 234-5 ditch. Trace uranium was found in the Laundry ditch, B ditch and swamp, and the U-swamp. Ground surveys following visual observation of particle emission from the Redox stack showed readings as high as 15 rep/hr during the middle of August. The contamination was confined to a region immediately south and east of the stack over a short period in August and was reduced to levels on the order of several hundred counts per minute after wind and rain during the latter part of the month. The activity densities of alpha and beta particle emitters in 300 area wastes was on the order of magnitude expected.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

The similarity in the average flow rate of the Columbia River over the past two quarters caused very little change in the average activity density of gross beta particle emitters in the river during the two periods. The average flow rate was 1,305,000 gallons per second during the quarter; average flow rates during July, August, and September were 2,070,000, 1,120,000, and 751,000 gallons per second, respectively. The maximum contamination was measured below the 100-H area where the average activity density was 6.1×10^{-6} μc/cc and the maximum measurement was 2.9×10^{-5} μc/cc. Samples obtained from the Patterson-McNary Dam area showed values on the order of 3×10^{-7} μc/cc. Downstream sampling showed values ranging up to 9.6×10^{-7} μc/cc at locations between Arlington and Vancouver. Trace contamination was detected at Vancouver during each of the three months in the quarter. I^{131} in the Columbia River averaged 8×10^{-8} μc/cc including a maximum measurement of 2.3×10^{-7} μc/cc at the Hanford Ferry. Alpha particle emission in Columbia River water averaged less than 5×10^{-9} μc/cc at all locations. Radioactive contamination in mud samples collected from the shore of the Columbia River was not significantly different from expected values. Two to threefold increases in the average activity density of beta particle emitters in raw water at reactor areas below the 100-C area were largely weighted by high measurements obtained during September when the flow rate of the river was at a minimum. Maximum raw water measurements were obtained at the 100-F area where the average activity density was 6.8×10^{-7} μc/cc including one sample which showed 1.3×10^{-6} μc/cc.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN

Expected significant decreases in the activity density of gross beta particle emitters in rain were observed throughout the environs although current average measurements were still from 10 to 50 times greater than those found during the first quarter of 1953. Particulate contamination entering the environs from outside sources weighted the magnitude of the current measurements. The maximum activity density of beta particle emitters in rain was 4.1×10^{-4} μc/cc in a sample collected at Riverland; the average activity density at this location was 2.1×10^{-4} μc/cc. Radioautographs of the evaporated rain of the samples showed evidence of particulate contamination during August and September.

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

Trace alpha particle emission identified as uranium was found in several wells in the Benton City and Richland area. Individual samples showed uranium ranging from 4×10^{-9} μc/cc to 3×10^{-8} μc/cc. Drinking water supplies showing detectable beta particle emission were those which used the Columbia River as a source of water. Sanitary water at the reactor areas showed this activity as high as 9.2×10^{-7} μc/cc in individual samples; samples from remote locations such as Kennewick and Pasco showed average values of 1.6×10^{-7} and 2.5×10^{-7} μc/cc, respectively. Samples obtained from various stages in the filtration process at the Pasco Filter Plant showed little change in the amount of contamination detected during this period when compared to similar measurements during the previous quarter. Trace quantities of alpha and beta particle emission were detected in several widely scattered test wells on the site; however, the magnitude of the positive results and the frequency of the occurrences was not indicative of a trend or departure from previously observed values.

INTRODUCTION

The magnitude and extent of radioactive contamination in the Hanford environs during July, August, and September, 1953, were determined from the results of over 20,000 samples and surveys obtained by the Regional Survey forces of the Biophysics Section. Various samples of material in the liquid, solid, and gaseous states were analyzed by the Control Laboratory according to radiochemical procedures as described in HW-20136. The subsequent counting rates obtained from these analyses were corrected for geometry, backscatter, self absorption, air-window absorption, collection efficiency, sources size, chemical yield, and weight-volume by the Control Services group according to correction factors itemized in documents HW-22682, HW-23769, and HW-27584. Decay corrections were applied to measurements for specific isotopes and to selected gross beta measurements which included short half-life emitters. The monitoring methods used by Regional Survey forces followed those procedures discussed in previous publications of this series (HW-27641, HW-28009, and HW-29514).

The locations at which the samples were collected may be identified from a series of maps which have been presented in HW-29514. Project boundaries indicated on the location maps are those defined by the Atomic Energy Commission in drawing SK-7-414.

Summaries of the results of these measurements are presented in Sections I through VII which discuss the amounts of contamination discharged in plant effluent materials and their effect on contamination of vegetation, soil, air, and water in the Hanford environs.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

The amounts of radioactive materials discharged to the atmosphere from the various manufacturing facilities were determined from the radiochemical analysis of samples collected directly from the stacks and discharge ducts at separation and reactor facilities. Continuous filter and scrubber samples from the separation facilities and daily intermittent samples from the reactor areas were employed; supplementary measurements were obtained from the inlet and outlet the the S-plant sand filter. The results of these findings are summarized for each monitoring location.

SEPARATION AREAS

200 EAST AREA

Approximately 20 curies of I^{131} were available in the irradiated metal dissolved at the C-plant during the present quarter compared to about 100 curies available during the previous quarter.

Results obtained from monitoring at the fifty foot level of the C-plant stack are presented in Table I. The samples were collected by a filter and scrubber in series and the results reported in the table represent the combined filter and scrubber measurements. Specific analyses for I^{131} and ruthenium were not performed unless the gross beta analysis indicated that more than 1.0×10^{-2} curie per day of gross beta particle emitters was emitted from the stack.

[redacted]

TABLE I

SUMMARY OF RESULTS FROM STACK MONITORING

C-PLANT STACK

JULY, AUGUST, SEPTEMBER

1953

Month	Curie of Gross Beta Particle Emitters Emitted Daily — Maximum	Curie of Gross Beta Particle Emitters Emitted Daily — Average	Curie of I^{131} Emitted Daily — Maximum	Curie of I^{131} Emitted Daily — Average	Curie of Ruthenium Emitted Daily — Maximum	Curie of Ruthenium Emitted Daily — Average
July	0.16	$<1.8 \times 10^{-2}$	5.7×10^{-3}	----	0.16	----
August	2.4×10^{-2}	$<6.6 \times 10^{-3}$	1.0×10^{-2}	$<9.8 \times 10^{-4}$	3.0×10^{-2}	3.3×10^{-3}
September	4.3×10^{-2}	$<4.2 \times 10^{-3}$	3.0×10^{-4}	9.0×10^{-5}	9.9×10^{-3}	1.2×10^{-3}
Quarter	0.16	$<8.4 \times 10^{-3}$	1.0×10^{-2}	$<5.8 \times 10^{-4}$	0.16	2.4×10^{-3}
Last Quarter	8.8×10^{-2}	$<4.0 \times 10^{-3}$	2.6×10^{-3}	$<3.4 \times 10^{-4}$	5.5×10^{-2}	$<4.7 \times 10^{-3}$

[redacted]

[redacted]

The one unusually high gross beta measurement during July was obtained on the sample collected between July 20 and July 22, 1953. All but a trace of the active material was found to be ruthenium; the I^{131} emission during this period was 5.7×10^{-3} curie per day.

There were no other I^{131} and ruthenium analyses performed during July and the single high measurement was not included in the monthly and quarterly averages for I^{131} and ruthenium emission.

200 WEST AREA - T-PLANT

Table II summarizes the results obtained from I^{131} monitoring at the fifty foot level of the T-plant stack.

TABLE II

SUMMARY OF RESULTS FROM I^{131} MONITORING
T-PLANT STACK
JULY, AUGUST, SEPTEMBER
1953

Month	Curies of I^{131} Dissolved per 24 hours		Curies of I^{131} Emitted Daily	
	Maximum	Average	Maximum	Average
July	1300	330	0.60	0.25
August	300	75	0.50	0.13
September	440	87	0.68	0.13
Quarter	1300	160	0.68	0.16
Last Quarter	1600	220	1.2	0.20

[redacted]

Shorter average cooling time of the metal dissolved during July, as compared to August and September, was reflected in the increased amounts of I^{131} available in the dissolvers and in the higher I^{131} emission rate from the stack during that month. The absence of any silver reactor failures at T-plant for several months was responsible for the continued low I^{131} emission rate from this stack.

200 WEST AREA - S-PLANT

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

TABLE III

SUMMARY OF RESULTS FROM I^{131} MONITORING
S-PLANT STACK
JULY, AUGUST, SEPTEMBER
1953

	Curies of I^{131} Dissolved Daily		Curies of I^{131} Emitted Daily	
Month	Maximum	Average	Maximum	Average
July	1300	490	27	3.9
August	890	290	1.8	0.47
September	910	250	12	1.8
Quarter	1300	340	27	2.3
Last Quarter	690	180	19	1.7

A reduction of four days in the average cooling time of the irradiated metal processed at S-plant during this quarter, as compared to the previous quarter, and an increased production schedule were responsible for the increased amount of I^{131} available in the dissolvers.

On July 7, 27 curies of I^{131} were emitted from the S-plant stack over a 24 hour period. During the week following this high I^{131} emission, both A and B cell silver reactors were regenerated. The I^{131} emission was measurably reduced but further regeneration was required during the week ending July 19 before the I^{131} emission rate was reduced to its former value.

Failure of the C cell silver reactor was responsible for the emission of 12 curies of I^{131} from the S-plant stack on September 3. Before regeneration of this reactor was accomplished, 23 curies of I^{131} were emitted to the atmosphere over a 3 day period. Regeneration effectively reduced the emission rate to approximately 0.5 curie of I^{131} per day during the remainder of the quarter.

Table IV is a summary of the results obtained from ruthenium monitoring at the S-plant stack.

TABLE IV

SUMMARY OF RESULTS FROM RUTHENIUM MONITORING

S-PLANT STACK

JULY, AUGUST, SEPTEMBER

1953

Ruthenium Emission

Curies Per Day

	Filter Collection		Scrubber Collection		Total	
Month	Maximum	Average	Maximum	Average	Maximum	Average
July	3.0	0.70	$<4.8 \times 10^{-2}$	$<1.5 \times 10^{-2}$	3.0	<0.72
August	2.5	0.67	0.77	<0.15	3.0	<0.82
September	84	5.3	3.8	0.67	84	6.0
Quarter	84	2.4	3.8	<0.31	84	<2.7
Last Quarter	3.1	0.19	0.46	$<1.6 \times 10^{-2}$	3.1	<0.21

Failure of the steam heating equipment on the H-4 oxidizer was responsible for emission of 137 curies of ruthenium over a 6 day period; maximum emission of 84 curies per day occurred on September 6. Insufficient heating of the H-4 vessel resulted in retention of some of the ruthenium in the solution and its release during subsequent operations where the effluent gases were not passed through a caustic scrubber. Replacement and removal of the faulty equipment to the burial ground during the week following the unusually high measurements reduced the ruthenium emission to approximately 0.5 curie per day during the remainder of the quarter.

The moving of this highly contaminated equipment released a large amount of particulate contamination to the ventilation air tunnel and two unusually high air filter samples were collected from the inlet to the S-plant sand filter during the week in which the removal occurred. Table V summarizes the results of the filter measurements at this location during the present quarter.

TABLE V

SUMMARY OF FILTER MEASUREMENTS
S-PLANT SAND FILTER INLET
JULY, AUGUST, SEPTEMBER
1953

	Gross Beta Particle Emitters Units of 10^{-3} $\mu c/ft^3$		mrep/hr per μc*	
Month	Maximum	Average	Maximum	Average
July	5.5	1.3	97	46
August	16	4.0	100	42
September	370	39	95	39
Quarter	370	14	100	39
Last Quarter	90	8.2	590	74

*Dosage determined from CP instrument surface reading.

The activity of beta particle emitters contained on the filter removed on September 16, was estimated from the CP meter surface reading of 50,000 mrep/hr to be approximately 1 mc. Based on this estimate, the activity density of gross beta particle emitters in the inlet gas was 0.37 $\mu c/ft^3$ and 20 curies of these emitters passed into the sand filter over a 24 hour period. The sampling filter operated at the outlet of the sand filter was removed on September 18 after 13 days of operation and contained 0.08 mc of gross beta particle emitters. The results of the measurements on this outlet filter indicated that around 1 mc passed out of the sand filter during the 13 day period. Assuming that the majority of these emitters passed out of the sand filter during the 24 hours of highest activity density in the inlet gas, the efficiency of the sand filter was calculated to be greater than 99.99 per cent.

Table VI is a summary of the results of measurements of the concentrations of radioactive particles in the gas leaving the sand filter during the quarter.

TABLE VI

SUMMARY OF PARTICLE MEASUREMENTS
S-PLANT SAND FILTER OUTLET
JULY, AUGUST, SEPTEMBER
1953

	Radioactive Particles			
	Units of 10^{-4} Particles/ft^3		Units of 10^3 Particles/day	
Month	Maximum	Average	Maximum	Average
July	6.4	6.4	37	37
August	20	14	110	81
September	700	330	3600	1900
Quarter	700	100	3600	580
Last Quarter	78	24	450	140

Increases in the concentration of radioactive particles in the gas leaving the sand filter compared favorably to the increases noted in the activity density of the total beta particle emitters in the gas entering the sand filter (Table V).

200 WEST AREA - U-PLANT STACK

The results obtained from filter measurements at the ten foot level of the U-plant stack are summarized in Table VII.

TABLE VII

SUMMARY OF FILTER MEASUREMENTS U-PLANT STACK JULY, AUGUST, SEPTEMBER 1953

	Gross Alpha Particle Emitters		Gross Beta Particle Emitters		Radioactive Particles	
	Units of 10^{-8} curie/day		Units of 10^{-5} curie/day		Units of 10^{4} particles/day*	
Month	Maximum	Average	Maximum	Average	Maximum	Average
July	8.5	4.2	9.3	4.1	30	7.3
August	7.0	3.5	8.7	4.6	24	9.0
September	25	12	88	38	>66	>37
Quarter	25	6.5	88	16	>66	>17
Last Quarter	25	3.1	3.4	0.8	4.9	1.4

*The radioautographs from the filters during September contained too high a concentration of darkened spots to allow accurate counting.

The upward trend noted last quarter in the activity density of the U-plant stack gases continued during the present quarter. Increases in the average radioactive particle concentrations caused radioautographs taken during September to be too dark to allow an accurate estimation of the number of darkened spots per film. Measurements of the gross emitters entering the sand filter, performed by the Industrial Hygiene forces as part of their particle size distribution studies, showed that the activity density of the gas entering the sand filter had increased during September. The increases in the emission rates from the U-plant stack reflect these increases in activity density of the gases entering the sand filter and do not necessarily indicate a decreased sand filter efficiency.

REACTOR AREAS

Reactor area stack gases were sampled from the ventilation ducts near the stack breeching. Tables VIII through XII summarize the results of the analysis of these samples for tritium oxide, C^{14}, S^{35}, radioactive particles, and gross alpha and beta particle emitters.

[redacted]

TABLE VIII

SUMMARY OF STACK MONITORING RESULTS

105-F STACK

JULY, AUGUST, SEPTEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Gross Alpha Units of 10^{-7}	Filterable Particle Emitters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} Particles/day
July						
Maximum	0.06	<4.5	10.6	7.7	82	21
Average	0.04	<4.5	4.9	5.2	59	6.5
August						
Maximum	0.40	11.9	18.5	7.2	800	30
Average	0.13	4.9	7.5	4.0	310	19
September						
Maximum	0.15	9.1	<4.5	8.3	210	>82*
Average	0.06	<4.5	<4.5	2.5	92	>57*
Quarter						
Maximum	0.40	11.9	18.5	8.3	800	>82*
Average	0.07	<4.5	4.5	3.8	160	>28*
Last Quarter						
Maximum	0.18	<4.5	<4.5	22	10	12
Average	0.07	<4.5	<4.5	5.4	2.6	1.6

*Several particle filters during September contained too many radioactive particles to permit accurate radioautography.

[redacted]

TABLE IX

SUMMARY OF STACK MONITORING RESULTS

105-D STACK

JULY, AUGUST, SEPTEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Gross Alpha Units of 10^{-7}	Filterable Particle Emitters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^5 Particles/day
July						
Maximum	0.12	<4.5	9.0	5.6	350	5.2
Average	0.05	<4.5	5.1	3.1	160	1.7
August						
Maximum	0.49	4.7	12	4.0	470	24
Average	0.19	<4.5	8.2	2.1	380	12
September						
Maximum	0.21	<4.5	<4.5	5.4	540	>85*
Average	0.08	<4.5	<4.5	1.8	210	>57*
Quarter						
Maximum	0.49	4.7	12	5.6	540	>85*
Average	0.11	<4.5	<4.5	2.3	260	>25*
Last Quarter						
Maximum	0.32	<4.5	14	13	470	21
Average	0.07	<4.5	<4.5	3.3	240	4.3

*Several particle filters during September contained too many radioactive particles to permit accurate radioautography.

TABLE X

SUMMARY OF STACK MONITORING RESULTS

105-DR STACK

JULY, AUGUST, SEPTEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Gross Alpha Units of 10^{-7}	Filterable Particle Emitters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} Particles/day
July						
Maximum	0.10	<4.5	5.9	2.7	0.10	<0.96
Average	0.04	<4.5	<4.5	1.3	0.06	<0.22
August						
Maximum	0.17	<4.5	<4.5	4.1	0.7	2.5
Average	0.05	<4.5	<4.5	2.5	0.4	1.1
September						
Maximum	0.07	<4.5	8.2	0.4	0.4	5.8
Average	0.05	<4.5	<4.5	0.3	0.1	1.7
Quarter						
Maximum	0.17	<4.5	8.2	4.1	0.7	5.8
Average	0.04	<4.5	<4.5	1.3	0.2	1.0
Last Quarter						
Maximum	0.20	<4.5	7.9	2.6	0.5	0.9
Average	0.05	<4.5	<4.5	1.0	0.2	0.2

[redacted]

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TABLE XI

SUMMARY OF STACK MONITORING RESULTS

105-H STACK

JULY, AUGUST, SEPTEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Gross Alpha Units of 10^{-7}	Filterable Particle Emitters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} Particles/day
July						
Maximum	0.11	<4.5	25	8.8	12	4.9
Average	0.03	<4.5	12	4.8	4.4	1.9
August						
Maximum	0.25	<4.5	36	8.5	8.5	340
Average	0.09	<4.5	11	3.6	4.0	100
September						
Maximum	0.33	<4.5	5.7	5.0	56	670
Average	0.08	<4.5	<4.5	2.1	23	120
Quarter						
Maximum	0.33	<4.5	36	8.8	56	670
Average	0.07	<4.5	8.2	3.4	11	80
Last Quarter						
Maximum	0.29	<4.5	10	43	6.5	57
Average	0.07	<4.5	4.5	10	2.8	15

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TABLE XII

SUMMARY OF STACK MONITORING RESULTS

105-C STACK

JULY, AUGUST, SEPTEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Gross Alpha Units of 10^{-7}	Filterable Particle Emitters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} Particles/day
July						
Maximum	0.04	<4.5	5.3	5.0	1.9	52
Average	0.01	<4.5	<4.5	2.7	1.7	37
August						
Maximum	0.21	<4.5	18	3.8	9.1	50
Average	0.05	<4.5	12	2.6	4.5	31
September						
Maximum	0.10	7.1	8.6	5.5	23	110
Average	0.03	<4.5	<4.5	2.6	10	66
Quarter						
Maximum	0.21	7.1	18	5.5	23	110
Average	0.03	<4.5	6.8	2.6	5.5	47
Last Quarter						
Maximum	0.09	<4.5	12	3.3	35	100
Average	0.02	<4.5	<4.5	1.3	6.4	39

 [redacted]

[redacted]

There were no significant changes in the average tritium oxide emission rate from the reactor stacks during the quarter. The total average emission from the five reactor stacks sampled was 0.32 curie of tritium oxide per day during the present quarter, compared to 0.28 curie per day during the previous quarter.

Several positive C^{14} measurements were noted at the 105-F stack during the quarter. The maximum measurement was 1.2×10^{-2} curie of C^{14} per day on August 11, 1953. Occasional positive C^{14} measurements were also noted at 105-D and 105-C during the quarter although the average emission rate was below the individual sample detection limit of 4.5×10^{-3} curie per day at all five reactor stacks.

Increases in the S^{35} emission rates were noted at the 105-F, 105-H, and 105-C stacks. The maximum S^{35} emission of 3.6×10^{-3} curie per day occurred at 105-H on August 11, 1953; the average S^{35} emission from this stack was 8.2×10^{-4} curie per day during the present quarter compared to $<4.5 \times 10^{-4}$ curie per day during the previous quarter.

Significant decreases in the average gross alpha particle emitter activity density in stack gases emitted from 105-H were noted during the present quarter. A review of the results of these measurements show that this decrease was the result of a steady downward trend throughout the entire 3 month period. There were no significant changes in the gross alpha particle emitter activity density in effluents from the other reactor stacks.

The average activity density of gross beta particle emitters in the reactor stack gases increased during the latter part of the quarter coincident with increases in the concentrations of radioactive particles. Some of these increases may have been influenced by the influx of radioactive particles from a source outside of Hanford (Section III). A possible explanation may be increases in the amount of particulate contamination entering the reactor buildings with the ventilation air.

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Approximately 2500 vegetation samples were collected from the Hanford environs to determine the extent and magnitude of radioactive contamination deposited by effluent gases. Nearly 1800 of these samples were obtained from locations in the immediate environs; the remaining samples were collected at remote locations in eastern Washington, southern Washington, and northern Oregon. All samples were analyzed for the activity density of I^{131} and over one-half of the samples were analyzed for the activity density of non-volatile beta particle emitters. Table I summarizes the results obtained from the beta particle measurements at generalized locations in the environs; average results representing the previous quarter's monitoring are included for comparison.

[redacted]

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION
JULY, AUGUST, SEPTEMBER
1953

	I^{131} Units of 10^{-6} μc/g				Non-Volatile Emitters Units of 10^{-6} μc/g		
Location	No. Samples	Max.	Avg.	Last Qtr. Avg.	Max.	Avg.	Last Qtr. Avg.
North of 200 Areas	212	26	3	51	1400	270	2200
Near the 200 Areas	148	34	5	70	1300	330	940
Route 3	13	19	7	16	----	---	----
200 West Gate	65	51	16	65	1100	210	460
200 East Tower #16	64	27	6	27	1800	200	330
Batch Plant	39	25	9	26	1100	220	220
Meteorology Tower	13	27	10	82	----	---	----
South of 200 Areas	349	210	4	32	1100	170	810
Richland	162	18	<3	39	1400	190	520
Pasco Environs	77	18	<3	39	560	110	720
Kennewick Environs	122	53	<3	31	1200	120	720
Benton City - Kiona	39	25	<3	33	1100	180	920
Richland "Y"	12	9	<3	7	----	---	----
Hanford	13	10	<3	3	----	---	----
200 East Area	48	8	<3	4	240	58	68
200 West Area	110	86	6	17	310	88	250
Redox Area	82	36	10	120	----	---	13000
Wahluke Slope	56	8	<3	<3	550	80	130
Goose Egg Hill	21	10	<3	4	75	48	110
Rattlesnake Mountain	62	21	5	<3	1000	260	37
PSN-300-310-330	39	18	5	69	490	140	210
Off-Area Sampling							
Pasco to Ringold	50	15	4	3	650	170	96
Prosser to Patterson-McNary	264	33	3	31	1500	140	1200
Eastern Washington	194	7	<3	260	330	53	4600
So. Washington and No. Ore.	248	47	<3	45	590	110	2000
Yakima Barricade to Ellensburg	---	--	-	320	----	---	4100

[redacted]

 [redacted]

The decrease of the average amount of I^{131} deposited on vegetation from the previous quarter's values was expected as the deposition of I^{131} and I^{133} during the previous quarter was influenced significantly by fallout from the test detonations at Nevada (HW-28925). The current average values were generally equal to or less than those which were found during the first three months of 1953 when the deposition pattern was not influenced by fallout from sources other than Hanford.

A review of the I^{131} measurements on a month-to-month basis shows that the deposition of I^{131} was negligible during July and August and that trace activity from this contaminant prevailed in most of the immediate environs during the month of September. The trend of these data may be appraised from the results shown in Table II which tabulates the data on a month-to-month basis and which also may be viewed as a deposition pattern in Figures 1 thru 3 which shows the estimated iso-activity distribution based on the individual sample results obtained during each of the three months in the quarter.

[redacted]

TABLE II

ACTIVITY DENSITY FROM I^{131} ON VEGETATION

JULY, AUGUST, SEPTEMBER

1953

Units of 10^{-6} μc/gram

Location	July Max.	July Avg.	August Max.	August Avg.	September Max.	September Avg.
North of 200 Areas	26	<3	18	<3	24	6
Near 200 Areas	10	<3	30	3	34	9
Route 3	18	8	7	3	19	10
200 West Gate	51	24	49	12	33	11
200 East Tower #16	11	4	26	3	27	9
Batch Plant	24	8	25	7	25	11
Meteorology Tower	12	8	27	12	12	11
South of 200 Areas	15	<3	36	<3	210	8
Richland	6	<3	15	<3	18	5
Pasco Environs	4	<3	6	<3	18	4
Kennewick Environs	53	<3	11	<3	22	5
Benton City - Kiona	6	<3	9	<3	25	7
Richland "Y"	<3	<3	<3	<3	9	4
Hanford	<3	<3	6	<3	10	5
200 East Area	8	<3	6	<3	6	<3
200 West Area	86	10	33	4	14	5
Redox Const. Area	25	8	15	5	36	14
Wahluke Slope	--	--	8	<3	8	7
Goose Egg Hill	--	--	10	<3	--	--
Rattlesnake Mountain	8	<3	--	--	21	10
PSN-300--310-320	10	5	17	3	18	8
Off-Area Sampling						
Pasco to Ringold	--	--	9	<3	15	6
Prosser to Patterson-McNary	8	<3	12	<3	33	6
Eastern Washington	4	<3	6	<3	7	<3
So. Washington and No. Ore.	8	<3	7	<3	47	4

[redacted]

The random deposition of trace quantities of I^{131} over small areas as shown in Figures 1 and 2 for the months of July and August was comparable to that deposition pattern found during February, March, April, and early May, 1953. The increase in the extent and magnitude of the deposition as indicated in Figure 3 for the month of September was associated with failure of a silver reactor at the 202-S facility which allowed highly significant quantities of I^{131} to be emitted over a three day period (Section I). These results may also have been influenced by fallout of fission products from outside sources.

Figure 4 is an estimated iso-activity map showing the average deposition of I^{131} based on all measurements obtained during the quarter.

The activity density of non-volatile beta particle emitters decreased from the previous high values which were associated with the fallout from the Nevada tests to values which were still higher than those normally found in the Hanford environs. Average values during this period were three to four times greater than those normally found for Hanford operation and the maximum measurements were approximately 10 times greater than the expected maximum value. A detailed study of data collected from three control plots located in Richland, Kennewick, and Pasco shows that the activity density of non-volatile beta particle emitters was less than 1×10^{-4} µc/g during the middle and toward the latter part of July. Highly significant increases appear during the middle and latter part of August and again during the last two weeks of September. These increases correlated with the findings from the air monitoring program (Section III) and were coincident with the announcement that nuclear explosions had occurred at foreign locations. Values at the control plots during the last week of the quarter were from two to four times greater than those normally expected. Figure 5 shows the trends of the measurements obtained from monitoring the three control plots discussed above.

Table III summarizes the results obtained from analyzing samples collected at remote locations for the activity density of I^{131} and of non-volatile beta particle emitters.

TABLE III

RADIOACTIVE CONTAMINATION ON VEGETATION OFF-AREA LOCATIONS 1953

Units of 10^{-6} $\mu c/g$

Location	I^{131} No. Sample	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters No. Sample	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Wallula	6	5	<3	3	330	150
Touchet	6	<3	<3	3	49	36
Walla Walla	12	7	<3	6	35	21
Dixie	6	<3	<3	3	49	31
Waitsburg	12	6	<3	6	130	60
Dayton	12	<3	<3	6	80	42
Pomeroy	12	4	<3	6	200	55
Lewiston	12	4	<3	6	75	43
Uniontown	6	5	<3	3	230	95
Pullman	12	7	<3	6	130	61
Colfax	6	5	<3	4	88	53
Steptoe	6	5	<3	3	130	76
Rosalia	6	7	<3	2	66	48
Spokane	12	3	<3	6	83	36
Cheney	12	<3	<3	6	66	34
Sprague	10	5	<3	5	45	27
Ritzville	12	<3	<3	6	97	55
Lind	12	6	<3	6	74	55
Connell	12	5	<3	6	300	100
Lowden	6	<3	<3	3	44	36
Spangle	4	<3	<3	2	29	26
Moxee City	12	4	<3	6	79	34
Union Gap	6	4	<3	4	190	72
Wapato	12	4	<3	6	450	110
Toppenish	12	4	<3	6	360	100
Toppenish to Goldendale	25	47	4	10	370	130

TABLE III (contd.)

Units of 10^{-6} μc/g

Location	I^{131} No. Sample	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters No. Sample	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Goldendale	12	14	3	6	340	92
Goldendale to Wishram	9	5	<3	1	51	51
Lyle	6	5	<3	3	69	36
Bingen	6	3	<3	3	110	60
Omak	12	7	<3	4	800	250
Vancouver	11	7	<3	5	290	85
Portland	12	8	<3	5	960	210
Troutdale	6	8	<3	3	500	180
Bonneville	6	6	<3	3	340	130
Hood River	6	5	<3	3	51	37
The Dalles	12	7	<3	6	220	66
Moody	6	7	<3	3	490	180
Rufus	6	4	<3	3	120	50
Blalock	6	11	<3	2	520	280
Arlington	6	8	<3	2	670	360
Heppner Junction	6	4	<3	2	270	190
Boardman	6	4	<3	2	150	92
Pendleton	6	9	<3	6	200	97
Meacham	4	4	<3	3	71	45
La Grande	4	<3	<3	4	590	190
North Powder	3	7	<3	3	140	91
Haines	3	7	<3	3	120	76
Baker	4	<3	<3	4	180	76
Pleasant Valley	1	<3	<3	1	31	31
Durkee	3	4	<3	3	290	130
Huntington	3	<3	<3	3	580	220
Payette, Idaho	4	5	<3	2	40	38
Junction, U. S. #30	1	<3	<3	1	40	40
Middleton	2	<3	<3	2	47	31
Boise	6	3	<3	6	110	72
Caldwell	2	5	4	1	120	120

A review of the data summarized in Table III shows that the same trends were observed at remote locations as were found in the immediate environs. Positive indications of I^{131} prevailed at many of the locations during the month of September and the non-volatile beta particle measurements which were significant were closely associated with the fallout of particulate contamination.

A number of samples of various crops and fruits grown in the farming area near the plant were analyzed for the activity density of I^{131} and non-volatile beta particle emitters. In all cases, the activity densities were comparable to those found on the predominant vegetation samples routinely collected from the same areas.

The activity density from gross alpha particle emitters on vegetation was determined by analyzing weekly samples collected at nine locations in the immediate environs. Table IV summarizes the results obtained from these measurements.

TABLE IV
ACTIVITY DENSITY
OF GROSS ALPHA PARTICLE EMITTERS ON VEGETATION
JULY, AUGUST, SEPTEMBER
1953

Location	July	August	September	Quarterly Average	Max. Result
	Units of 10^{-6} μc/gram				
Near 200 Areas					
200 West Gatehouse	19	15	27	21	46
Batch Plant	33	34	43	37	54
Rt. 4S Mile 4	7	17	19	14	33
Meteorology Tower	46	13	71	43	79
Rt. 4S Mile 6	8	6	6	7	10
300 Area	120	44	69	69	120
Outlying					
Richland	94	18	15	38	150
Pasco	29	8	17	20	54
Benton City	<5	<5	6	<5	8

[redacted]

The average activity density of alpha particle emitters on vegetation was not significantly different from that measured during the previous quarter. Examination of individual measurements showed that maximum values were generally lower during this quarter and the contamination pattern fluctuated less than during the previous three months. The data were not indicative of any trend occurring within the period.

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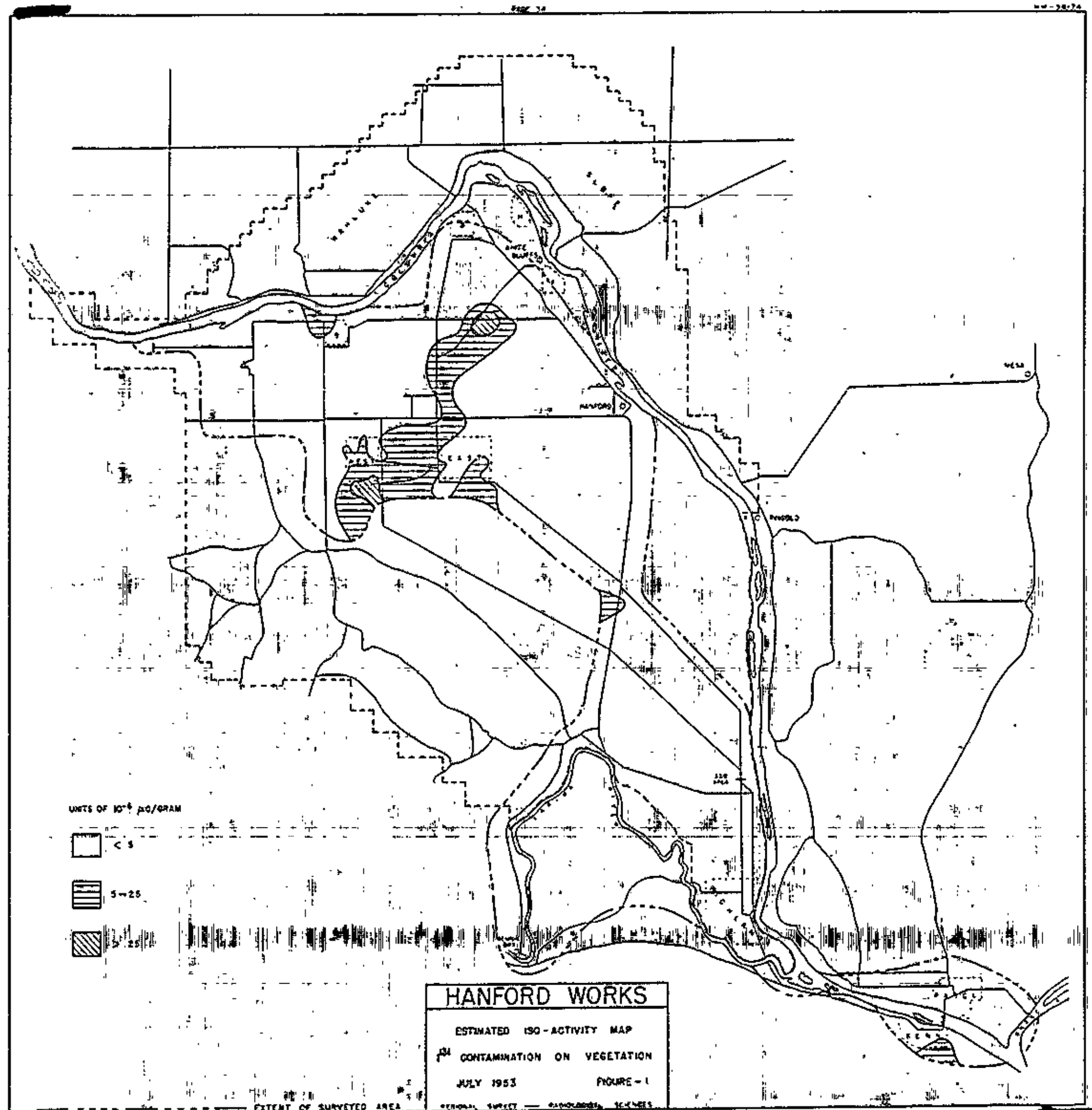

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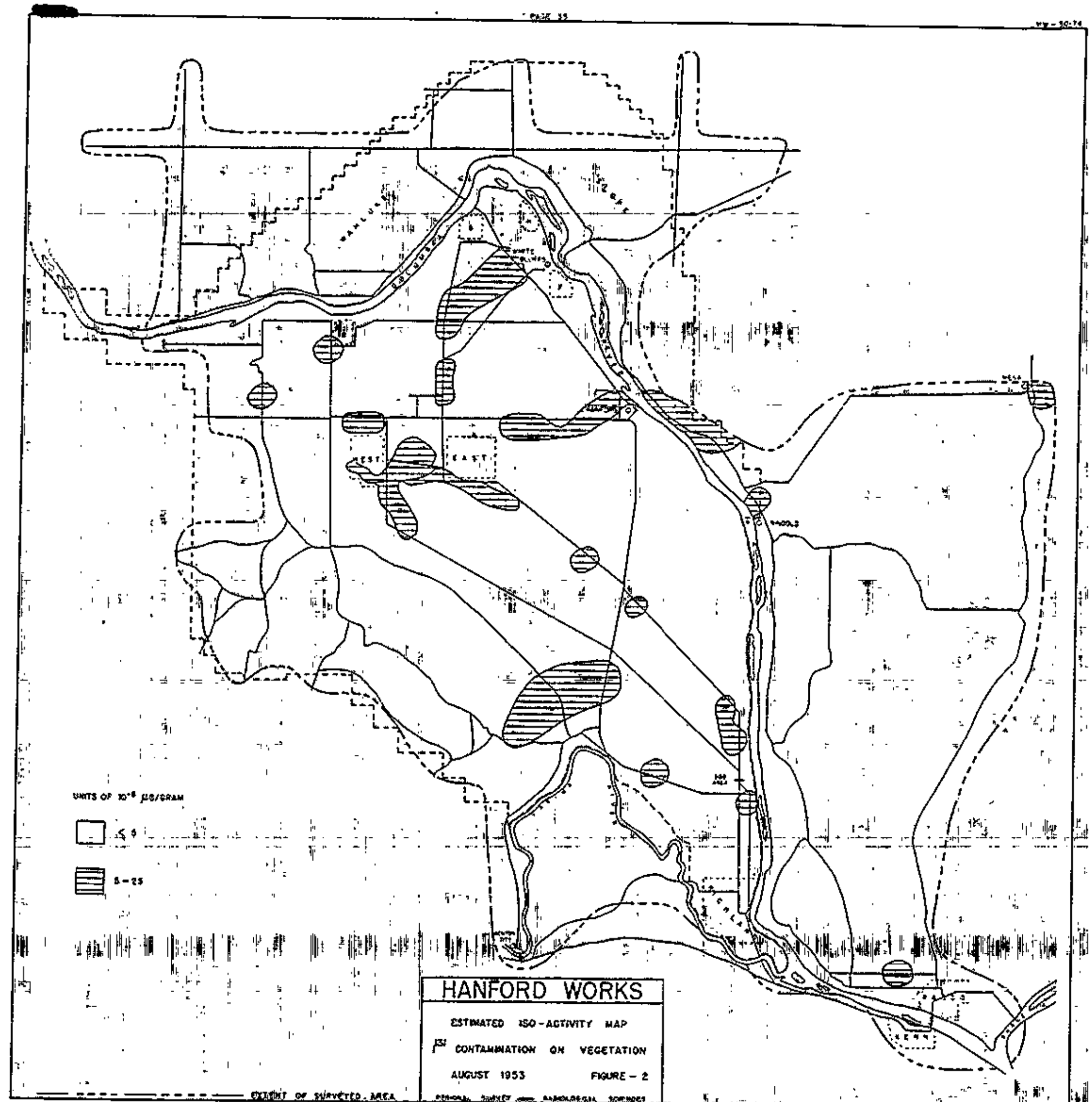

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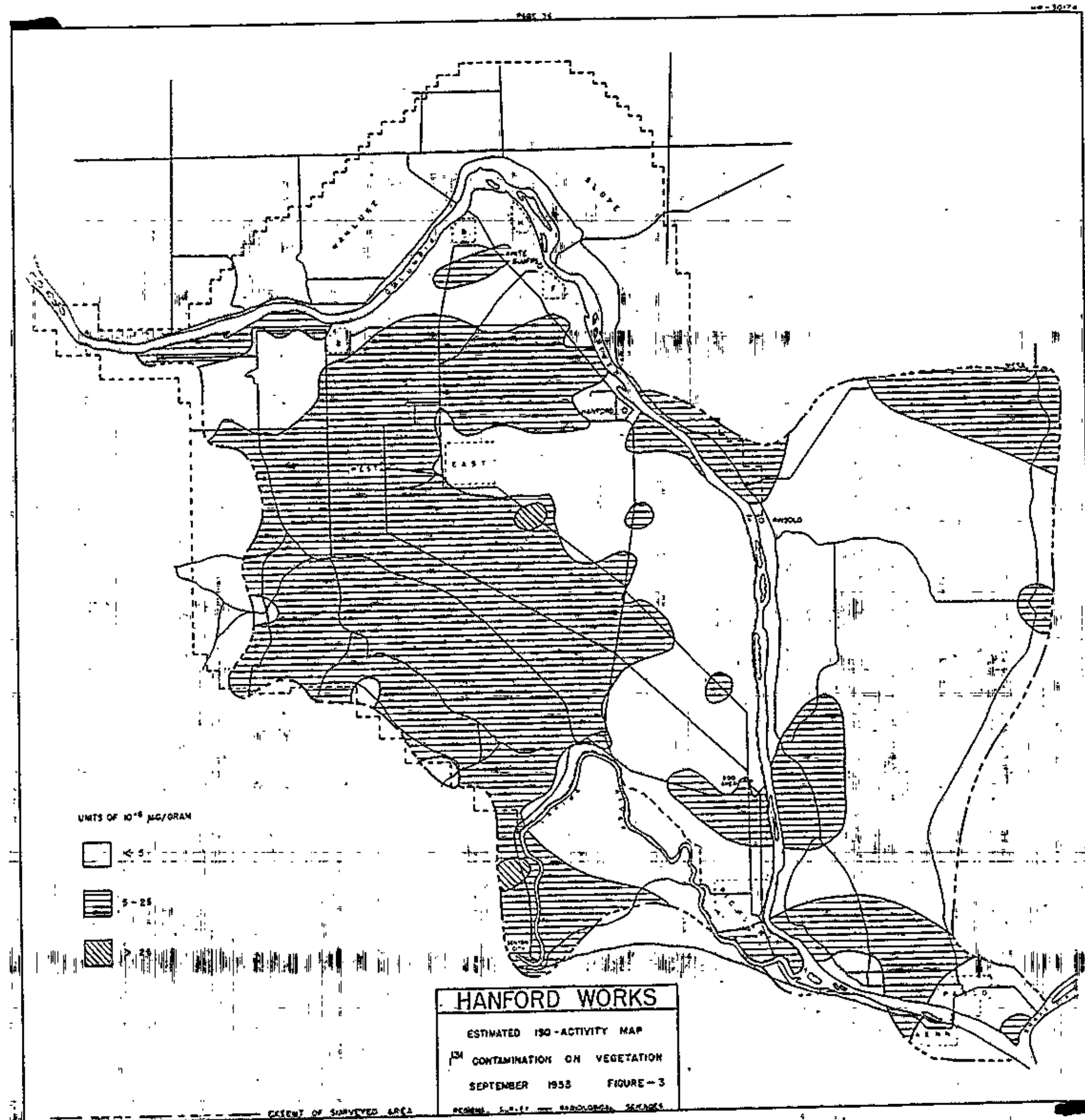
UNITS OF 10^{-6} µC/GRAM
< 5
5 - 25
WEST
EAST
HANFORD
HANFORD WORKS
ESTIMATED 130-ACTIVITY MAP
I^{131} CONTAMINATION ON VEGETATION
SEPTEMBER 1953 FIGURE - 3
EXTENT OF SURVEYED AREA

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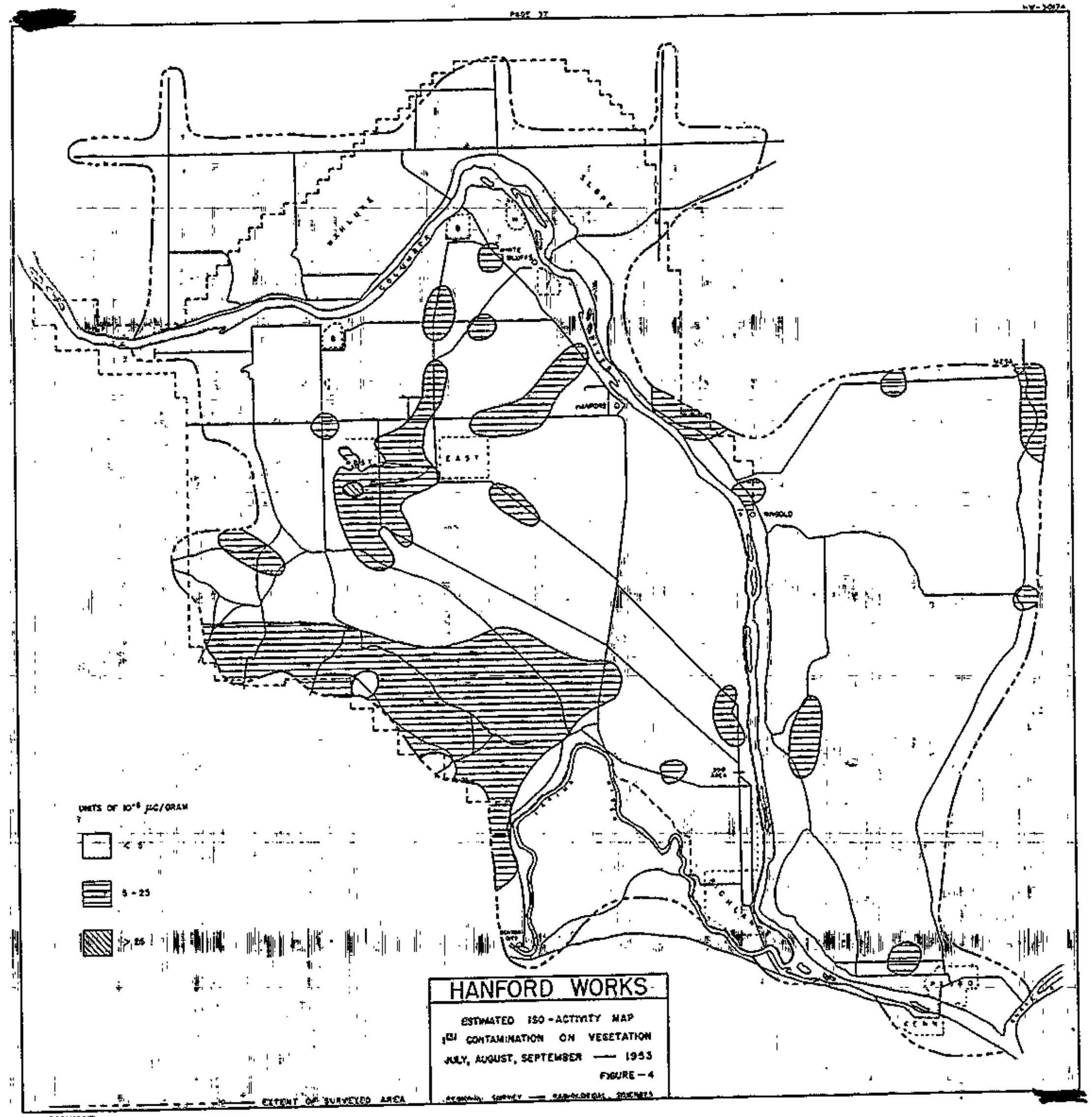

HANFORD WORKS

ESTIMATED ISO-ACTIVITY MAP

I131 CONTAMINATION ON VEGETATION

JULY, AUGUST, SEPTEMBER — 1953

FIGURE - 4

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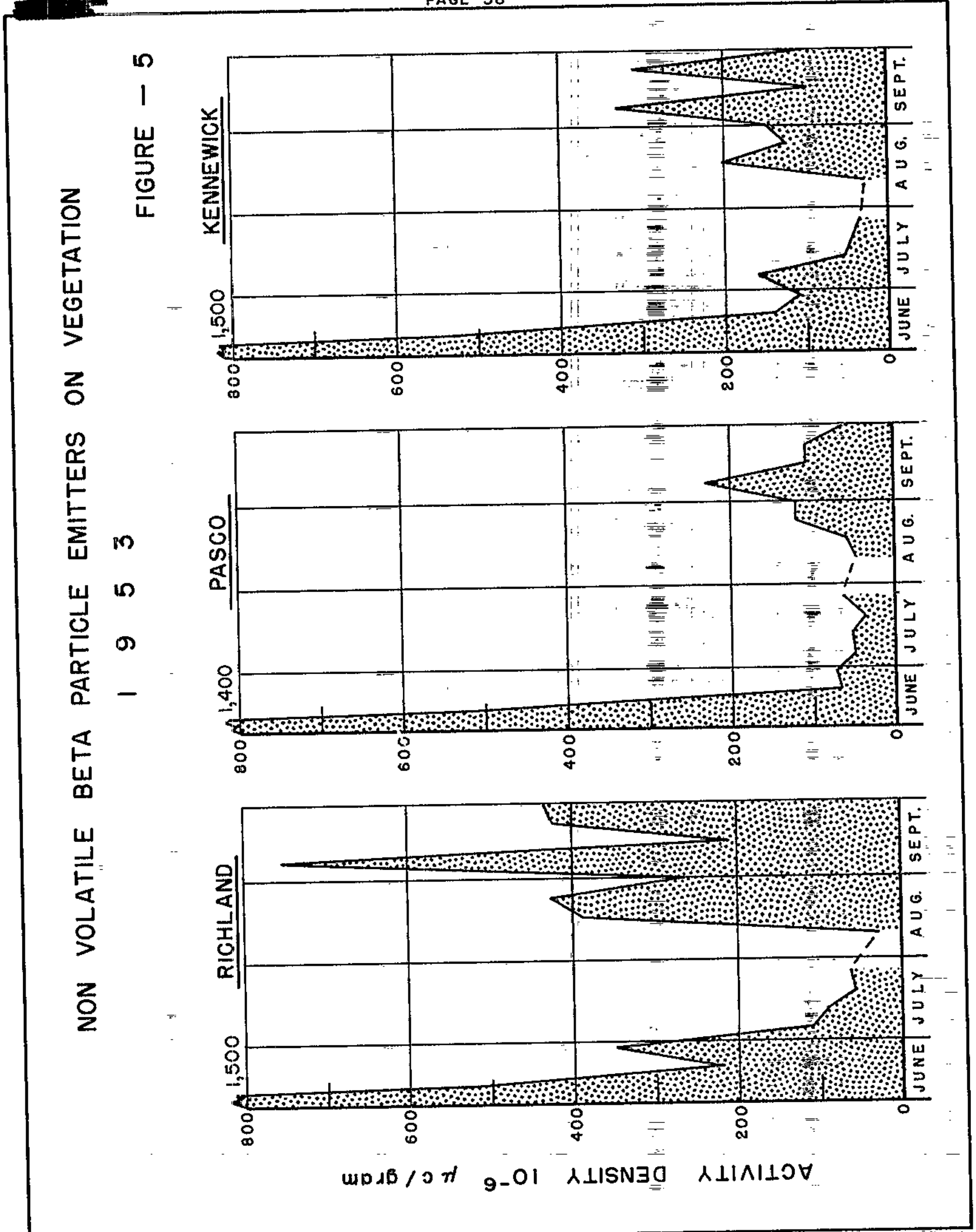

NON VOLATILE BETA PARTICLE EMITTERS ON VEGETATION

1 9 5 3

FIGURE — 5

AEC-GE-RICHLAND, WASH.

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SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Radiation dosage rates from airborne contaminants and from radioactive material on the ground were evaluated from data recorded from operation of Victoreen Integrons and detachable ionization chambers. The Integron units were operated at the perimater of the manufacturing areas and near the residential areas surrounding the plant; detachable ionization chambers were placed at intermediate locations and at several Integron stations where duplicate measurements appeared desirable. Table I summarizes the average dosage rates based on the accumulated 8 hour readings from Integrons during the three month period.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JULY, AUGUST, SEPTEMBER

1953

Units of mrep per 24 hours

Location	No. of Integrons	July	August	September	Quarterly Average
100-B Area	3	0.9	0.7	0.5	0.7
100-D Area	3	0.6	0.3	0.4	0.4
100-F Area	3	0.5	1.3	0.5	0.8
100-H Area	3	0.5	0.4	0.5	0.5
200-West Area	2	0.7	0.9	1.9	1.2
Redox	1	*	*	1.5	*
200 East Area	3	0.9	0.4	0.1	0.5
200-E Semi-Works	1	2.0	*	<0.1	*
Riverland	1	0.5	*	*	*
300 Area	1	0.7	1.3	1.6	1.2
Richland	1	0.4	2.8	0.5	1.2
Pasco	1	1.4	3.2	3.3	2.6
Benton City	1	1.1	0.8	1.3	1.1
North Richland	1	<0.1	2.0	<0.1	2.0
Hanford	1	1.2	0.5	0.1	0.6
Kennewick	1	0.2	<0.1	0.4	0.3

*The recorded data were not evaluated because the unit was found defective and the recordings did not allow differentiation between valid discharge and leakage.

The average dosage rates measured at most of the locations indicated in Table I were comparable to those measured during the first and second quarters of 1953. Data obtained from the Redox, Semiworks, and Riverland stations were deleted due to the influence of leaky chambers on the recorded data. Although evidence of slight leakage also appeared in some of the data recorded at Pasco and North Richland, the averages shown in Table I include the gross findings at these two stations. Supplementary monitoring at each of these locations in the form of detachable ionization chambers showed that the mean dosage rate was 0.5 mrep/hr. Film packets, which were placed at all five stations at which the data appeared questionable, showed that the average dosage rate did not exceed 5 mrep/day in any event.

Detachable "C" type ionization chambers were exposed at all monitoring stations in the operating areas. Dosage rates were evaluated from the chamber which showed the minimum discharge; Table II summarizes the average results of these measurements which were comparable to those found during the past year.

TABLE II

RADIATION LEVEL OBSERVED
WITH "C" TYPE DETACHABLE IONIZATION CHAMBERS
JULY, AUGUST, SEPTEMBER
1953

Units of mrep per 24 hours

Location	July	August	September	Quarterly Average
100-B Area	0.5	0.6	1.0	0.7
100-D Area	0.6	0.5	0.8	0.6
100-F Area	0.3	0.4	0.4	0.4
100-H Area	0.5	0.5	0.5	0.5
200 West Area	0.7	0.4	0.4	0.5
200 East Area	0.5	0.5	0.6	0.5
200-E Semiworks	0.4	0.6	0.8	0.6

Radiation measurements at intermediate locations were obtained with "M" and "S" type ionization chambers which were read at frequencies varying from one to three times per week. Again, the dosage rate was determined by using the minimum reading of two chambers at each location. Table III summarizes the results from these measurements.

TABLE III

RADIATION LEVEL OBSERVED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
1953

Location	July	August	September	Quarterly Average	Group Average
	Units of mrep per 24 hours				
100 Areas and Environs					
Route 1, Mile 8	0.60	0.51	0.50	0.54	
Route 2N, Mile 10	0.48	0.51	0.57	0.52	
Route 2N, Mile 5	0.47	0.43	0.56	0.49	
White Bluffs	0.48	0.43	0.61	0.51	
Route 11A, Mile 1	1.75	0.83	1.11	1.23	
Hanford 614 Bldg.	0.37	0.22	0.48	0.36	0.56
Intersection Rt. 1 and Rt. 4N	0.50	0.38	0.46	0.45	
Hanford 101 Bldg.	0.54	0.50	0.56	0.53	
100-H Area	0.46	0.51	0.48	0.48	
Within 5 Miles of 200 East Area					
Route 4S, Mile 6	0.94	0.61	1.59	1.05	
Batch Plant	0.46	0.45	0.70	0.54	
Route 11A, Mile 6	1.21	0.72	1.14	1.02	
Route 3, Mile 1	1.07	0.79	1.82	1.23	
Route 4S, Mile 2.5	1.15	0.77	1.26	1.06	
Redox Area	0.63	0.81	0.87	0.77	1.13
Route 4S, Mile 4.5	1.60	0.40	1.01	1.0	
Military Camp PSN 300	1.02	2.05	1.18	1.42	
PSN 310	1.16	1.36	1.13	1.21	
PSN 320	0.78	0.84	1.56	1.06	
PSN 330	0.95	0.53	0.91	.80	
Redox Perimeter	2.19	2.65	2.43	2.42	

TABLE III (contd.)

Location	July	August	September	Quarterly Average	Group Average
	Units of mrep per 24 hours				
Within 10 Miles of 200 East					
Route 4S, Mile 10	0.89	0.64	0.45	0.66	
Route 10, Mile 1	1.39	0.65	1.04	1.03	
Route 10, Mile 3	1.65	0.95	1.08	1.23	1.15
Route 2S, Mile 4	2.08	1.95	1.04	1.69	
300 Area and Environs					
Route 4S, Mile 16	0.73	0.27	0.69	0.56	
Route 4S, Mile 22	0.77	0.58	0.76	0.70	
North Richland	0.53	0.32	0.66	0.50	0.59
300 Area	0.66	0.50	0.66	0.61	
Outlying Areas					
Richland	0.69	0.58	0.69	0.65	
Benton City	0.81	0.31	0.41	0.51	
Pasco	0.68	0.33	0.34	0.45	
Kennewick	0.36	0.64	0.48	0.49	0.52

The average dosage rates in the five general areas summarized in Table III were nearly identical to those measured during the previous quarter; the maximum difference between present values and those previously measured was 0.08 mrep/24 hours in the region which included the residential communities near the plant perimeter. Significant observations noted while reviewing the data included decreases in mean radiation levels at Route 3 Mile 1 and Miles 16 and 22 on Route 4S. These locations showed a twofold increase in average dosage rates during the previous quarter (HW-29514) and the current trend appears to be an indication of a return to expected values.

The activity density of filterable beta particle emitters in air samples was determined from the radiochemical analysis of air filter samples which were collected from representative locations in the environs.

The samples were collected continuously for a seven day period and were analyzed several days after sampling to insure the decay of the daughter products of natural particle emitters present in the atmosphere. Table IV summarizes the results obtained from these measurements during the quarter.

TABLE IV

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

JULY, AUGUST, SEPTEMBER

1953

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

Location	July	August	September	Quarterly Average	Weekly Maximum
200 Areas and Vicinity					
200-E Semiworks	130	510	690	450	2000
200-W Tower #4	260	170	1500	740	2800
200-W Redox Area	750	860	1200	990	2700
Gable Mountain	220	130	1100	530	2600
PSN 320	100	200	2800	810	7200
100 Area and Vicinity					
100-D	140	96	720	420	1800
100-H	230	130	920	470	1800
Hanford, 101 Bldg.	130	160	1300	460	1700
Hanford, 614 Bldg.	73	60	310	150	420
White Bluffs	200	200	680	360	1700
300 Area 614 Bldg.	89	150	300	180	470
Outlying Areas					
North Richland	91	130	840	340	2300
Pasco	79	83	260	150	460
Benton City	45	45	270	120	620
Riverland	150	150	690	310	1200

Concentrations of filterable beta particle emitters measured during the quarter were considerably above natural background with many of the measurements obtained during the last week of August and first week of September accounting for the maximum values indicated in Table IV.

Additional evaluations of the activity density of filterable beta particle emitters were made by analyzing the small air filters removed from continuous dual monitors operated at three locations. Table V summarizes the results obtained from these analyses.

TABLE V

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR
DUAL UNIT MONITORS
JULY, AUGUST, SEPTEMBER
1953

Activity Density - Units of 10^{-14} $\mu c/cc$

Location	July	August	September	Quarterly Average	Weekly Maximum
200 West East Center #1	280	180	650	390	1300
200 West East Center #2	250	130	640	470	1400
200 East Southeast #1	230	180	820	390	1800
200 East Southeast #2	59	180	1300	500	2300
Richland #1	130	86	420	230	690
Richland #2	170	93	540	290	990

Although the results summarized for the month of July were somewhat contradictory to those found at the air monitoring stations shown in Table IV for the same period, the upward trend noted during the month of September was clearly defined in these data.

Specific measurements for the number of radioactive particles in the atmosphere were performed by analyzing the radioautographs obtained from exposing air filters to type "K" x-ray films. The sample collection periods ranged from daily to weekly and the length of exposure to the film was 168 hours. Table VI and VII summarize the results of these findings for air monitoring stations operated on and off the immediate reservation.

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TABLE VI

PARTICULATE DEPOSITION NEAR THE SEPARATION AREAS

JULY, AUGUST, SEPTEMBER

1953

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

Location	Total Volume of air Sampled M^3	July	August	September	Present Quarter Averages	Previous Quarter Averages
200-E and Vicinity						
2704 Outside	9061	310	312	520	390	130
BY - SE	9282	360	140	770	450	110
BY - NE	9248	250	210	660	390	99
"B" Gate	9176	230	230	450	310	100
2701 Outside	9252	330	270	880	520	150
2704 Inside	9244	330	240	710	450	72
221-B	9282	160	120	450	260	38
200-W and Vicinity						
2701 Outside	9278	390	360	1200	700	160
2722	7484	240	230	760	480	440
"T" Gate	8866	210	220	510	340	210
222-T Outside	8883	450	290	610	460	190
231	9282	310	170	>1100	>560	100
Redox	9159	1700	2200	3800	2600	430
W Guard Tower	8768	320	220	>1300	>690	120
2701 Inside	8925	310	240	390	320	210
272	8866	240	190	990	530	220
222-T Hall	8993	340	230	450	350	92
222-T Lab.	9278	280	240	890	500	96
222-U Lab.	9278	230	270	440	320	77
Meteorology Tower						
3'	37145	24	85	240	120	58
50'	40001	78	72	260	140	22
100'	31766	86	86	440	210	25
150'	27765	120	83	540	260	45
200'	25648	69	84	660	280	51
250'	25648	84	81	750	320	40
300'	23765	88	87	>750	>330	47
350'	23765	110	150	>760	>350	40
400'	16000	120	160	>1200	>520	47

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TABLE VII

PARTICLE DEPOSITION OUTSIDE THE SEPARATIONS AREAS

JULY, AUGUST, SEPTEMBER

1953

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

Location	Total Volume of air Sampled M^3	July	August	September	Present Quarterly Averages	Previous Quarterly Averages
Area Locations						
100-B Area	8067	78	250	540	310	40
100-D Area	37519	73	150	290	180	48
White Bluffs	37822	38	310	230	200	51
100-F Area	18989	160	210	370	270	37
300 Area	36856	150	190	310	220	55
Hanford 101	37383	47	160	260	160	45
Off Area Locations						
Benton City, Wn.	37434	54	150	230	150	32
Pasco, Wn.	37315	94	200	300	210	30
Richland, Wn.	33031	75	260	560	320	49
Boise, Idaho	9312	180	350	920	510	170
Klamath Falls, Oregon	9248	250	320	840	500	68
Great Falls, Mont.	9338	140	220	400	260	52
Walla Walla, Wn.	9512	310	490	880	580	82
Meacham, Oregon	9313	96	230	390	250	38
Lewiston, Idaho	9342	240	470	960	590	100
Spokane, Wn.	38794	54	270	410	250	55
Kennewick, Wn.	9388	160	280	620	380	50
Yakima, Wn.	26792	99	150	94	110	27

The upward trend noted in the data summarized in Table IV was clearly confirmed in the radioactive particle measurements made on filters collected at all stations indicated in Table VI and VII during the latter part of this quarter. An examination of the data obtained from stations at which the particle filters were operated on a daily basis shows that the maximum concentrations occurred on the following days: Richland, 1.5 ptles/m^3 on September 11; Klamath Falls, Oregon, 4.5 ptles/m^3 on September 4; Walla Walla, 8 ptles/m^3 on August 30; Spokane, 2.5 ptles/m^3 on August 23, and 3.0 ptles/m^3 on August 29. Average concentration of radioactive particles in the atmosphere over a seven day period exceeded 1 ptle/m^3 during late August and early September at these stations. The daily monitoring data clearly defined at least three peak periods of influx occurring during the quarter. One peak occurred during July, the greatest peak during the last week of August, and another peak during the middle of September. The last two peaks were apparently associated with the detonation of atomic bombs as announced by news agencies. The source of the first increase during July has not been identified. Figure 6 is a graph showing the results of the particle measurements obtained at six representative stations during the period covered in the above discussion.

A comparison of the average concentration of radioactive particles during the current period with the results of similar measurements obtained during the previous quarter shows that the majority of present values are from 2 to 10 times higher than those measured during April, May, and June although the April, May, and June values were at least 10 times higher than those measured during the first quarter of 1953 (HW-28925) due to fallout from the Nevada tests.

I^{131} concentrations in the atmosphere were determined from the radiochemical analysis of caustic scrubber solutions through which an air flow of 2 cfm was passed for periods varying from one day to one week. The results obtained from these measurements are summarized in Table VIII.

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TABLE VIII

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

JULY, AUGUST, SEPTEMBER

1953

Units of 10^{-12} μc/cc

Location	July	August	September	Quarterly Average	Weekly Maximum
200 Area and Vicinity					
200 East Southeast	0.9	0.1	0.3	0.4	2.6
200 East Tower #16	1.0	0.2	1.8	1.2	16.0
200 West Gatehouse	1.1	0.4	0.5	0.6	1.7
Gable Mountain	0.1	<0.1	0.6	0.3	2.5
Redox Area	2.6	1.2	2.1	2.0	7.5
200 West Tower #4	0.5	<0.1	1.2	0.6	2.4
200 East Semiworks	0.5	0.1	0.3	0.3	0.8
Outlying Locations					
100-H Area	<0.1	<0.1	1.7	0.7	5.2
300 Area	<0.1	0.2	0.6	0.3	1.8
Richland	0.1	<0.1	1.1	0.5	2.1
North Richland	0.2	0.2	0.6	0.3	1.2
Benton City	<0.1	<0.1	<0.1	<0.1	0.1
Pasco	<0.1	<0.1	0.2	0.1	0.4

[redacted]

 [redacted]

The average activity density of I^{131} in the atmosphere during the present period was the highest measured during any quarter of 1953. General increases, which approached a factor of 6 in the extreme case when compared to the results of similar measurements obtained during the previous quarter, were largely weighted by high measurements obtained during July and September when silver reactor failures at the 202-S plant caused increased emission of I^{131} in the effluent gases from this facility. In one incident during September, 23 curies of I^{131} were emitted from this source over a three day period; gross I^{131} emission at the 202-S plant was 33 per cent greater during this quarter than was the emission during the previous quarter. Positive average values at perimeter locations during this period approached significance as the mean activity at the same locations during the previous period was below the detection limit of the measurement (less than 1×10^{-13} μc/cc).

Special samples collected from the downstream effluent near the Redox facility during periods of low atmospheric dilution ratios showed only one instance where the activity density of I^{131} exceeded a value of 1×10^{-9} μc/cc. A sample collected on July 11 at a location 100 feet downwind from the Redox effluent stack during a period when the atmospheric dilution of stack effluent gas was less than 300:1 had a concentration of 1.6×10^{-9} μc/cc.

The activity density of alpha particle emitters in the atmosphere was measured by counting air filters which were exposed at environmental locations for seven day periods. The results of these measurements are summarized in Table IX.

TABLE IX

CONCENTRATION OF AIRBORNE ALPHA PARTICLE EMITTERS

JULY, AUGUST, SEPTEMBER

1953

Location	Number Samples	Alpha Particle Emitters Units of 10^{-15} μc/cc Weekly Maximum	Quarterly Average
200 West Tower #4	10	40	14
200 East Semiworks	13	12	<4
Gable Mountain	13	33	9
Pasco	9	25	7
300 Area	13	14	9
100-D Area	11	80	12
Benton City	12	7	<4
Hanford 614 Bldg.	12	13	<4
White Bluffs	12	38	12
North Richland North	12	16	4
200 West Redox Area	14	96	11
100-H Area	13	91	12
Hanford 101 Bldg.	11	17	7
Riverland	13	15	<4
PSN 320	12	29	7
DUAL UNITS			
200 WEC #1	13	37	8
200 WEC #2	12	35	11
200 ESE #1	13	9	<4
200 ESE #2	13	32	5
Richland #1	13	37	10
Richland #2	13	70	14

The average activity density of alpha particle emitters in the atmosphere remained on the same order of magnitude as that measured during the previous quarter at all the locations indicated in Table IX. A review of the individual weekly measurements was not indicative of any trend occurring within the three month period.

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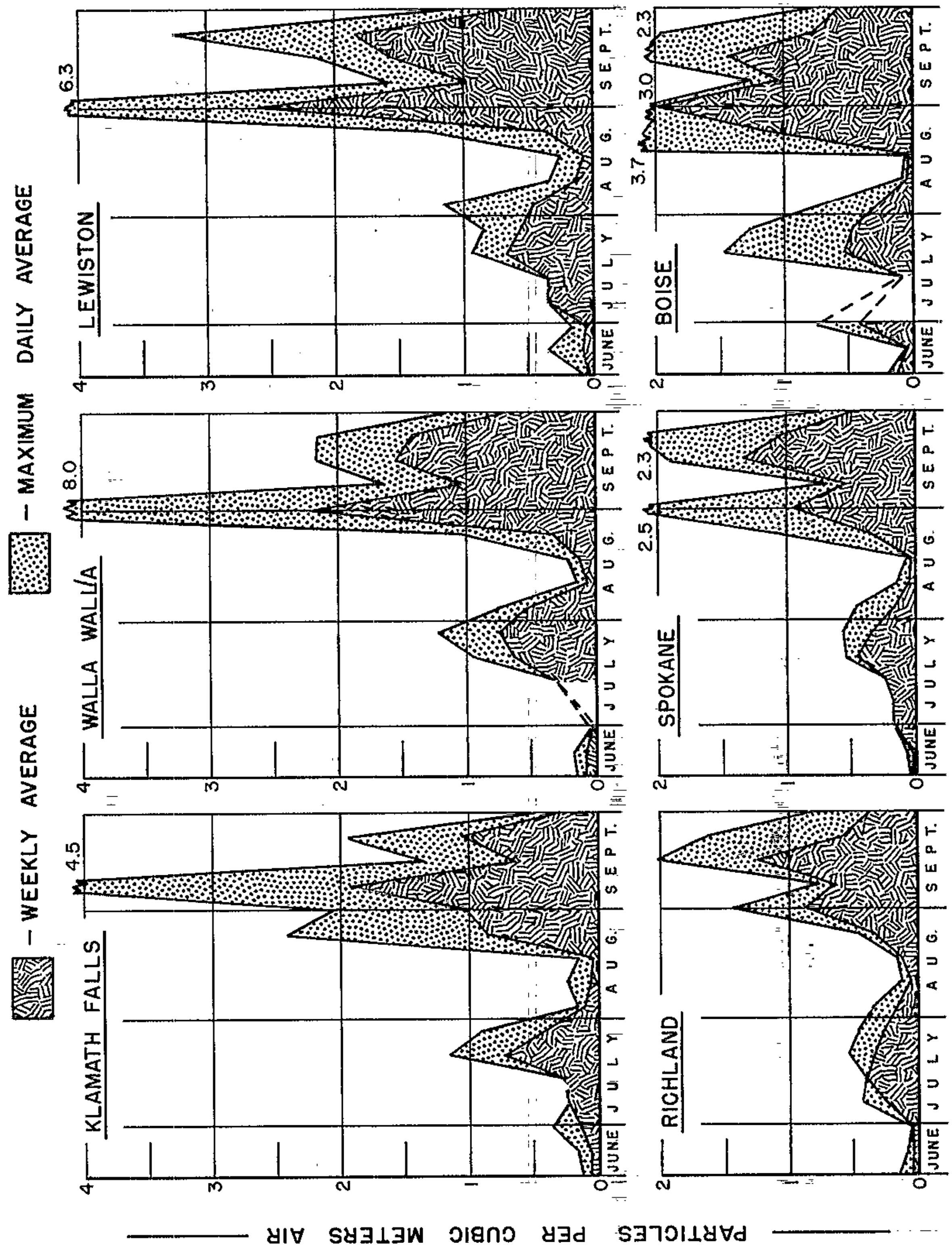
RADIOACTIVE PARTICLE CONCENTRATION IN AIR SAMPLES
JUNE 9 TO OCTOBER 19, 1953
FIGURE — 6



AEC-GE RICHLAND, WASH.

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SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The amount of radioactive contamination discharged in waste from the manufacturing areas was determined by analyzing liquid and solid samples for the activity density of gross beta and alpha particle emitters. Over 1,000 samples were collected from the various waste sources at frequencies varying from daily to weekly during the three month period. Selected samples from all waste areas were also analyzed specifically for the activity density of uranium and/or plutonium. The direct sample measurements were supplemented with the results of instrument surveys performed at the perimeter of the open waste areas and along the various ditches that contribute to the retention areas. Special contamination surveys were performed during and immediately after all known incidents involving unusual contamination. The results of these measurements are summarized for each of the manufacturing areas.

100 AREA WASTES

Daily samples were collected from the outlet side of each of the reactor effluent basins when the power levels indicated that normal operation of the reactor was in progress. All samples were analyzed on the same day that they were collected and the subsequent counting rates were corrected for decay based on data accumulated from hold-up time and decay studies of samples from the basin's inlet. Table I summarizes the results obtained from the analysis of these samples for the activity density of gross beta particle emitters.

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TABLE I

RADIOACTIVE CONTAMINATION IN REACTOR EFFLUENT WATER
DURING PERIODS OF NORMAL OPERATION
JULY, AUGUST, SEPTEMBER
1953

Activity Density from Gross Beta Particle Emitters
Units of 10^{-3} µc/cc

Location	Total Samples	July Max.	July Avg.	August Max.	August Avg.	September Max.	September Avg.	Quarterly Max.	Quarterly Avg.
100-B Area	89	6.7	3.9	7.8	3.6	5.5	4.1	7.8	3.9
100-C Area	106	3.3	2.5	4.6	3.2	5.4	3.7	5.4	3.1
100-D Area	95	4.6	3.4	5.1	3.7	6.0	4.4	6.0	3.8
100-DR Area	109	5.2	4.0	5.5	4.5	6.4	5.0	6.4	4.5
100-H Area	100	3.7	3.1	5.2	3.4	4.0	3.2	5.2	3.2
100-F Area	109	5.4	4.1	4.3	3.4	5.3	3.9	5.4	3.8

The average activity density of gross beta particle emitters in reactor effluent at the 100-B, 100-C, 100-DR, 100-H, and 100-F areas was significantly lower than that measured during the second quarter of 1953. A small increase in the average and maximum activity density measured at the 100-D area was not a significant departure from previous findings. Isotopic analyses performed by technical personnel of the Control Laboratory indicate that significant decreases in the amounts of Mn^{56} and Si^{35} along with smaller decreases in the amount of Na^{24} and P^{32} influenced the magnitude of the decreases noted in the gross activity density of beta particle emitters discharged to the Columbia River.

The activity density of alpha particle emitters in reactor effluent discharged to the Columbia River averaged less than 5×10^{-9} µc/cc at all areas except 100-DR; the three month average of 6×10^{-9} µc/cc at the latter location included a maximum measurement of 9.8×10^{-8} µc/cc in a sample collected on August 25. Maximum measurements obtained from samples collected at the other reactor areas ranged from 1×10^{-8} μc/cc at the 100-D area to 1.1×10^{-7} μc/cc at the 100-H area. The number of positive alpha particle measurements and their respective order of magnitude were comparable to values found during the second quarter of 1953.

Radiochemical analysis of 148 effluent samples from the various reactor areas for the activity density of uranium showed all values to be below the detection limit of 2×10^{-9} μc/cc.

Nine samples out of a total of 37 samples which were analyzed for the activity density of plutonium showed values exceeding the detection limit of 3×10^{-9} μc/cc. Although the amount of contamination measured in each case barely exceeded the detection limit (values ranged from 3×10^{-9} μc/cc to 5.4×10^{-9} μc/cc) the number of positive measurements represented a significant increase when compared to the number of positive measurements found during the previous quarter. Indications of this contaminant were found at each of the reactors during some time in the period; three positive measurements were obtained at 107-DR basin and two positive measurements at the 107-F basin.

Trace amounts of polonium were found in the effluent water at all reactors except 100-C area. Thirteen positive measurements included a range of values from 6×10^{-10} μc/cc to 1.9×10^{-9} μc/cc. Maximum measurements were found at the 100-B and 100-F areas in samples which showed 1.9×10^{-9} and 1.3×10^{-9} μc/cc, respectively.

The activity density of I^{131} in waste discharged to the Columbia River from the Biology Farm at the 100-F area was measured by analyzing composite samples collected from the sump in the waste discharge line. The average activity density over the three month period was 6.3×10^{-7} μc/cc including a maximum measurement of 2.7×10^{-6} μc/cc. Average values for the months of July, August, and September were 8.7×10^{-7}, 4.8×10^{-7}, 5.3×10^{-7} μc/cc, respectively. I^{131} discharged to the Columbia

River averaged 0.04 mc/day based on the metered volume of water used in the flushing operation at the Biology Farm. The maximum discharge was observed during July when an average of 0.06 mc were discharged to the river daily.

Portable instrument surveys were maintained on a monthly basis at the burning grounds in the reactor areas. The results of these surveys showed that negligible contamination existed as the VGM and TGM readings were within 200 c/m of natural background in all cases.

200 AREA WASTES

Table II summarizes the results obtained from the radiochemical analysis of liquid and solid samples collected from 200 area waste sources.

TABLE II

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS

JULY, AUGUST, SEPTEMBER

1953

LIQUID SAMPLES

Location	Number Samples	Uranium + Plutonium, Units of 10^{-8} μc/cc: Maximum	Uranium + Plutonium, Units of 10^{-8} μc/cc: Average	Beta Particle Emitters, Units of 10^{-7} μc/cc: Maximum	Beta Particle Emitters, Units of 10^{-7} μc/cc: Average
T-Swamp	38	5.8	<0.5	6.5	1.8
U-Swamp	28	15.0	1.8	18.0	3.1
Laundry Ditch	28	36.0	4.9	11.0	3.5
231 Ditch	27	30.0	2.7	2.3	<0.5
200-E "B" Ditch	38	1.8	<0.5	7.1	1.5
200-E "B" Swamp	25	1.9	<0.5	23.0	3.7
234-35 Ditch	12	130.0	13.0	0.7	<0.5
200-E Retention Pond	27	<0.5	<0.5	6.5	2.1
200-W Retention Pond	28	1.2	<0.5	2.5	0.9
234 Retention Pond	4	5.0	2.2	<0.5	<0.5
Redox Swamp	13	16.0	2.3	1700.0	690.0

SOLID SAMPLES

Location	Number Samples	Uranium + Plutonium, Units of 10^{-6} μc/g: Maximum	Uranium + Plutonium, Units of 10^{-6} μc/g: Average	Beta Particle Emitters, Units of 10^{-5} μc/g: Maximum	Beta Particle Emitters, Units of 10^{-5} μc/g: Average
T-Swamp	25	120.0	23.0	110.0	18.0
Laundry Ditch	14	52.0	14.0	23.0	13.0
200-E "B" Ditch	39	96.0	7.5	280.0	57.0
200-E "B" Swamp	25	16.0	3.0	300.0	71.0
234-35 Ditch	13	61,000.0	5,400.0	7.3	4.4
Redox Swamp	13	2,200.0	350.0	1,200,000.	180,000.0

A comparison of the values summarized in Table II with the results of similar measurements obtained during the previous quarter shows negligible changes in the magnitude of contamination in 200 area wastes except for the wide fluctuation noted at the Redox swamp and the 234-5 ditch. General increases in the activity density of alpha and beta particle emitters in mud samples collected from the perimeter of the Redox swamp were the continuation of previously observed trends which started early in 1953. Similar measurements at the 234-35 ditch showed a decrease from those measured during the previous quarter but still remained considerably above the values found during 1952.

Liquid samples which showed the activity density of uranium to exceed the detection limits were confined to the laundry ditch, B ditch and swamp, and the U-swamp. Average values were on the order 3 to 4×10^{-9} μc/cc except at the laundry ditch where an average based on 28 analyses showed a value of 5.9×10^{-8} μc/cc. The maximum uranium measurement obtained at the laundry ditch was 3.1×10^{-7} μc/cc.

Solid samples obtained from the edges of the B, T, and Redox swamp showed trace uranium contamination on the order of 10^{-6} μc/g on several occasions during the quarter. Maximum uranium contamination was found in the T-swamp where a sample showed 1.4×10^{-3} μc/g; the three month average at this location was 1.4×10^{-4} μc/g.

Portable instrument surveys performed on a weekly basis around the T and B swamps showed counting rates on the order of 400 to 600 c/m above background. Maximum readings were found around the B-ditch at a point approximately 1,000 feet from the inlet where counting rates were 4,000 to 5,000 c/m above background. Similar surveys performed around the laundry ditch in the 200 West area showed values less than 1000 c/m in all cases.

Several ground surveys were performed in the region near the Redox stack after visual observation indicated significant quantitite of large particulate contamination leaving the S-plant stack on August 17. Detailed surveys were performed on August 17 and 18 and spot surveys were maintained throughout the balance of the month. Results obtained during the initial survey on August 17 indicated that CP meter readings in the range of 100 to 600 mrep/hr prevailed inside an area approximately 500 feet due southeast of the stack. Readings decreased with increase of distance from the stack and on the roadways at the area perimeter, counting rates measured with a GM meter ranged from 1,000 to 10,000 c/m. A survey in the construction area west of the S-plant exclusion area showed one reading of 7,000 c/m; the remaining readings did not exceed 200 c/m above background.

A resurvey of the same area on August 18 revealed increases in ground contamination with readings as high 15 rep/hr southeast of the stack. Readings from 1,000 to 60,000 c/m and up to 20 mr/hr were found on the roads south and east of the stack. A survey in the previously mentioned construction area showed no measureable contamination. Spot surveys during the balance of the month showed a continual decrease in ground contamination near the S-plant stack and after the wind and rain during the latter part of the month, the general contamination levels on the roadways were reduced to 500 c/m or less.

Instrument surveys of three proposed sites for military installations at locations south and southeast of the separation facilities on September 16 showed no measureable ground contamination. Several vegetation samples collected from each of the surveyed areas showed no significant differences in the activity density of gross beta particle emitters when these results were compared with samples collected routinely near these locations.

300 AREA WASTES

Table III summarizes the results obtained from the analysis of samples collected from 300 area waste sources.

TABLE III

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
JULY, AUGUST, SEPTEMBER
1953

Location	Number Samples	Beta Particle Emitters, Units of 10^{-7} μc/cc Max.	Beta Avg.	Alpha Particle Emitters, Units of 10^{-8} μc/cc Max.	Alpha Avg.	Uranium, Units of 10^{-6} μc/cc Max.	Uranium Avg.
Old Pond Inlet Liquid	13	140	23	1000	210	17.	2.8
New Pond Inlet Liquid	13	210	21	400	200	4.0	1.6
300 Area Waste Line	58	2600	92	7300	410	59.0	1.6
		Units of 10^{-3} μc/gram		Units of 10^{-3} μc/gram		Units of 10^{-3} μc/gram	
Old Pond Inlet Solid	13	14.	4.1	17	2.0	5.4	2.6
New Pond Inlet Solid	13	17.	4.4	3.7	1.1	11	3.4

The amounts of contamination measured in samples collected from 300 area wastes were well within the order of magnitude expected when comparing the present values to those accumulated over the past several quarters. In general, the small increases, noted at nearly every location during the present period, were not significantly different from values found during the previous quarter.

Fifty-seven samples which were obtained directly from the 300 area waste line showed that the average activity density of plutonium in water entering the 300 area ponds was 1.4×10^{-8} μc/cc. The maximum measurement was 1.6×10^{-7} μc/cc. These values were nearly identical to those measured during the second quarter of 1953.

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

The activity density of gross alpha and beta particle emitters in the Columbia River was determined by analyzing nearly 500 samples of river water. Samples were collected at frequencies varying from daily to weekly at representative locations between the reactor areas and McNary Dam; samples were obtained from the down stream portion of the river between McNary Dam and Portland, Oregon, on a monthly basis. Evaluations of the activity density from natural alpha and beta particle emitters in the river water were made by analyzing samples of the Columbia River obtained from a location upstream from the first reactor and from samples collected from the Yakima and Snake Rivers which enter the river above McNary Dam.

Table I summarizes the results obtained from analyzing river water samples collected upstream of McNary Dam for the activity density of gross beta particle emitters.

TABLE I

AVERAGE CONTAMINATION FROM GROSS BETA PARTICLE EMITTERS IN RIVER WATER

Activity Density - Units of 10^{-8} $\mu c/cc$

Location	July Avg.	August Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Maximum Measurement This Quarter
Wills Ranch	<5	<5	<5	<5	<5	7
181-B Area	<5	8	5	5	7	15
181-C Area	7	9	9	8	19	18
Allard Station	63	24	17	26	75	200
181-D Area	100	210	340	230	260	440
181-H Area	280	310	480	390	300	720
Below 100-H Area	290	1100	560	610	460	2900
181-F Area	250	430	610	460	590	1100
Below 100-F Area	400	400	840	530	830	1500
Hanford South Bank	360	580	850	590	740	1300
300 Area	170	370	250	250	290	790
Richland	80	210	350	230	230	920
Kennewick Highlands Pumping Station	130	230	320	230	190	390
Pasco Bridge (Kenn. Side)	58	170	150	120	170	270
Pasco Bridge (Pasco Side)	79	220	190	160	210	340
Sacajawea Park	58	60	110	80	140	200
McNary Dam #1	35	30	38	34	51	58
McNary Dam #2	37	22	27	29	47	62
Patterson	23	24	29	26	37	57
Snake River at Mouth	5	9	6	7	15	23
Yakima River at Prosser	24	<5	<5	9	<5	95
Yakima River at Mouth	<5	<5	7	<5	18	32

The average activity density of gross beta particle emitters in the Columbia River water was not significantly different than that measured during the second quarter of 1953. The negligible change was largely accounted for by the similarity in the mean flow rate of the Columbia River during the two periods under comparison; the average flow during the present period was 1,305,000 gallons per second as compared with an average of 1,311,000 gallons per second during the previous quarter. A comparison of the measurements in Table I on a month to month basis shows an increasing trend in the average activity density during the three month period. This trend was consistent with that observed during this period in previous years and again, was related to the decreasing dilution ratio of the Columbia River to reactor effluents during the months of August and September. Average flow rates of the river for the months of July, August, and September were 2,070,000, 1,120,000, and 751,000 gallons per second, respectively. The maximum flow rate was 2,603,000 gallons per second measured on June 25, and the minimum flow rate was 638,000 gallons per second measured on September 15. The trend of the measured flow rate is presented graphically in Figure 7. As expected, the majority of the maximum measurements shown in Table I represented samples that were collected during the middle and latter part of September.

The results obtained from monthly samples collected at remote downstream locations showed detectable activity density of gross beta particle emitters in all samples collected between McNary Dam and Vancouver, Washington. As in the past, the maximum measurements were obtained in the Maryhill-Arlington region where the average activity density from gross beta particle emitters was on the order of 1×10^{-7} µc/cc throughout the period. Individual sample results ranged up to 9.6×10^{-7} µc/cc at eight locations between Arlington and Vancouver. At Vancouver, which was the most downstream location sampled, the activity density during July, August, and September was 4.2×10^{-8}, 2.6×10^{-8}, and 3.7×10^{-8} µc/cc, respectively. The maximum measurement below McNary Dam was found at the Maryhill ferry where a sample collected on September 3 showed 1.5×10^{-7} µc/cc.

Twenty-five samples collected from the south bank of the Hanford ferry were analyzed specifically for the activity density of I^{131}. The average activity density obtained from these measurements was 8×10^{-8} μc/cc which included a maximum measurement of 2.3×10^{-7} μc/cc. These values were nearly identical to those measured during the same period in 1952 and do not represent a significant departure from the results obtained during the first six months of 1953.

The average activity density of alpha particle emitters at the monitoring stations indicated in Table I averaged less than 5×10^{-9} μc/cc at all locations except the 300 area. Twelve samples collected at the latter location showed an average of 1.0×10^{-8} μc/cc and a maximum of 3.4×10^{-4} μc/cc.

Several river samples which were obtained from unrelated locations throughout the Pacific Northwest were analyzed for the activity density of alpha and beta particle emitters. In all cases, the activity density for these emitters was below the detection limit of the measurement.

Deposition of radioactive material by the water of the Columbia River was evaluated from data obtained by analyzing mud samples collected each week from 15 locations. Two samples were obtained at each sampling station; one sample was taken from the point where the water joined the shore and another sample was collected from an underwater location approximately five feet removed from the shore line. Table II summarizes the results obtained from analyzing these samples for the activity density of beta particle emitters.

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TABLE II

RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES

JULY, AUGUST, SEPTEMBER

1953

Beta Particle Emitters - Units of 10^{-5} $\mu c/g$

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Maximum This Quarter
Wills Ranch						
Shore	2.6	4.6	4.0	3.7	3.1	6.1
5' Out	3.2	3.2	4.1	3.5	3.0	9.4
Allard Station						
Shore	3.9	5.9	3.3	4.3	5.4	9.2
5' Out	4.5	3.3	4.6	4.3	6.0	13.0
100-H Area						
Shore	3.5	5.4	8.3	5.6	7.7	16.0
5' Out	4.4	7.2	6.1	5.8	6.0	13.0
Below 100-F						
Shore	5.8	11.0	16.0	11.0	6.5	31.0
5' Out	8.2	12.0	12.0	10.0	8.0	16.0
Hanford Ferry						
Shore	7.1	15.0	9.3	10.0	5.6	36.0
5' Out	9.9	13.	14.0	13.0	7.4	25.
300 Area						
Shore	10.0	9.0	8.9	9.4	21.0	26.0
5' Out	10	14	8.2	11.0	74.0	28.0
Byers Landing						
5' Out	---	5.5	2.9	4.2	3.8	5.5
Richland Dock						
Shore	3.5	4.2	6.3	4.8	5.5	11.0
5' Out	4.4	11.0	8.4	8.0	7.0	19.0
Kennewick Highlands Pump Station						
Shore	2.9	4.1	3.2	3.4	3.8	5.1
5' Out	4.3	7.1	4.7	5.3	5.6	11.
PK Bridge (Pasco)						
Shore	4.1	4.7	3.0	3.9	2.6	9.3
5' Out	2.7	5.4	3.9	4.0	4.0	7.9
PK Bridge (Kenn.)						
Shore	3.2	3.6	4.0	3.7	2.9	6.2
5' Out	3.6	3.7	4.3	4.0	3.7	6.6
Sacajawea Park						
5' Out	11.0	11.0	12.	12.	7.5	21.

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TABLE II (contd.)

Beta Particle Emitters - Units of 10^{-5} μc/g

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Maximum This Quarter
McNary Dam 5' Out	3.0	3.3	2.8	3.0	2.7	4.3
Patterson 5' Out	5.2	4.7	5.8	5.3	3.7	13
Snake River Mouth 5' Out	5.4	3.0	3.6	4.0	3.5	7.1

Except for an expected decrease in the activity density of beta particle emitters measured at the 300 area location, the average values summarized in Table II were not significantly different than those found earlier in 1953. A decrease from a previous average of 7.4×10^{-4} μc/g to a current average of 1.1×10^{-4} μc/g at the 300 area was largely the result of one exceptionally high measurement during the previous quarter; the current average is identical to the average found at this location during the first three months of 1953.

All samples collected from locations shown in Table II were analyzed for the activity density of alpha particle emitters. Eight of the locations showed average values above the detection limit of 1.5×10^{-6} μc/g. The average activity density at seven of these locations ranged from 2×10^{-6} μc/g to 5×10^{-6} μc/g; the maximum measurement in this group was 3.1×10^{-5} μc/g in a sample collected at McNary Dam. Thirteen samples collected from the shore opposite the 300 area showed an average activity density of 2.4×10^{-4} μc/g; this average was weighted heavily by one sample which showed 3.1×10^{-3} μc/g. Deletion of this exceptionally high measurement from the data would reduce the three month average to 3×10^{-6} μc/g which would be a value comparable to that noted at the other monitoring locations.

Weekly samples collected directly from the raw water-river export lines at the 183 and 283 buildings in the reactor and separations areas were used to evaluate the activity density of beta and alpha particle emitters in raw reactor cooling water. Table III summarizes the results obtained from the analysis for the activity density of beta particle emitters.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER RIVER EXPORT LINE

JULY, AUGUST, SEPTEMBER

1953

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

Location	July Avg.	Aug. Avg.	Sept. Avg.	Qtr. Avg.	Last Qtr. Avg.	Maximum This Quarter
183 Bldg., 100-B Area	<5	<5	<5	<5	<5	<5
183 Bldg., 100-C Area	<5	<5	<5	<5	<5	<5
183 Bldg., 100-D Area	12	22	76	40	12	100
183 Bldg., 100-DR Area	16	25	87	46	13	150
183 Bldg., 100-F Area	26	71	99	68	32	130
183 Bldg., 100-H Area	26	44	87	53	22	110
283 Bldg., 200 East Area	5	6	<5	<5	12	10
283 Bldg., 200 West Area	5	22	<5	9	75	74

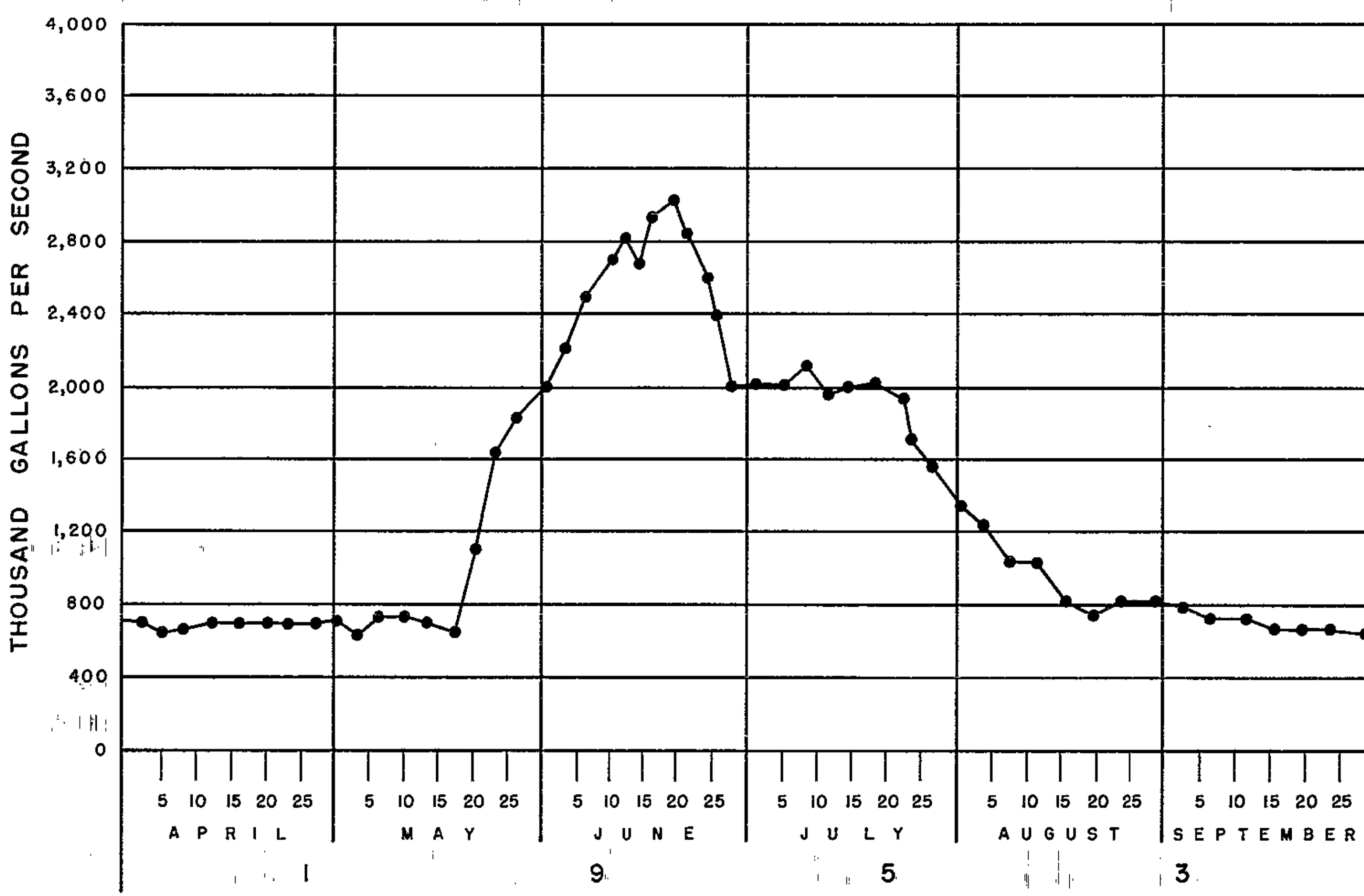
Two to threefold increases in the average activity density of beta particle emitters at the reactor areas below the 100-C area were largely weighted by the high measurements obtained during the month of September when the flow rate of the Columbia River, from which the water is pumped, was at the minimum measured during the period. The measurements obtained during July and August were comparable to those found during the previous quarter.

Radiochemical analysis of the raw water samples collected at locations indicated in Table II for the activity density of alpha particle emitters showed an average value below the detection limit of 5×10^{-9} µc/cc at each manufacturing area.

COLUMBIA RIVER FLOW

JULY - AUGUST - SEPTEMBER

FIGURE — 7



SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

The activity density of gross beta particle emitters in rainfall was determined from the results obtained from the analysis of 48 samples collected from random locations. Exceptionally high amounts of precipitation during the month of August confined the bulk of the monitoring to that month. The absence of significant rainfall during the month of July prevented any measurements from being obtained during that period. In general, the amount of precipitation over the three month period was higher by nearly a factor of 2 than the normal rainfall as determined from the 35 year average for this area; normal precipitation over this three month period is 0.69 inches as compared with a total of 1.09 inches during the present period. Table I summarizes the precipitation data as measured at the Meteorology Station adjacent to the 200 West Area. Comparable data for the previous three years are included for comparison.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS
JULY, AUGUST, SEPTEMBER
1953

Units - Inches

Year	July	August	September	Quarterly Total
1950	0.07	Trace	0.01	0.08
1951	0.37	0.15	0.10	0.62
1952	Trace	0.08	0.08	0.16
1953	Trace	0.96	0.13	1.09

Table II summarizes the results obtained from the radiochemical analysis of rain samples collected during the quarter.

TABLE II

ACTIVITY DENSITY OF GROSS BETA PARTICLE EMITTERS IN RAIN

JULY, AUGUST, SEPTEMBER

1953

Location	Number Samples	Units of 10^{-6} $\mu c/cc$ Maximum	Average
In 200 East Area	7	64	37
250' E of stack	2	50	50
2000' E of stack	3	35	21
3500' SE of stack	2	64	49
In 200 West Area	9	110	49
1000' E of stack	2	110	93
7000' E of stack	2	21	19
8000' SE of stack	2	15	15
4900' SE of stack	1	85	85
Redox Area	2	81	49
100 Area Environs	8	48	16
100-B SE	0	--	--
100-D SW	2	30	16
Hanford 614	2	48	25
Hanford 101	1	2	2
White Bluffs	1	37	37
100-H SE	2	6	3
Perimeter Locations	10	410	53
700-A 614	2	42	21
Pasco H and R	2	15	8
Benton City	3	30	14
Riverland	2	410	210
3000 A. North	1	10	10
Intermediate Locations	14	100	30
Route 4S, Mile 6	3	100	49
300 Area 614	1	17	17
200 North 614	3	22	9
Gable Mountain	1	60	60
Batch Plant	1	30	30
622 Building	5	56	28

Expected significant decreases in the activity density of gross beta particle emitters in rain were observed at nearly all monitoring locations during this period. The general decrease largely resulted from the exceptionally high measurements which were found during the previous quarter when the influx of considerable quantities of particulate matter from the Nevada tests occurred (HW-28925). Current average measurements were still from 10 to 50 times greater than those found during the first quarter of 1953 when the monitoring was not influenced by contamination from sources other than the Hanford operation. The contamination found in the rain did not appear to be associated with any significant emission from the Hanford stacks but to be influenced by particulate contamination from outside sources which entered the environs in significant quantities during the middle of the quarter (Section III, Tables VI and VII).

A comparison of the values summarized in Table II with the results of similar measurements obtained during the same period in 1952 show that the present values are approximately ten times above those measured a year ago; the average activity density of gross beta particle emitters did not exceed 3×10^{-6} μc/cc at any location during this period in 1952.

Several of the evaporated rain samples which were collected during August were radioautographed in an effort to determine whether the contamination was of particulate or gaseous origin. Although the results from these measurements were not obtained until approximately 15 days after the actual sample was collected, each of the samples showed at least three radioactive particles. The maximum number of particles in an individual sample was 10. A comparison of the radioautograph results with C^{14} and S^{35} standards indicated that the intensity of the individual particles 15 days after collection was in the range of 3 to 5 d/m/ptle.

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Radioactive contamination of drinking water supplies in the Hanford environs was determined from the results obtained from radiochemical analysis of nearly 1,000 samples for the activity density of gross beta and alpha particle emitters. The volume of water analyzed ranged from 500 ml to 11.7 liters; the smaller volumes were used for repetitive analysis for alpha and beta particle emitters and the larger volume was used when it appeared desirable to increase the sensitivity of the measurements. Samples from selected locations were analyzed for uranium as were all samples which indicated trace alpha particle emission. The studies were supplemented with special measurements at the Pasco filter plant and at several locations where drinking water was treated prior to consumption.

Table I summarizes the results obtained at all locations which showed the average activity density of alpha particle emitters exceeding the individual sample detection limit of 5×10^{-9} $\mu c/cc$ during July, August, and September.

TABLE I

CONTAMINATION FROM ALPHA PARTICLE EMITTERS IN DRINKING WATER

JULY, AUGUST, SEPTEMBER

1953

500 ml Samples

		Alpha Particle Emitters			Uranium	
		Units of 10^{-9} µc/cc			Units of 10^{-9} µc/cc	
Location	Number Samples	Max.	Avg.	Number Samples	Max.	Avg.
Richland Well #2	13	68	11	13	9	6
Richland Well #14	13	17	6	13	4	3
Richland Well #18	12	38	6	12	5	3
300 Area Well "J"	6	41	18	--	--	--
Benton City Store	13	16	8	12	12	8
Benton City Water Co. Well	10	28	12	10	12	9
Byers Landing	2	410	210	--	--	--
Sacajawea Park	13	8	6	13	8	5

The trace activity density of alpha particle emitters detected in Richland and Benton City drinking water sources was nearly identical to the amounts found during the previous quarter when the range of these same values was from 5×10^{-9} μc/cc to 1.2×10^{-8} μc/cc. All samples which showed detectable alpha particle emitters also showed trace amounts of uranium when analyzed by measuring the fluorescence. Uranium, measured in these wells, was comparable to that found during the previous quarter. Confirming the results obtained during April, May, and June (HW-29514), a sample from the Benton City Water Company well indicated that the uranium in this water was due to natural sources. The presence of radon in this water also was in agreement with measurements obtained during the spring of 1950 (HW-18321).

A number of drinking supplies other than those indicated in Table I showed trace alpha particle emission during some part of the quarter. Individual values seldom exceeded 1×10^{-8} μc/cc and the three month averages were below the individual detection limit of 5×10^{-9} μc/cc. These positive measurements occurred at random locations and resamples collected within two or three days after the individual measurements generally did not confirm the magnitude of activity in the initial analyses. The results obtained from the radiochemical analysis of all drinking water supplies sampled during the quarter are presented in Table II.

TABLE II

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN DRINKING WATER SUPPLIES JULY, AUGUST, SEPTEMBER 1953

500 ml Samples

Location	Number Samples	Alpha Particle Emitters Units of 10^{-9} µc/cc		Beta Particle Emitters Units of 10^{-8} µc/cc	
		Maximum	Average	Maximum	Average
Richland Well #2	13	68	11	5	<5
Richland Well #4	59	16	<5	41	<5
Richland Well #5	13	<5	<5	16	<5
Richland Well #12	13	9	<5	<5	<5
Richland Well #13	9	<5	<5	<5	<5
Richland Well #14	13	17	6	7	<5
Richland Well #15	13	7	5	34	<5
Richland Well #18	12	38	6	<5	<5
Tract House J-685	14	<5	<5	12	<5
3000 Area Well "A"	14	8	<5	<5	<5
3000 Area Well "B"	14	<5	<5	<5	<5
3000 Area Well "C"	14	6	<5	21	<5
3000 Area Well "D"	13	<5	<5	11	<5
3000 Area Well "E"	13	<5	<5	6	<5
3000 Area Well "J"	6	41	18	<5	<5
3000 Area Well "L"	8	<5	<5	<5	<5
Durand Well #5	12	42	<5	6	<5
Columbia Field Well "A"	14	<5	<5	<5	<5
Columbia Field Well "B"	14	8	<5	5	<5
Columbia Field Well "C"	14	<5	<5	<5	<5
Hanford Well #4	6	10	<5	<5	<5
Headgate Well	13	<5	<5	20	<5
1100 Area Well #8	13	<5	<5	<5	<5
Midway	13	<5	<5	<5	<5
Riverland	14	9	<5	64	8
Lower Knob	13	<5	<5	370	30
Wills Ranch	13	<5	<5	<5	<5

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TABLE II (contd.)

Location	Number Samples	Alpha Particle Emitters, Units of 10^{-9} μc/cc: Maximum	Alpha Particle Emitters, Units of 10^{-9} μc/cc: Average	Beta Particle Emitters, Units of 10^{-8} μc/cc: Maximum	Beta Particle Emitters, Units of 10^{-8} μc/cc: Average
Pistol Range	13	6	<5	6	<5
White Bluffs Fire Hall	13	<5	<5	28	<5
White Bluffs Tele. Exch.	4	<5	<5	7	<5
Benton City Store	13	16	9	<5	<5
Benton City Water Co. Well	10	28	12	<5	<5
Kiona	13	38	<5	<5	<5
Enterprise Well	13	<5	<5	<5	<5
Kennewick Std. Station	13	7	<5	34	16
Hanford Well #7	9	<5	<5	6	<5
100-B Sanitary	13	6	<5	35	<5
100-C Sanitary	13	<5	<5	<5	<5
100-D Sanitary	13	<5	<5	59	14
100-DR Sanitary	13	<5	<5	40	18
100-H Sanitary	13	<5	<5	40	15
100-F Sanitary	13	<5	<5	92	22
100-K Area Well #1	11	<5	<5	<5	<5
200 East Sanitary	13	6	<5	<5	<5
200 West Sanitary	14	7	<5	11	<5
300 Area Sanitary	14	<5	<5	21	<5
251 Building	12	10	<5	43	<5
Byers Landing	2	410	210	<5	<5
Redox Ad. Building	13	16	<5	6	<5
Sacajawea Park	13	8	6	<5	<5
McNary Dam	14	5	<5	<5	<5
Patterson	14	<5	<5	7	<5
Plymouth	14	<5	<5	11	<5
Prosser	13	46	<5	11	<5
Pasco Improvement Farm	2	<5	<5	<5	<5

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Results summarized in Table II were not indicative of any trend or departure from expected values. The number of locations at which trace activity was noted in one or two samples over the three month period was comparable to the number of these random occurrences during the past several months.

Over 200 large volume samples (11.7 liters) were analyzed for the activity density of alpha particle emitters when the results obtained from analyzing the smaller volume samples indicated trace contamination which could not be differentiated from the sensitivity of the measurement. Table III summarizes the results obtained from analyzing the larger volume samples.

TABLE III

ACTIVITY DENSITY FROM ALPHA PARTICLE EMITTERS MEASURED IN DRINKING WATER

JULY, AUGUST, SEPTEMBER

1953

11. 7 liter Samples

Location	No. of Samples	Units of 10^{-10} $\mu c/cc$ Maximum	Average
Richland Well #2	7	43	22
Richland Well #4	5	22	16
Richland Well #5	6	26	15
Richland Well #12	6	28	17
Richland Well #13	6	24	14
Richland Well #14	5	25	12
Richland Well #15	7	27	15
Richland Well #18	5	23	15
Track House #J-685	6	8	6
Columbia Field Well "A"	7	5	4
Columbia Field Well "B"	6	8	6
Columbia Field Well "C"	7	10	4
1100 Area Well #8	4	16	9
3000 Area Well "A"	7	10	4
3000 Area Well "B"	5	15	5
3000 Area Well "C"	6	13	6
3000 Area Well "D"	4	10	4
3000 Area Well "E"	6	13	10
3000 Area Durand #5	6	18	7
Benton City Store	6	71	31
Benton City Water Co. Well	3	92	28
Cobb's Corner (Kiona)	7	24	7
Enterprise Well	5	9	6
Headgate Well	4	9	5
Kennewick Std. Station U.S. 410	5	7	5
Riverland	6	4	<2
Midway	6	13	5
Lower Knob	6	3	<2
Wills Ranch	7	74	13
Hanford Well #4	4	8	5
White Bluffs Fire Hall	4	10	7
Pistol Range	7	110	28
B-Y Well	6	23	14
McGee Well	6	4	<2
Ford Well	6	<2	<2
Meeker	7	<2	<2
251 Building	5	7	3
3000 Pond Inlet River (Raw)	8	11	5

Except for two samples which were collected at Wills Ranch and at the Pistol Range, the results in Table III were not significantly different from previously measured values. The values of 7.4×10^{-9} µc/cc and 1.1×10^{-8} µc/cc found at Wills Ranch and the Pistol Range were several times greater than the values obtained from analyzing six other samples from these locations during the quarter. Although no assignable cause has been found to account for the two high measurements, it may be possible that these samples were contaminated in the laboratory or were interchanged or mislabeled by the personnel collecting the samples. Deletion of the two suspected results from the overall data would reduce the three month average values at these two locations to 3×10^{-10} µc/cc and 1.5×10^{-9} µc/cc; each of these values would be comparable to those measured at these locations in the past.

Over 700 well water samples were analyzed specifically for uranium. Several Richland wells other than those indicated in Table I showed trace amounts of uranium several times during the three month period. Average values at the Richland locations were on the order 3 to 4×10^{-9} µc/cc with maximum measurements at individual wells ranging from 6×10^{-9} µc/cc to 3.0×10^{-8} µc/cc. The latter measurement was obtained at Richland Well #4.

Samples of various types of filtering media and material were obtained weekly from the Pasco Filter Plant and analyzed for the activity density of gross alpha and beta particle emitters. Table IV summarizes results obtained from the beta particle measurements.

TABLE IV

RADIOACTIVE CONTAMINATION MEASURED AT PASCO FILTER PLANT JULY, AUGUST, SEPTEMBER 1953

Type Sample	Number Samples	Activity Density -- Gross Beta Particle Emitters Maximum	Average
Water Entering Plant From River	12	3.4×10^{-6} μc/cc	1.6×10^{-6} μc/cc
Sand (Surface of sand filter)	7	3.8×10^{-4} μc/g	1.6×10^{-4} μc/g
First Backwash Material (Liquid)	8	7.0×10^{-7} μc/cc	2.9×10^{-7} μc/cc
First Backwash Material (Solid)	8	8.2×10^{-2} μc/g	3.7×10^{-2} μc/g
Coal (Surface of coal filter	8	2.3×10^{-4} μc/g	8.1×10^{-5} μc/g
First Backwash Material (Liquid)	8	6.5×10^{-7} μc/cc	3.7×10^{-7} μc/cc
First Backwash Material (Solid)	8	6.4×10^{-2} μc/g	2.8×10^{-2} μc/g
Water Leaving Plant	13	5.4×10^{-7} μc/cc	2.5×10^{-7} μc/cc

The average values summarized in Table IV were in close agreement with the results of similar measurements obtained during the previous quarter. The similarity in the two sets of data was expected as the magnitude of activity detected at the filter plant is generally related to the flow rate of the Columbia River and, as shown in Section V, the mean flow during this quarter was nearly identical to that observed during the previous quarter.

Samples of foam-like material were collected from the surface of the filters at the Pasco Filter Plant and analyzed for the activity density of beta particle emitters. Six samples collected from the coal filter showed an average of 1.1×10^{-2} μc/g and a maximum of 2.3×10^{-2} μc/g. Four similar samples obtained from the sand filter showed an average of 1.1×10^{-2} μc/g and a maximum of 0.12 μc/g.

Thirty-seven samples from the filter plant were analyzed for the activity density of alpha particle emitters. Samples of the liquid portion of the backwash material from the coal filter and samples of the water leaving the plant for consumption showed no detectable activity. Eight samples collected from the backwash of the sand filter showed average values of 8×10^{-9} μc/cc in the liquid portion and 2.7×10^{-5} μc/g in the solid portion. The solid fraction of the backwash collected from the coal filter averaged 3.8×10^{-5} μc/g. The maximum alpha particle measurements were found in the solid portion of backwash materials; values of 3.8×10^{-5} μc/g and 7.7×10^{-5} μc/g were found at the sand and coal filters, respectively.

Nearly 200 samples were collected from wells which were not used for drinking purposes including those drilled by the Earth Sciences group for experimental purposes. The majority of these wells were sampled on a weekly or monthly basis during the period. Table V summarizes the results obtained at locations which were sampled weekly and showed an average activity density above the detection limit of the alpha and beta particle measurements.

TABLE V

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS
MEASURED IN TEST WELLS
JULY, AUGUST, SEPTEMBER
1953

500 ml. Samples

Location	Number Samples	Alpha Particle Emitters Units of 10^{-9} $\mu c/cc$ Maximum	Alpha Particle Emitters Units of 10^{-9} $\mu c/cc$ Average	Beta Particle Emitters Units of 10^{-8} $\mu c/cc$ Maximum	Beta Particle Emitters Units of 10^{-8} $\mu c/cc$ Average
300 Area Well #1	33	360	55	<5	<5
300 Area Well #3	34	430	220	9	<5
300 Area Well #4	30	480	240	34	<5
300 Area North Well	2	1000	510	9	5

The values indicated in Table V for the activity density of beta particle emitters were nearly identical to those measured during the previous quarter. Increases approaching a factor of 2 in the alpha particle emitter measurements at the three 300 Area Wells were a continuation of a seasonal trend observed during spring and early summer when the Columbia River reaches maximum flow. The contaminant accounting for the activity in the 300 Area Wells was again identified as uranium; average values at Wells #1, 3, and 4 were 4.8×10^{-8}, 2.3×10^{-7}, and 2.4×10^{-7} μc/cc, respectively. The maximum uranium measurement was 5.1×10^{-7} μc/cc in a sample collected from Well #4. Four of the test wells drilled by the Earth Sciences group showed trace contamination which barely exceeded the sensitivity of the individual analysis. Wells 32-77 and 47.5-60.5 showed the average activity density of beta particle emitters to be 9×10^{-8} μc/cc; the maximum measurement was 1.9×10^{-7} μc/cc at Well #32-77. Wells #1.9-3.4 and 17.4-4.5 showed the average activity density of alpha particle emitters to be 2.6×10^{-8} and 6×10^{-9} μc/cc, respectively. The maximum alpha particle measurement was 2.6×10^{-8} μc/cc at Well #1.9-3.4.

H. J. Paas
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