HW-30744

BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS

FOR THE PERIOD

OCTOBER, NOVEMBER, DECEMBER

1953

GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

[redacted]

HW-30744

Health and Safety

This document consists of 84 pages. [redacted]

HANFORD TECHNICAL RECORD

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER 1953

By

H. J. Paas

January 29, 1954

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

I^{131} emission from separation facilities averaged 1.7 curies per day during the quarter. Approximately 82 per cent of the I^{131} was emitted from the S-plant where the maximum emission of 10 curies occurred on October 21. Ruthenium emission from the S-plant averaged 0.94 curie per day including a maximum emission of 3.2 curies on October 12. An average of 0.48 curie per day of tritium oxide emitted from the five reactors was weighted significantly by the emission of 3.8 curies from the 105-H stack on November 4. Increased emission of S^{35} was noted at all reactors except 100-H; total emission from the five reactors averaged 4.6×10^{-2} curie per day. C^{14} emission averaged less than 4.5×10^{-3} curie per day at each reactor although occasional positive measurements were obtained during the quarter.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION

I^{131} deposited on vegetation was not significantly different from that measured during the previous quarter. Maximum deposition on the order of 1×10^{-5} μc/g to 5×10^{-5} μc/g was confined to the area in and around the separation areas. Deposition at the plant perimeter and in residential areas near the plant averaged less than 3×10^{-6} μc/g. Trace quantities of I^{131} were again found in the Pomeroy-Dayton area and at Blalock, Oregon. Decreases in the activity density of non-volatile beta particle emitters noted during the previous quarter continued during this period with the December values representing the lowest concentrations measured since the fallout from nuclear explosions during the middle of the year. Non-volatile emitters at off-area locations averaged within a factor of 5 of the activity density which may be attributed to naturally occurring isotopes. The activity density of alpha particle emitters on vegetation was comparable to that noted during the previous quarter.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dosage rates measured by Integrons showed decreases at all locations except the 200 West area where averages at two stations were 1.4 mrad/day and 0.4 mrad/day. Average values at several residential locations were less than 0.2 mrad/day. Detachable ionization chamber monitoring showed an increase in dosage rate in the area within a 5 mile radius of the separation areas and a comparable decrease in dosage rate in the area within a 10 mile radius of the separation facilities. Decreases in the activity density of filterable beta particle emitters and in the number of radioactive particles in the atmosphere were observed throughout the environs; maximum

activity densities ranging from 1×10^{-12} to 4×10^{-12} μc/cc were found in the separation areas and the maximum average particle concentration of 0.6 particle per meter^3 was measured near the Redox area. I^{131} in the atmosphere averaged less than 1×10^{-13} μc/cc at residential locations; maximum measurements in the 200 West area showed an average of 4.3×10^{-12} μc/cc over a one week period. The activity density of alpha particle emitters averaged between $< 4 \times 10^{-15}$ μc/cc and 3.8×10^{-14} μc/cc in the environs; high concentrations continued at the 200 West and 100-H areas.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The activity density of beta particle emitters in reactor effluent water increased significantly at all areas; average values ranged from 3.9×10^{-3} μc/cc at the 100-C area to 5.8×10^{-3} μc/cc at 100-DR. Higher power levels along with seasonal increases in certain isotopes influenced this increase. Trace quantities of uranium, plutonium, and polonium were detected in reactor effluent water. I^{131} discharged to the river from the Biology Farm averaged 0.06 mc/day. Monitoring of separation area wastes showed wide fluctuation in the activity density of alpha and beta particle emitters. Uranium was detected in the swamps where average values ranged from 4×10^{-9} to 1.8×10^{-8} μc/cc. Portable instrument surveys at the perimeter of the waste zones in the 200 areas and at the burning grounds in the 100 areas showed readings comparable to those expected.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

Seasonal decreases in the flow rate of the river and the increased activity density of beta particle emitters in reactor effluent water caused two to three-fold increases in the activity density of beta particle emitters at locations between the reactors and Pasco-Kennewick Bridge. The average flow rate was 597,000 g/s; maximum flow was 698,000 g/s on October 26 and minimum flow was 413,000 g/s on November 24. The maximum activity density of beta particle emitters was found on the sourth shore of the river between the 100-H area and the Hanford Ferry where the average was 1.2×10^{-5} μc/cc. Samples obtained from several locations across the river at McNary Dam showed no difference in the activity density of beta particle emitters. Samples obtained from 10 locations between McNary Dam and Portland, Oregon showed values ranging from 5×10^{-8} to 1.3×10^{-7} μc/cc with the higher values generally confined to the Arlington, Oregon region. Alpha particle emitters in the Columbia River were below detection limits at all locations except the 300 area where the activity density averaged 4×10^{-8} μc/cc. Trace amounts of uranium were found at the 300 area sample location. I^{131} in river water collected from the Hanford Ferry showed an average of 2.5×10^{-7} including a maximum measurement of 2.2×10^{-6} μc/cc. Radioactive contamination in mud samples was on the order of magnitude expected. Increases noted in the activity density of beta

particle emitters in raw water were associated with the decrease in river flow; maximum measurements were found at the 100-F area where the average of 1.4×10^{-6} μc/cc included a maximum measurement of 2.1×10^{-6} μc/cc.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN

Significant decreases in the activity density of beta particle emitters in rain were closely related to the decreases noted in radioactive particle concentration and the activity density of non-volatile beta particle emitters deposited on the ground. With the possible exception of one sample collected at the Redox area which showed 5.3×10^{-5} μc/cc, the activity density of beta particle emitters in rainfall was comparable to that observed during the first quarter of 1953 prior to the influx of radioactive debris from nuclear detonations.

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

Locations at which the average activity density of alpha particle emitters exceeded a value of 5×10^{-9} μc/cc included three Richland wells and two Benton City drinking water sources. Uranium was detected in each of these wells with average values ranging from 4×10^{-9} to 1.1×10^{-8} μc/cc. Gross beta particle emitters in sanitary water at the manufacturing areas showed average activity densities ranging from 2×10^{-7} to 4×10^{-7} μc/cc; maximum measurements obtained at the 100-DR and 100-H area were on the order of 8×10^{-7} μc/cc. Beta particle emitters in Pasco and Kennewick drinking water averaged 2.9×10^{-7} and 2.3×10^{-7} μc/cc, respectively. Uranium in the 300 area wells showed average values of 5×10^{-9}, 1.1×10^{-7}, and 1.5×10^{-7} μc/cc in wells #1, #2, and #3, respectively. Alpha particle emitters were detected in 19 out of 24 different test wells sampled in the environs. Ten of these same wells showed detectable beta particle emission.

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INTRODUCTION

This document summarizes the results obtained from monitoring the Hanford environs for radioactive contamination originating from HAPO and from naturally occurring isotopes during the period October, November, and December, 1953. Samples were collected in the liquid, solid, and gaseous states from representative locations on the project and from remote locations in the states of Washington, Oregon, and Idaho according to procedures outlined in previous publications of this series (HW-30174, HW-29514, and HW-28009). The samples were analyzed by the Control Laboratory of the Biophysics Section according to radiochemical procedures described in HW-20136. The measurements thus obtained were corrected for geometry, backscatter, air window, self absorption, source size, collection efficiency, chemical yield, and weight-volume by Control Services personnel of the Biophysics Section according to the procedures and factors summarized in HW-22682, HW-23769, and HW-27854. Samples which contained significant quantities of short half-life beta particle emitters and samples which were analyzed for specific isotopes were also corrected for the decay interval between collection time and counting time. The findings from the direct analysis of samples by radiochemical methods were supplemented with the results obtained from portable instrument surveys performed by Regional Survey personnel. Maps which show the location of the monitoring stations and sampling locations mentioned in the discussion may be referred to in HW-29514. Project boundaries referred to in the subsequent discussions are those defined by the Atomic Energy Commission in drawing SK-7-414.

The results obtained from the measurements described above are presented in Sections I through VII which discuss the amounts of contamination discharged in plant effluent materials and their effect on the contamination of vegetation, air, soil, and water in the environs of HAPO.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

Radioactive contamination discharged to the atmosphere from HAPO manufacturing facilities was measured by analyzing samples which were collected from the stack effluents. Continuous monitoring was used in the separation areas where scrubber and filter samples were analyzed for I^{131} and ruthenium. Daily monitoring and periodic analysis of filters removed from the inlet and outlet of the Redox sand filter were directed toward identifying the source of contamination emitted from this facility. Monitoring was continuous at reactor areas where several types of samples were collected for specific evaluation of different contaminants. Summaries of the results obtained from these measurements are presented for the separation and reactor facilities.

SEPARATION AREAS

200 EAST AREA

No dissolving was undertaken at the C-plant during this quarter since the facility was shutdown for decontamination prior to additional construction work. Monitoring was maintained throughout the quarter, however, to detect possible contamination of the atmosphere by the decontamination work. Table I summarizes the combined results of the filter and scrubber samples collected at C-plant during the quarter. The general decrease in activity density of the stack gases from that of last quarter, when 20 curies of I^{131} were available in the metal processed at this facility, can be noted from this table.

TABLE I

SUMMARY OF RESULTS FROM STACK MONITORING

C-PLANT STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Month	Curie of Gross Beta Particle Emitters Emitted Daily		Curie of I^{131} Emitted Daily		Curie of Ruthenium Emitted Daily	
	Maximum	Average	Maximum	Average	Maximum	Average
October	1.4×10^{-2}	$<2.4 \times 10^{-4}$	3.7×10^{-4}	9.2×10^{-5}	1.3×10^{-3}	$<3.2 \times 10^{-4}$
November	1.0×10^{-3}	$<3.2 \times 10^{-4}$	6.6×10^{-5}	5.5×10^{-6}	4.9×10^{-4}	2.0×10^{-4}
December	8.5×10^{-4}	$<3.3 \times 10^{-4}$	4.5×10^{-5}	1.1×10^{-5}	3.8×10^{-4}	$<1.3 \times 10^{-4}$
Quarter	1.4×10^{-2}	$<2.9 \times 10^{-4}$	3.7×10^{-4}	4.9×10^{-5}	1.3×10^{-3}	$<2.4 \times 10^{-4}$
Last Quarter	0.16	$<8.4 \times 10^{-3}$	1.0×10^{-2}	$<5.8 \times 10^{-4}$	0.16	2.4×10^{-3}

200 WEST AREA T-PLANT

Table II summarizes the results obtained from monitoring at the fifty foot level of the T-plant stack.

TABLE II

SUMMARY OF RESULTS FROM I^{131} MONITORING

T-PLANT STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Month	Curies of I^{131} Dissolved Daily		Curies of I^{131} Emitted Daily	
	Maximum	Average	Maximum	Average
October	1100	140	2.3	0.40
November	2100	220	3.7	0.37
December	140	29	0.23	0.06
Quarter	2100	130	3.7	0.28
Last Quarter	1300	160	0.68	0.16

[redacted]

Decreased efficiency of the 3-5R silver reactor was responsible for the emission of 2.3 curies of I^{131} per day during the period October 17 to 19 from the T-plant stack. On November 13, 3.7 curies of I^{131} emitted to the atmosphere from this stack over a one day period was also caused by faulty silver reactor operation. Neither of these incidents resulted in a permanent loss of efficiency of the silver reactors because later in the month the I^{131} emission returned to values on the order of 0.05 to 0.1 curie per day even though regeneration of the reactors was not attempted.

200 WEST AREA S-PLANT

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

TABLE III

SUMMARY OF RESULTS FROM I^{131} MONITORING

S-PLANT STACK

OCTOBER, NOVEMBER, DECEMBER

1953

	Curies of I^{131} Dissolved Daily		Curies of I^{131} Emitted Daily	
Month	Maximum	Average	Maximum	Average
October	1200	370	10	3.0
November	890	84	0.76	0.65
December	480	190	2.3	0.68
Quarter	1200	210	10	1.4
Last Quarter	1300	340	27	2.3

Failure of the A and C cell silver reactors during October was responsible for the emission of 35.5 curies of I^{131} from the S-plant stack over a four day period. The maximum emission of 10 curies per day

occurred on October 21 when both faulty reactors were in use. Regeneration of these silver reactors returned the I^{131} emission rate to a level of less than one curie per day.

During December, occasional periods of I^{131} emission greater than one curie per 24 hours were noted although no specific silver reactor failure could be detected.

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

OCTOBER, NOVEMBER, DECEMBER

1953

Ruthenium Emission

Units of Curies Per Day

	Filter Collection		Scrubber Collection		Total	
Month	Maximum	Average	Maximum	Average	Maximum	Average
October	3.2	0.80	1.1	<0.19	3.2	<0.99
November*	---	-----	0.44	<0.14	---	----
December	1.1	0.46	1.3	<0.51	1.8	<0.96
Quarter	3.2	0.70	1.3	<0.24	3.2	<0.94
Last Quarter	84	2.4	3.8	<0.31	84	2.7

* No filter samples were collected during November.

The maximum ruthenium emission of 3.2 curies per day occurred October 10 to 12, 1953, and occasional periods of emission greater than one curie per day were noted during the quarter. No specific equipment failure or faulty process operations were noted that would account for these increases and the average ruthenium emission during the quarter was less than one curie per day (Table IV). The average of 2.7 curies per day noted last quarter was weighted by the unusually high emission of 84 curies per day on September 6, 1953.

The results of filter monitoring at the inlet to the S-plant sand filter are summarized in Table V.

TABLE V

SUMMARY OF FILTER MEASUREMENTS

S-PLANT SAND FILTER INLET

OCTOBER, NOVEMBER, DECEMBER

1953

	Gross Beta Particle Emitters Units of 10^{-3} $\mu c/ft^3$		mrad/hr per μc*	
Month	Maximum	Average	Maximum	Average
October	166	35.8	250	42
November	115	15.7	180	49
December	541	49.0	310	64
Quarter	541	34.9	310	53
Last Quarter	370	14.1	105	39

* Dosage determined from CP instrument surface readings.

Decreases in the average activity density of gross beta particle emitters in the gas entering the S-plant sand filter were noted during the middle part of the quarter after the canyon deck at the 202-S Building was washed. The activity density of the gas remained at this lower level until December 19 to 21 when one unusually high measurement was noted.

During the weekend of December 19 to 21, one of the process lines in the 202-S Building was opened and cleaned and contamination resulting from this operation entered the ventilation air stream and was carried to the sand filter. Samples taken at the inlet to the sand filter showed that the concentration of beta particle emitters was 0.54 $\mu c/ft^3$ of gas; 62 curies of gross beta activity passed into the sand filter during the two day sampling period. Radiochemical analysis by Control Laboratory personnel showed that most of this activity (>95%) was from ruthenium. This was the highest activity density noted at this location since monitoring of the sand filter was initiated and as this unusually high result does not appear to represent normal operation, the inclusion of this value weights the monthly and quarterly averages significantly.

Filter measurements at the outlet of the S-plant sand filter during the period of high inlet gas activity density indicated that less than 0.02 percent of the activity entering the sand filter passed through to the stack. Table VI is a summary of filter measurements obtained from monitoring at the S-plant sand filter outlet.

TABLE VI

SUMMARY OF FILTER MEASUREMENTS

S-PLANT SAND FILTER OUTLET

OCTOBER, NOVEMBER, DECEMBER

1953

Month	Gross Beta Particle Emitters Units of 10^{-5} μc/ft^3 Maximum	Average
October	106	16
November	100	30
December	4.7	1.4
Quarter	106	16

Measurements of the concentration of radioactive particles in the gases leaving the sand filter were discontinued during this quarter and were replaced by gross beta particle emitter analysis of the filters.

Only spot measurements of the gross beta activity were obtained before October and no comparison of this quarter's averages with previous data was possible.

200 WEST AREA U-PLANT STACK

Table VII is a summary of the results of filter measurements obtained from the U-plant stack.

TABLE VII

SUMMARY OF FILTER MEASUREMENTS

U-PLANT STACK

OCTOBER, NOVEMBER, DECEMBER

1953

	Curie Emitted Per Day				Radioactive Particles	
	Gross Alpha Particle Emitters Units of 10^{-8}		Gross Beta Particle Emitters Units of 10^{-5}		Units of 10^{4} particles/day	
Month	Maximum	Average	Maximum	Average	Maximum	Average
October	20	6.2	42	12	>64	>38
November	4.8	1.4	1.6	0.8	>61	>52
December	3.1	1.4	0.8	0.4	>59	>29
Quarter	20	2.9	42	4.0	>64	>39
Last Quarter	25	6.5	88	16	>66	>17

The majority of the particle filters yielded radioatuographs which were too dense to interpret. This is a continuation of the upward trend in the number of particles noted in September although the activity of gross beta particle emitters decreased markedly during the quarter. Examination of the radioautographs revealed that the radioactive material was deposited on the filters in a finely divided state or else condensed on the filters from the gaseous phase. Toward the end of the quarter, a few filters were obtained which gave good radioautographs and these filters only contained one or two particles. The data from the latter filters indicated that the concentration of radioactive particles was returning to a value on the order of 1×10^{4} particles per day which was comparable to that noted at the beginning of the previous quarter.

[redacted]

Decreases were noted this quarter in the gross alpha and gross beta particle emitter activity density of the U-plant stack gas (Table VII). These data indicate a reversal of the trend toward higher concentrations noted in the previous two quarters.

REACTOR AREAS

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

[redacted]

TABLE VIII

SUMMARY OF STACK MONITORING RESULTS

105-F STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day*
October						
Maximum	0.27	<4.5	24	19	350	
Average	0.09	<4.5	13	9.8	250	
November						
Maximum	0.22	<4.5	28	14	330	
Average	0.08	<4.5	12	7.6	220	
December						
Maximum	0.22	14.2	30	2.1	300	
Average	0.08	<4.5	17	1.9	200	
Quarter						
Maximum	0.27	14.2	30	19	350	
Average	0.08	<4.5	14	5.8	220	
Last Quarter						
Maximum	0.40	12	18	8.3	800	
Average	0.07	<4.5	4.5	3.8	160	

* Radioautographs of particle filters were too dark to accurately count individual particles.

TABLE IX

SUMMARY OF STACK MONITORING RESULTS

105-D STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day*
October						
Maximum	0.24	<4.5	26	7.7	870	
Average	0.10	<4.5	12	3.4	470	
November						
Maximum	0.42	<4.5	10	5.5	470	
Average	0.13	<4 5	5.3	2.9	340	
December						
Maximum	0.21	<4.5	6.1	2.6	540	
Average	0.11	<4.5	<4.5	1.5	280	
Quarter						
Maximum	0.42	<4.5	26	7.7	870	
Average	0.11	<4.5	6.9	2.4	340	
Last Quarter						
Maximum	0.49	4.7	12	5.6	540	
Average	0.11	<4.5	<4.5	2.3	260	

* Radioautographs of particle filters were too dark to accurately count individual particles.

TABLE X

SUMMARY OF STACK MONITORING RESULTS

105-DR STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
October						
Maximum	0.22	<4.5	16	4.0	0.17	1.6
Average	0.05	<4.5	7.2	2.0	0.06	0.41
November						
Maximum	0.16	6.6	6.7	1.3	0.72	<0.91
Average	0.04	<4.5	<4.5	0.6	0.31	<0.18
December						
Maximum	0.12	<4.5	7.0	2.2	0.70	<0.82
Average	0.04	<4.5	4.6	0.9	0.31	<0.12
Quarter						
Maximum	0.22	6.6	16	4.0	0.73	1.60
Average	0.05	<4.5	5.1	1.0	0.25	0.11
Last 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

TABLE XI

SUMMARY OF STACK MONITORING RESULTS

105-H STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
October						
Maximum	0.22	<4.5	8.1	11	33	180
Average	0.07	<4.5	<4.5	5.9	14	69
November						
Maximum	3.8	6.7	36	7.1	23	>200
Average	0.35	<4.5	13	4.4	11	> 45
December						
Maximum	0.23	<4.5	11	3.4	12	>200
Average	0.08	<4.5	6.7	1.5	8.8	> 69
Quarter						
Maximum	3.8	6.7	36	11	33	>200
Average	0.17	<4.5	8.1	3.5	11	> 62
Last Quarter						
Maximum	0.33	<4.5	36	8.8	56	670
Average	0.07	<4.5	8.2	3.4	11	80

TABLE XII

SUMMARY OF STACK MONITORING RESULTS

105-C STACK

OCTOBER, NOVEMBER, DECEMBER

1953

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Filterable Particle Emitters: Total Alpha Units of 10^{-7}	Filterable Particle Emitters: Total Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
October						
Maximum	0.05	<4.5	13	14	8.5	60
Average	0.03	<4.5	8.4	5.4	6.0	38
November						
Maximum	0.16	<4.5	25	92	96	100
Average	0.06	<4.5	12	5.8	25	53
December						
Maximum	0.79	<4.5	44	4.8	10	50
Average	0.12	<4.5	16	2.4	5.7	31
Quarter						
Maximum	0.79	<4.5	44	92	96	100
Average	0.07	<4.5	12	4.6	13	40
Last Quarter						
Maximum	0.21	7.1	18	5.5	23	110
Average	0.03	<4.5	6.8	2.6	5.5	47

The average tritium oxide emission rate from the five reactor stacks monitored increased from the value of 0.32 curie per day noted last quarter to 0.48 curie per day during the present quarter. Most of this increase was due to the unusually high measurement of 3.8 curies per day obtained at the 105-H stack on November 4, and the high measurement of 0.79 curie per day obtained at the 105-C stack on December 18. There were no significant changes in the tritium oxide emission rates noted at the other three reactor stacks.

Three positive C^{14} measurements were obtained this quarter; all other C^{14} measurements at the 5 reactor stacks and all monthly and quarterly averages were below the detection limit of 4.5×10^{-3} curie per day. The positive C^{14} measurements were 1.4×10^{-2} curie per day at 105-F on December 1, 6.7×10^{-3} curie per day at 105-H on November 24, and 6.6×10^{-3} curie per day at 105-DR on November 17. None of these values represent a significant increase.

S^{35} emission increased at all reactor stacks except 105-H during the quarter. The most significant increase occurred at 105-F stack where the average for the present quarter was 1.4×10^{-3} curie per day compared to 4.5×10^{-4} curie per day during the previous quarter. The maximum emission from 105-F was 3.0×10^{-3} curie of S^{35} per day on December 8, 1953 compared to a maximum of 1.8×10^{-3} curie per day last quarter. The maximum S^{35} emission measured during the present quarter was at 105-C reactor stack on December 8, 1953 when 4.4×10^{-3} curie per day was emitted to the atmosphere.

Gross alpha particle emitter activity density increased in the 105-F and 105-C stack gases during the first two months of the present quarter. The maximum and average values for the present quarter were 1.9×10^{-6} and 5.8×10^{-7} curie per day, respectively, from the 105-F stack, and 9.2×10^{-6} and 4.5×10^{-7} curie per day, respectively, at 105-C stack.

The average activity density of gross beta particle emitters in the stack gases at the 105-F and 105-C stacks also increased during the quarter. The higher emission rate at the 105-F reactor stack was noted throughout the quarter; average emission was 2.2×10^{-3} curie per day during the present quarter compared to 1.6×10^{-3} curie per day during the previous quarter. The average emission of 1.3×10^{-4} curie per day at 105-C was weighted by one high measurement of 9.6×10^{-4} curie per day during November. During the remainder of the quarter the emission of gross beta particle emitters from this stack was on the order of magnitude noted during the previous quarter when the average was 5.5×10^{-5} curie per day.

The particle filters operated at the 105-F and 105-D stacks yielded radioautographs which were too dense to count throughout the quarter. The radioautographs indicated that a finely divided or gaseous radioactive material was responsible for the darkening of the films.

Measurement of the concentration of radioactive particles in the stack gases emitted from the 105-H stack revealed a questionable decrease in average concentration. Several filters collected near the end of the quarter yielded radioautographs which were too dark to count accurately and only an estimate of the number of darkened spots per film could be made. The average for the present quarter was estimated at 6×10^{6} particles per day compared to 8.0×10^{6} particles per day during the previous quarter.

There was a significant decrease in the radioactive particle concentration in the 105-DR reactor stack gases during the present quarter; several of the filters collected during November and December revealed no radioactive particles when radioautographed. The average concentration for the present quarter was 1.1×10^{4} particles per day compared to 1.0×10^{5} particles per day during the previous quarter. There was no

significant change in the average concentration of radioactive particles in the gases emitted from the 105-C reactor stack during the quarter.

Initial measurements obtained at the 105-B stack during the quarter included only two sampling periods. The average values obtained from these measurements were (in curies per day) tritium oxide, 0.04; S^{35}, 5.1×10^{-3}; C^{14}, less than 4.5×10^{-3}; gross alpha particle emitters, 1.8×10^{-7}; and gross beta particle emitters, 1.2×10^{-3}. No previous measurements are available for comparison with these spot measurements.

[redacted]

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

The magnitude and extent of the deposition of radioactive contaminants in the Hanford Environs was determined from the results obtained from analyzing nearly 3000 vegetation samples. Nearly 2300 samples were collected from locations on and immediately adjacent to HAPO; approximately 700 samples were obtained from remote locations in the states of Washington, Oregon, and Idaho. All samples were analyzed for the activity density of I^{131} and approximately 75 per cent of the samples were analyzed for the activity density of non-volatile beta particle emitters. The activity density of alpha particle emitters on vegetation was determined by analyzing samples collected from nine locations in the immediate environs.

Table I summarizes the results obtained from analyzing vegetation samples for the activity density of I^{131} and of non-volatile beta particle emitters from grouped locations during this quarter; previous quarterly averages are included for comparison.

[redacted]

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

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	210	54	<3	3	490	120	270
Near the 200 Areas	149	30	3	5	370	120	330
Route 3	12	52	13	7	---	---	---
200 West Gate	63	270	20	16	500	160	210
200 East Tower #16	63	14	4	6	280	98	200
Batch Plant	34	19	6	9	360	120	220
Meteorology Tower	12	26	8	10	---	---	---
South of 200 Areas	337	22	<3	4	250	81	170
Richland	243	36	<3	<3	710	98	190
Pasco Environs	178	14	<3	<3	200	50	110
Kennewick Environs	210	9	<3	<3	260	56	120
Benton City - Kiona	38	9	<3	<3	190	63	180
Richland "Y"	13	5	<3	<3	---	---	---
Hanford	12	6	<3	<3	---	---	---
200 East Area	47	10	3	<3	230	120	58
200 West Area	88	83	10	6	350	250	88
Wahluke Slope	154	44	<3	<3	290	96	80
Goose Egg Hill	63	52	8	<3	180	91	48
Rattlesnake Mountain	67	11	<3	5	250	89	260
PSN-300-310-330	39	47	7	5	380	110	140
Redox Construction	91	43	9	10	---	---	---
Off-Area Sampling							
Pasco to Ringold	75	27	<3	4	710	110	170
Prosser to Patterson-McNary	212	18	<3	3	550	55	140
Eastern Washington	198	13	<3	<3	180	37	53
So. Washington and No. Oregon	207	18	<3	<3	210	49	110

The average amount of I^{131} deposited on vegetation during this period was not significantly different than that measured during the previous quarter. Maximum deposition in the range of 1×10^{-5} μc/g to 5×10^{-5} μc/g in and around the separation areas also was comparable to that found during the previous quarter. One sample collected near the 200-W area gate on November 13 which showed the activity density of I^{131} to be 2.7×10^{-4} μc/g appeared to result from the failure of a silver reactor at one of the 200-W facilities on this same day; the reactor failure caused a gross emission of 3.7 curies of I^{131} over a 24 hour period. If this one exceptionally high measurement were deleted from the data, the maximum deposition in the region near the 200-W gate would be 5.7×10^{-5} μc/g.

Examination of the I^{131} deposition data on a month to month basis during this quarter reveals a small increasing trend in the amount of I^{131} found in and near the separation areas during the latter part of the quarter. This trend was comparable to that noted during the same period in 1952 and, as in the past, appeared to be influenced by seasonal meteorological conditions (HW-27641). The higher deposition during the latter part of the quarter was also influenced by high I^{131} emission on November 13 when the amount of I^{131} discharged at the 202-S facility was 10 times greater than the average emission during the remainder of the quarter.

Table II summarizes the trend of the I^{131} measurements for each of the three months in the quarter.

SECRET

TABLE II

ACTIVITY DENSITY FROM I^{131} ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

1953

Units of 10^{-6} μc/gram

Location	October		November		December	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	54	4	29	<3	7	<3
Near the 200 Areas	19	3	15	3	30	4
Route 3	7	5	14	9	52	24
200 West Gate	19	7	270	30	49	23
200 East Tower #16	9	3	14	5	12	4
Batch Plant	9	4	19	7	12	7
Meteorology Tower	17	6	26	10	6	4
South of 200 Areas	20	<3	14	<3	11	<3
Richland	35	<3	29	<3	14	<3
Pasco Environs	10	<3	14	<3	11	<3
Kennewick Environs	9	<3	9	<3	9	<3
Benton City - Kiona	4	<3	3	<3	9	<3
Richland "Y"	<3	<3	<3	<3	5	<3
Hanford	6	4	4	<3	4	<3
200 East Area	8	4	7	<3	10	<3
200 West Area	12	5	43	11	83	15
Wahluke Slope	16	<3	4	<3	7	<3
Goose Egg Hill	52	10	21	5	21	9
Rattlesnake Mountain	11	<3	9	<3	8	4
PSN-300-310-330	47	8	21	7	23	5
Redox Area	13	5	43	11	32	11
Off-Area Sampling						
Pasco to Ringold	10	<3	27	4	8	<3
Prosser to Patterson-McNary	18	<3	12	<3	10	<3
Eastern Washington	13	<3	12	<3	6	<3
So. Washington and No. Oregon	6	<3	18	<3	9	<3

Estimated iso-activity maps showing the deposition of I^{131} based on the individual measurements obtained from the locations shown in Table II are shown in Figures 1 through 3. Figure 4 is a similar map which shows the extent and magnitude of the deposition based on all measurements obtained during the quarter. In general, the region in which detectable quantities of I^{131} was deposited was essentially confined to the area in and around the separation areas and in an elongated area extending southeast of the separation facilities for approximately 10 miles. The location of significant deposition correlates favorably with prevailing wind directions. Random occurrences of trace quantities of radioactive iodine at isolated locations as shown in Figures 1 through 4 may have been attributed to meteorological conditions but was also weighted considerably by the varying frequencies of sample collection at remote locations.

The decreasing trend noted in the activity density of non-volatile beta particle emitters in the environs during the previous quarter continued during this period. Values observed during the month of December were the lowest measured since the significant deposition of particulate contamination caused by fallout from nuclear explosions during the middle of the year (HW-28925). Statistical evaluations of average measurements obtained from several selected locations showed that the decrease in activity density observed during this period was significant. Table III summarizes the results obtained from analyzing vegetation samples for the activity density of non-volatile beta particle emitters.

[redacted]

TABLE III

ACTIVITY DENSITY FROM NON-VOLATILE BETA PARTICLE EMITTERS ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

1953

Units of 10^{-6} μc/g

Location	October		November		December	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	490	180	340	110	110	67
Near the 200 Areas	370	160	210	100	140	87
Route 3	---	---	---	---	---	---
200 West Gate	500	210	390	140	330	140
200 East Tower #16	280	110	210	94	180	89
Batch Plant	360	150	250	110	110	77
South of 200 Areas	250	91	180	77	180	76
Richland	710	130	210	84	140	60
Pasco Environs	200	59	140	51	110	38
Kennewick Environs	260	70	120	48	150	45
Benton City -- Kiona	180	81	190	67	60	41
200 East Area	230	150	190	110	140	96
200 West Area	350	170	270	200	1600	420
Wahluke Slope	290	110	250	100	120	72
Goose Egg Hill	190	100	170	99	120	76
Rattlesnake Mountain	250	110	140	79	130	62
PSN-300-310-330	380	140	230	100	140	79
Off-Area Sampling						
Pasco to Ringold	710	180	120	65	160	65
Prosser to Patterson-McNary	550	72	220	48	140	41
Eastern Washington	130	36	180	46	92	29
So. Washington and No. Oregon	210	67	180	42	110	39

Deposition of radioactive contaminants on vegetation in remote locations was determined from the results of samples collected in southern and eastern Washington, northern Oregon, and eastern Idaho. Samples were collected near residential areas in this region at monthly intervals during the quarter. Table IV summarizes the results obtained from analyzing samples collected at remote locations.

TABLE IV

RADIOACTIVE CONTAMINATION ON VEGETATION

OFF-AREA LOCATIONS

OCTOBER, NOVEMBER, DECEMBER

1953

Units of 10^{-6} μc/g

Location	No. Samples	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Moxee	12	6	<3	37	19
Union Gap	6	9	4	41	26
Wapato	12	4	<3	100	35
Toppenish	12	5	<3	54	36
Toppenish to Goldendale	24	4	<3	140	49
Goldendale	12	6	<3	110	50
Goldendale to Wishram	9	<3	<3		
Lyle	6	4	<3	82	41
Bingen	6	3	<3	48	33
Camas	12	6	<3	99	64
Vancouver	12	<3	<3	46	26
Portland	12	6	<3	160	57
Troutdale	6	6	<3	175	100
Bonneville	6	<3	<3	43	31
Hood River	6	4	<3	67	55
The Dalles	12	5	<3	89	53
Moody	6	<3	<3	98	53
Rufus	6	<3	<3	69	47
Blalock	6	18	3	78	68
Arlington	6	<3	<3	89	89
Heppner Junction	6	7	<3	210	110
Boardman	6	6	<3	180	73

TABLE IV (contd.)

Location	Units of 10^{-6} µc/g: No. Samples	I^{131} Max.	I^{131} Avg.	Non Volatile Beta Emitters Max.	Non Volatile Beta Emitters Avg.
Wallula	6	3	<3	61	44
Touchet	6	<3	<3	46	34
Lowden	6	7	<3	43	30
Walla Walla	12	5	<3	52	32
Dixie	6	4	<3	60	39
Waitsburg	12	7	<3	30	22
Dayton	12	10	<3	65	39
Pomeroy	12	13	<3	26	17
Lewiston	12	6	<3	69	33
Uniontown	6	7	<3	120	50
Pullman	11	5	<3	35	22
Colfax	6	<3	<3	36	27
Steptoe	6	5	<3	69	35
Rosalia	6	<3	<3	32	27
Spangle	6	4	<3	180	81
Spokane	12	4	<3	46	25
Cheney	12	5	<3	43	31
Sprague	12	4	<3	110	49
Ritzville	12	4	<3	87	61
Lind	12	4	<3	92	61
Connell	12	12	<3	66	39
Pendleton	2	<3	<3	20	20
Stanfield	2	<3	<3	--	--
Meacham	2	4	3	68	68

The average activity density of I^{131} at off-area locations was below the sensitivity limit of the measurements (3×10^{-6} µc/g) at nearly all locations. Trace quantities of I^{131} detected in individual samples from locations in the Pullman, Pomeroy, Lewiston area, and at Blalock, Oregon was a continuation of observations noted during the previous quarter. Maximum deposition on the order of 1×10^{-5} µc/g was comparable in magnitude to maximum measurements obtained at two remote locations during the previous quarter.

The decrease in the activity density of non-volatile beta particle emitters noted at locations in the immediate environs (Table I) was also reflected in the average results obtained from remote locations. In general, the average activity density of non-volatile beta particle emitters at remote locations was within a factor of 5 of the activity density which may be attributed to naturally occurring isotopes such as K^{40}.

Monitoring for the activity density of alpha particle emitters on vegetation was confined to the immediate environs. Table V summarizes the results obtained from analyzing weekly samples collected at nine representative locations.

TABLE V

ACTIVITY DENSITY OF GROSS ALPHA PARTICLE EMITTERS ON VEGETATION

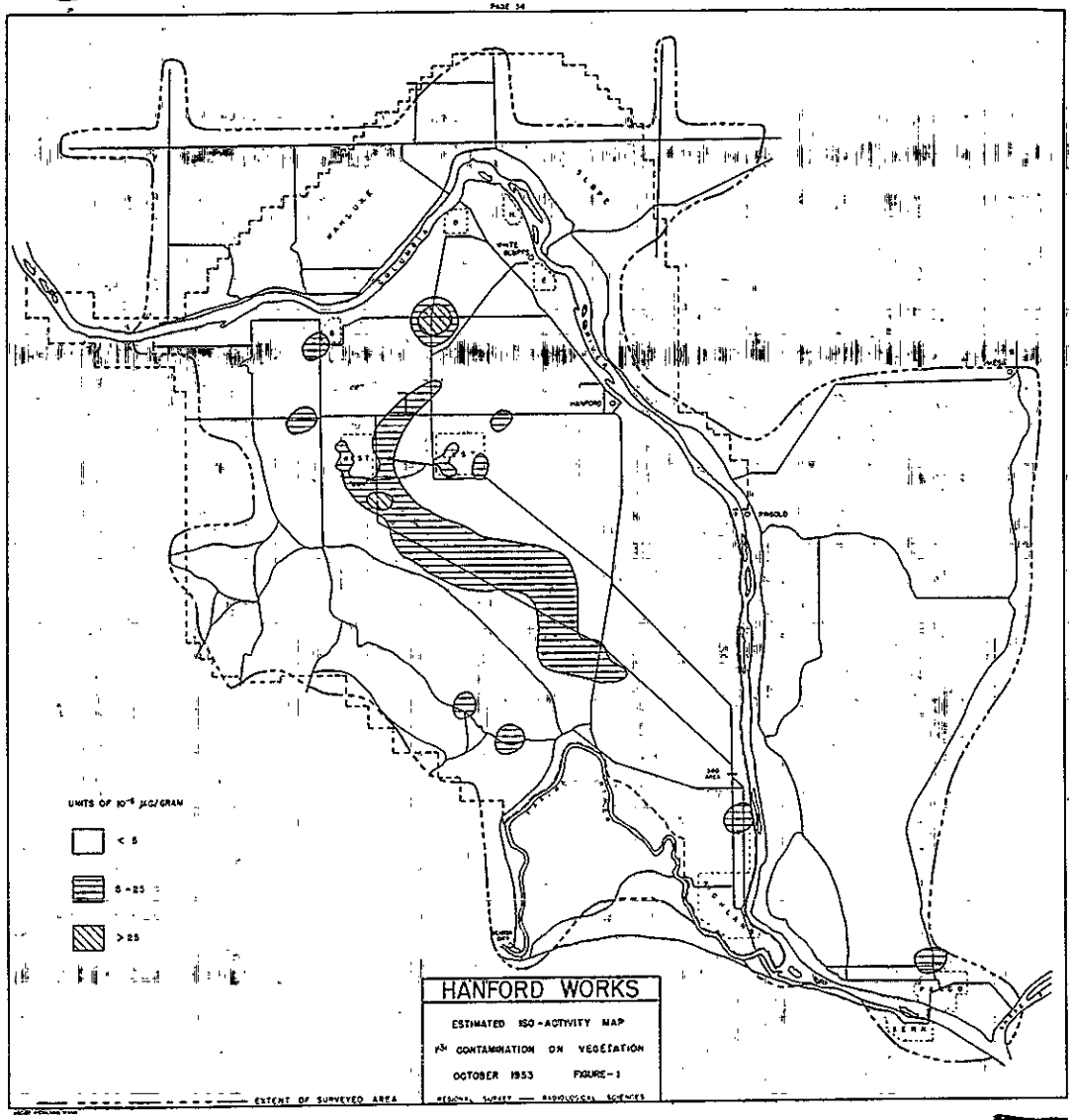
OCTOBER, NOVEMBER, DECEMBER 1953

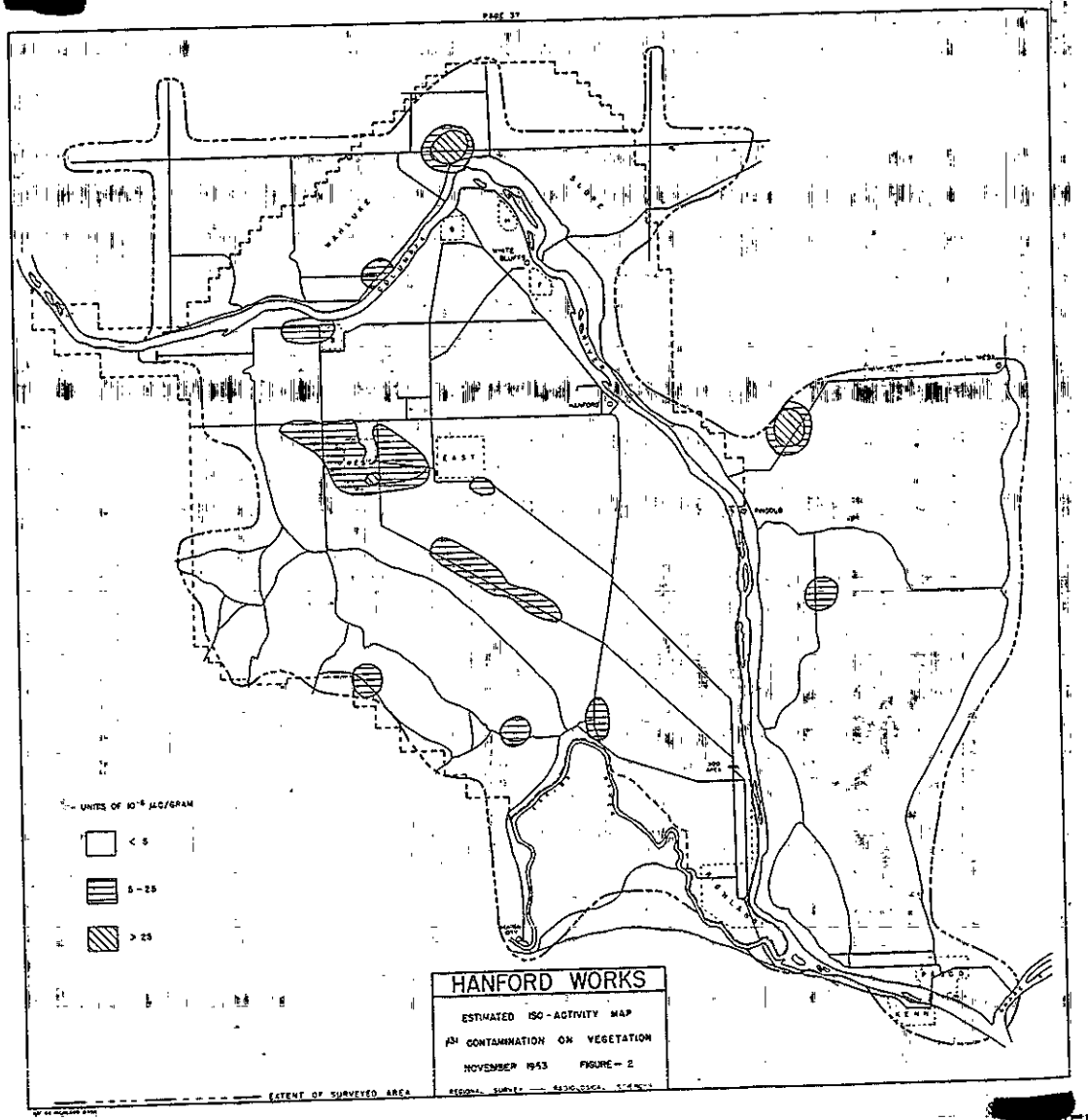
Units of 10^{-8} µc/g*

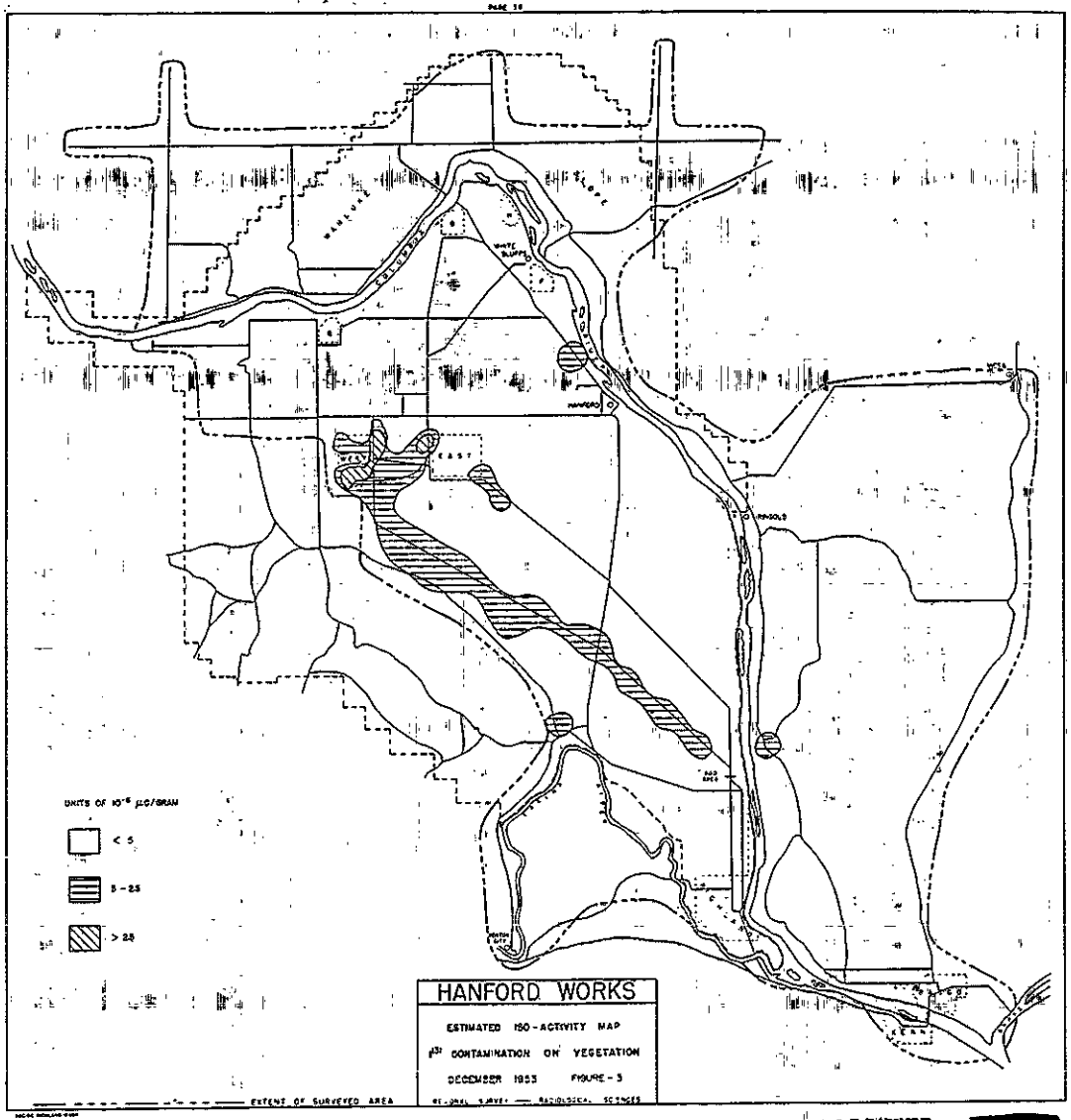
Location	October	November	December	Quarterly Avg.	Max. Result
Near 200 Areas					
200 West Gatehouse	71	51	60	61	120
Batch Plant	54	12	24	31	73
Route 4S, Mile 4	10	6	14	9	17
Meteorology Tower	16	7	24	16	25
Route 4S, Mile 6	19	<5	7	12	34
300 Area	100	15	36	36	100
Outlying					
Richland	8	8	5	6	12
Pasco	61	7	5	34	230
Benton City	<5	<5	<5	<5	6

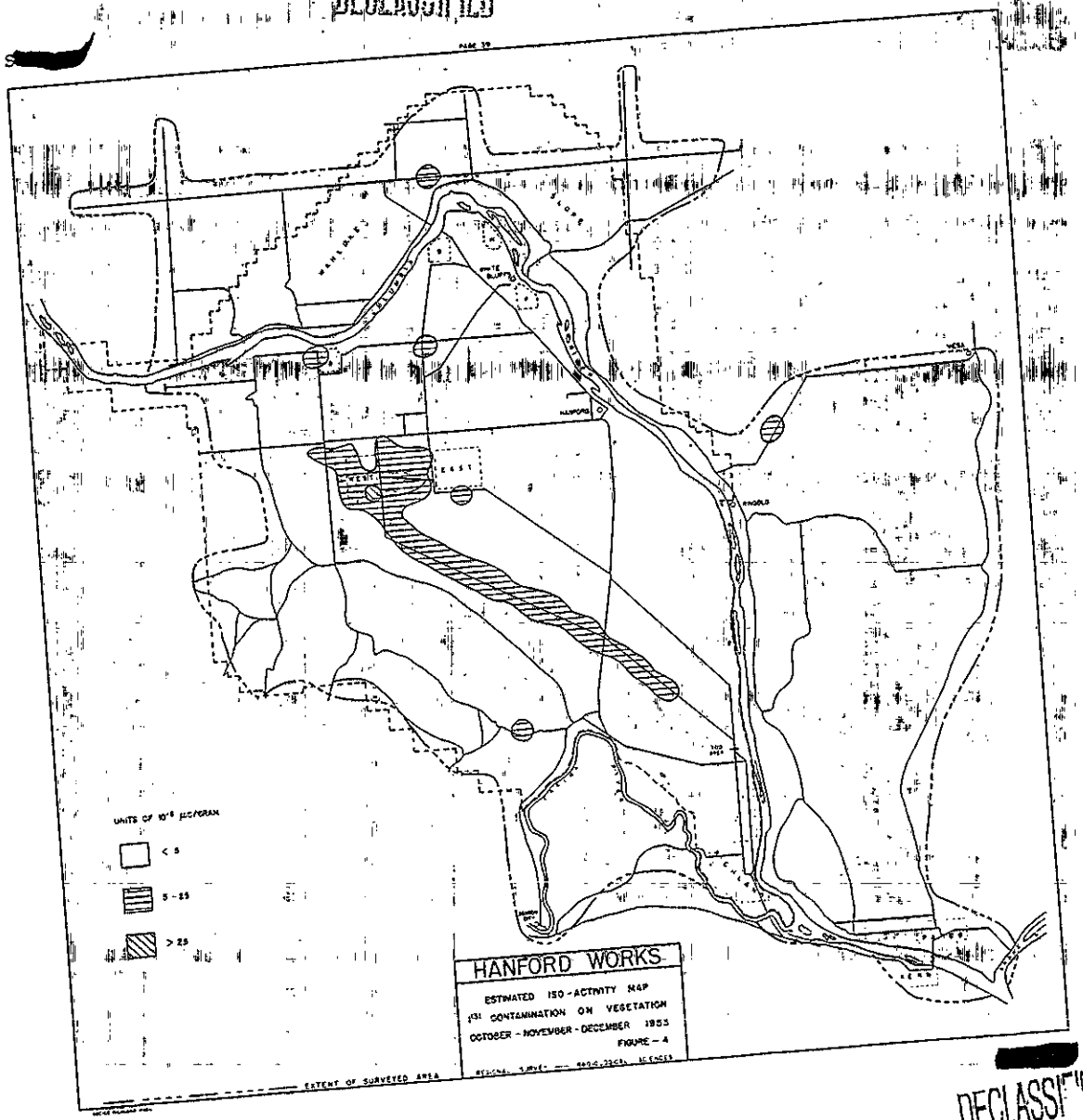
*The values tabulated in the previous quarterly report of this series (HW-30174) were erroneously shown in units of 10^{-6} µc/g. The true values were in units of 10^{-8} µc/g, similar to those in this, and previous publications of this series.

A comparison of the values summarized in Table V with the results of similar measurements obtained during the previous quarter showed no significant trend.









SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Airborne contamination in the environs of HAPO was determined from results obtained from various methods of monitoring which included fixed instrumentation, portable type ionization chambers, air filtering devices, and air scrubbing monitors.

Dosage rates in manufacturing areas and at nearby residential locations were evaluated from the data recorded from the operation of Integrons. The recordings were interpreted for each eight hour period during the quarter and the average dosage rates as shown in Table I represent the average of these accumulated readings.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

OCTOBER, NOVEMBER, DECEMBER

1953

Units of mrad per 24 hours

Location	No. of Units	October	November	December	Quarterly Average
100-B Area	3	0.1	0.7	0.5	0.4
100-D Area	3	0.5	0.5	0.4	0.5
100-F Area	3	0.2	0.1	1.2	0.5
100-H Area	3	0.5	0.5	0.5	0.5
200 West Area	2	0.7	1.4	2.1	1.4
200 East Area	2	0.1	0.1	<0.1	0.1
200 East Semi-Works	1	0.2	0.2	<0.1	0.1
300 Area	1	<0.1	<0.1	0.5	0.2
Riverland	1	2.5	0.4	<0.1	1.0
Richland	1	0.5	0.1	<0.1	0.2
No. Richland No.	1	<0.1	<0.1	<0.1	<0.1
Pasco	1	0.1	<0.1	0.2	0.1
Kennewick	1	<0.1	<0.1	0.1	<0.1
Benton City	1	0.8	1.0	<0.1	0.6
Hanford	1	<0.1	<0.1	0.2	0.1
Redox	1	0.6	0.4	0.2	0.4

General decreases in dosage rates were observed at nearly all monitoring stations during this period. This decrease was significant at perimeter locations such as Richland and Pasco and was also reflected at intermediate locations and at the reactor areas. Monitoring at the 200 West areas showed a continuation of the higher measurements noted at this location during the past several months. The decrease noted at the plant perimeter correlated favorably with decreases noted in the deposition of non-volatile beta particle emitters on vegetation and with decreases noted in a number of radioactive particles in the atmosphere.

Supplementary evaluations of dosage rates at the perimeter of HAPO manufacturing areas were obtained from readings from detachable "C" type ionization chambers which were located inside the air monitoring stations at the perimeter of each area. Two chambers were employed at each location and the dosage rate was determined from the chamber which showed the minimum discharge. Table II summarizes the average findings from this type of measurement.

TABLE II

"C" TYPE DETACHABLE IONIZATION CHAMBERS

OCTOBER, NOVEMBER, DECEMBER

1953

Units of mrad per 24 hours

Location	October	November	December	Quarterly Average
100-B Area	0.9	0.8	0.7	0.8
100-D Area	0.7	0.8	0.6	0.7
100-F Area	0.4	0.5	0.4	0.4
100-H Area	0.5	0.5	0.6	0.5
200 West Area	0.5	0.5	0.4	0.5
200 East Area	0.5	0.5	0.4	0.5
200 East Semi-Works	0.5	0.6	0.5	0.5

A comparison of the dosage rates summarized in Table II with the results of similar measurements obtained during the previous quarter showed no significant differences. The maximum deviation when compared to previous data for the individual locations was only 0.1 mrad/day.

Readings obtained from detachable M and S type ionization chambers were used to evaluate dosage rates at intermediate locations, military installations, and were also used to confirm related types of measurements at residential locations. The frequency of reading the chambers varied from one to three times per week, dependent on the capacity of the chamber and the magnitude of the dosage rate at the sample location. Table III summarizes the results obtained from this type of measurement during the quarter.

TABLE III

RADIATION LEVELS OBSERVED WITH "M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS

Units of mrad per 24 hours

Location	October	November	December	Quarterly Average	Group Average
100 Areas and Environs					
Route 1, Mile 8	0.66	0.60	0.91	0.72	
Route 2N, Mile 10	0.52	0.55	0.66	0.58	
Route 2N, Mile 5	0.47	0.92	0.50	0.63	
At White Bluffs	0.50	0.56	0.47	0.51	
Route 11A, Mile 1	0.85	1.60	1.06	1.17	
Hanford 614 Bldg.	0.43	0.52	0.36	0.44	
Intersection Rt. 1 and Rt. 4N	0.51	0.53	0.58	0.54	
At Hanford 101 Bldg.	0.46	0.46	0.50	0.47	
P-11 Area	0.51	0.48	0.55	0.51	0.62

TABLE III (contd.)

Units of mrad per 24 hours

Location	October	November	December	Quarterly Average	Group Average
Within 5 miles of 200 East Area					
Route 4S, Mile 6	1.06	1.17	0.92	1.05	
Batch Plant	0.54	0.52	0.56	0.54	
Route 11A, Mile 6	1.31	1.50	1.18	1.33	
Route 3, Mile 1	1.19	1.53	3.98	2.23	
Route 4S, Mile 2.5	0.75	0.70	1.63	1.03	
Redox Area	1.31	0.85	0.99	1.05	
Military Camp PSN 300	1.03	1.13	0.92	1.03	
PSN 310	1.04	0.85	3.60	1.83	
PSN 320	1.18	1.00	0.65	0.94	
PSN 330	0.91	1.26	1.41	1.19	
Redox Perimeter	2.70	4.06	4.13	3.63	1.44
Within 10 miles of 200 East					
Route 4S, Mile 10	0.52	0.54	0.46	0.51	
Route 10, Mile 1	0.90	1.33	1.11	1.11	
Route 10, Mile 3	0.82	0.67	0.59	0.69	
Route 2S, Mile 4	0.96	0.71	0.60	0.76	0.77
Near 300 Areas					
Route 4S, Mile 16	0.60	0.64	0.53	0.59	
Route 4S, Mile 22	0.86	1.21	1.25	1.11	
North Richland North	0.61	0.85	0.28	0.58	
300 Area	0.61	0.95	0.39	0.65	0.73
Outlying					
Richland	0.87	0.62	0.60	0.70	
Benton City	0.65	0.49	0.52	0.55	
Pasco	0.35	0.33	0.55	0.41	
Kennewick	0.28	0.47	0.43	0.39	0.51

Average dosage rates at grouped monitoring stations in the environs of the 100 areas, the 300 area, and the outlying locations were not significantly different than those measured during the previous quarter. A significant trend was observed when examining the data for locations within a 5 mile radius and within a 10 mile radius of the separation facilities. The average dosage rate at 11 locations within a 5 mile radius showed an increase of 0.3 mrad/day whereas the average dosage rate obtained from four locations within a 10 mile radius showed a decrease of 0.4 mrad/day. The shift of the higher dosage rates into the region closer to the manufacturing facilities was attributed to meteorological conditions which seasonally tend to cause heavier deposition of radioactive materials at locations nearer to the source of emission.

The activity density of filterable beta particle emitters in the atmosphere was measured by analyzing air filters through which air was passed at a flow rate of 2 to 2.5 cfm for periods varying from daily to weekly. The filters were analyzed several days after the sampling period ended to allow decay of daughter products from natural particle emitters which may have been deposited on the filters. Table IV summarizes the results obtained from this type of measurement.

TABLE IV

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

OCTOBER, NOVEMBER, DECEMBER

1953

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

Location	October	November	December	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-D Area	140	71	55	86	170
100-H Area	180	85	83	110	230
Hanford 614 Bldg.	74	33	9	39	120
White Bluffs	120	45	42	66	200
200 Areas and Vicinity					
200 West Tower #4	210	130	94	140	360
200 West, Redox Area	500	140	130	250	830
Gable Mountain	180	51	58	94	270
200 East Semi-Works	1100	80	74	390	3300
PSN 320	190	92	120	130	260
300 Area 614 Bldg.	58	25	22	34	68
Outlying					
North Richland	140	32	20	62	240
Pasco	120	84	22	71	180
Benton City	54	19	23	29	82
Riverland	140	54	24	72	190

The average activity density of filterable beta particle emitters in the atmosphere decreased to values on the order of 1/2 to 1/8 of those measured during the previous three month period. The decrease in this activity was largely the result of a significant decrease in the number of radioactive particles entering the environs from sources other than HAPO and was also influenced by the near absence of any significant emission of particulate contamination from the HAPO manufacturing areas. The decrease was

progressive through the three month period and the values obtained during the month of December were comparable in magnitude to those observed during April and early May, 1953 prior to the significant deposition in the area from the nuclear explosion tests.

Dual monitors operated at several locations for purposes of studying the rate of buildup and decay of beta particle emitters provided a supplementary means of evaluating the activity density of filterable beta particle emitters in the area. The filters removed from these monitors were analyzed similarly to the method described for the measurements summarized in Table IV. Table V summarizes the results obtained from filters removed from dual monitors.

TABLE V

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

DUAL UNIT AIR MONITOR

OCTOBER, NOVEMBER, DECEMBER

1953

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

Location	October	November	December	Quarterly Average	Weekly Maximum
200 West Area #1	330	90	88	160	500
200 West Area #2	180	110	84	120	200
200 East Area #1	190	68	64	100	310
200 East Area #2	120	22	89	71	220
Richland #1	130	33	28	60	160
Richland #2	140	38	38	70	240

As expected, the activity density measurements shown in Table V show a decreasing trend similar to those observed at the location shown in Table IV.

Airborne concentrations of radioactive particles were determined from the results obtained from radioautographing air filters through which flow rates ranging from 2 to 10 cfm were passed for periods ranging from 1 to 7 days. The filters were exposed to type "K" x-ray film for a period of 168 hours after which the number of particles were determined by visually counting the number of darkened spots on the developed film. Disintegration rates as low as 3 to 5 d/m were detected. Results obtained from this type of measurement at locations near the separation areas and at outlying monitoring stations are summarized in Table VI and VII.

TABLE VI

SUMMARY OF PARTICLE DEPOSITION

OCTOBER, NOVEMBER, DECEMBER

1953

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

Location	Total Volume of air Sampled Cubic Meters	October	November	December	Present Quarter Averages	Previous Quarter Averages
200-E and Vicinity						
2704 Outside	8653	400	20	43	180	390
BY - SE	9278	330	32	70	160	450
BY - NE	9278	350	32	23	150	390
"B" Gate	8470	240	16	21	90	310
2701 Outside	9278	440	25	32	190	520
2704 Inside	9278	320	24	57	150	450
221-B	8479	110	8.7	6.1	50	260
200-W and Vicinity						
2701 Outside	8662	460	22	42	190	700
2722	9269	360	41	31	160	480
"T" Gate	9274	320	20	22	140	340
222-T Outside	9278	370	17	53	160	460
231	9278	390	39	47	180	>560
Redox	8861	1400	130	110	580	2600
"W" Guard Tower	9274	490	57	32	220	>690
2701 Inside	8900	330	32	54	150	320
272	9274	210	27	34	98	530
222-T Hall	9274	180	13	56	75	350
222-T Lab.	9252	120	8.5	35	59	500
222-U Lab.	9278	130	12	45	69	320
"U" Plant Gate	9269	420	29	71	190	550
Meteorology Tower						
3'	37111	89	3.2	12	39	120
50'	37111	140	13	8.8	60	140
100'	31654	190	6.3	9.3	70	210
150'	25759	170	11	12	70	260
200'	23795	160	37	25	81	280
250'	23795	170	22	15	78	320
300'	22048	200	13	12	85	>330
350'	22048	200	15	11	80	>350
400'	14844	220	30	15	97	>520

TABLE VII

SUMMARY OF PARTICLE DEPOSITION

OCTOBER, NOVEMBER, DECEMBER

1953

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

Location	Total Volume of air Sampled Cubic Meters	October	November	December	Present Quarter Averages	Previous Quarter Averages
Area Locations						
100-B Area	9146	330	3.6	7.2	130	310
100-D Area	36499	340	14	17	140	180
White Bluffs	36601	400	5.6	4.5	160	200
100-F Area	36618	320	4.7	5.6	120	270
300 Area	36584	380	4.6	3.0	150	220
Off Area Locations						
Benton City, Wn.	36703	180	3.4	2.1	68	150
Pasco, Wn.	36550	280	4.6	1.5	110	210
Richland, Wn.	35802	350	4.4	1.4	140	320
Boise, Idaho	9057	650	8.6	0.9	200	510
Klamath Falls, Ore.	8942	500	5.0	1.0	160	500
Great Falls, Mont.	6834	550	0.7	0.9	260	260
Walla Walla, Wn.	8921	660	6.1	2.2	250	580
Meacham, Ore.	8976	270	3.2	0.8	110	250
Lewiston, Idaho	8934	740	6.6	1.8	280	590
Spokane, Wn.	36652	500	3.1	0.7	190	250
Kennewick, Wn.	9422	590	13	7.7	210	380
Yakima, Wn.	28747	960	2.5	0.1	220	110

The average number of radioactive particles in the atmosphere decreased significantly at nearly all monitoring locations in the immediate environs during this quarter. Comparable decreases of a lesser order of magnitude were also observed at remote locations in Idaho, Oregon, and Washington. Examination of the data on a month to month basis shows that

the number of radioactive particles in the atmosphere during October was significantly higher than that observed during November and December. The higher values during the month of October represented a continuation of the high concentrations noted during the previous quarter whereas the values obtained during November and December represent concentration approaching the same order of magnitude as those observed during the first four months of 1953.

Airborne concentrations of I^{131} were measured by analyzing caustic scrubber solutions through which air was passed at flow rates of 2.5 cfm for intervals ranging from 1 day to 1 week. Table VIII summarizes the results obtained from these measurements during the quarter.

TABLE VIII

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

OCTOBER, NOVEMBER, DECEMBER

1953

Units of 10^{-12} μc/cc

Location	October	November	December	Quarterly Average	Weekly Maximum
200 Area and Vicinity					
200 East-Southeast	0.1	0.1	<0.1	<0.1	0.2
200 East Tower #16	0.6	0.2	0.1	0.3	2.2
Gable Mountain	<0.1	<0.1	<0.1	<0.1	0.1
200 West Area Gate	0.6	0.5	0.9	0.6	1.6
200 West Tower #4	1.5	0.3	1.1	1.0	4.3
Semi-Works	<0.1	<0.1	<0.1	<0.1	<0.1
Redox Area	0.4	0.4	0.6	0.5	1.0
Outlying Areas					
100-H Area	<0.1	<0.1	<0.1	<0.1	<0.1
300 Area	0.1	<0.1	<0.1	<0.1	0.3
North Richland	0.1	<0.1	<0.1	<0.1	0.3
Richland	0.3	<0.1	0.1	0.1	0.6
Pasco	<0.1	<0.1	<0.1	<0.1	0.2
Benton City	<0.1	<0.1	<0.1	<0.1	<0.1

The reduction in the amount of I^{131} emitted from separation facilities during the quarter (Section I) was reflected in the decrease in the activity density of I^{131} noted in all monitoring locations except those inside the 200 West area. In outlying areas where the average activity density was less than 1×10^{-13} μc/cc, the present trend represented a complete reversal of the upward trend noted during the previous quarter and the current averages were nearly identical to those observed during April, May, and June of 1953. The average value of less than 1×10^{-13} μc/cc at two locations in the 200 East area was the lowest observed in this area during any quarter in 1953.

Radiochemical analyses of several scrubber samples which were collected at field locations in the downstream effluent from the 202-S facility showed no instances where the activity density of I^{131} exceeded 1×10^{-9} μc/cc.

The activity density of alpha particle emitters in the atmosphere was measured by analyzing air filter samples removed from 20 locations in and adjacent to HAPO. Sampling at these locations was continuous throughout the period and the filters were changed at weekly intervals. Table IX summarizes the results obtained from these analyses.

TABLE IX

CONCENTRATION OF AIRBORNE ALPHA PARTICLE EMITTERS

OCTOBER, NOVEMBER, DECEMBER

1953

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

Location	No. Samples	Weekly Maximum	Quarterly Average
200 West Tower #4	13	57	38
200 East Semi-Works	13	8	< 4
Gable Mountain	13	29	10
Pasco	13	63	22
300 Area	13	36	10
100-D Area	13	41	17
Benton City	12	10	< 4
Hanford	12	10	< 4
White Bluffs	13	8	5
North Richland	13	8	< 4
200 West Redox Area	13	26	8
100-H Area	13	91	18
Riverland	13	5	< 4
PSN 320	13	12	6
Dual Unit Monitors			
200 WEC #1	11	33	11
200 WEC #2	12	62	16
200 ESE #1	13	7	< 4
200 ESE #2	13	11	< 4
Richland #1	13	27	7
Richland #2	13	31	11

Airborne concentrations of alpha particle emitters during this quarter were not significantly different than those measured during the past six months. High concentrations continued at the 200 West and 100-H areas. Individual samples from random locations which showed concentrations above 3×10^{-14} μc/cc appeared to be influenced by meteorological conditions as the previous and subsequent samples from the same location seldom confirmed the high individual measurement.

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

Radioactive contamination in Hanford wastes was determined from the results obtained from nearly 1500 sample analyses and surveys. Liquid and solid samples were collected directly from open waste areas and analyzed for the activity density of gross beta and gross alpha particle emitters. Specific isotopic analyses were performed when measurements indicated unusual contamination and also were carried out repetitively at locations which have a high probability of containing unusual quantities of certain contaminants. These studies were supplemented with field surveys which were performed at the perimeter of open waste areas and along the various open waste ditches which carry the waste effluents. Instrument surveys were used to define ground contamination in and adjacent to the separation facilities. Summaries of the findings for each of the manufacturing areas follow.

100 AREA WASTES

The activity density of gross beta particle emitters in the effluent water discharged from the reactor areas to the Columbia River was measured by analyzing samples collected directly from the outlets of the 107 retention basins. These samples were analyzed on the day that they were collected and the subsequent counting rates were corrected for the decay interval between collection time and counting time. Table I summarizes the results obtained from these measurements.

TABLE I

RADIOACTIVE CONTAMINATION IN REACTOR EFFLUENT WATER
DURING PERIODS OF NORMAL OPERATION
OCTOBER, NOVEMBER, DECEMBER
1953

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

Location	No. Samples	October		November		December		Quarter	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B Area	102	6.2	5.0	7.2	5.1	6.8	5.7	7.2	5.3
100-C Area	80	4.1	3.3	6.1	3.9	5.8	4.9	6.1	3.9
100-D Area	113	6.4	5.2	5.1	4.3	7.5	6.3	7.5	5.2
100-DR Area	112	8.8	6.7	6.8	5.6	8.1	5.4	8.8	5.8
100-F Area	116	5.0	4.0	7.9	4.5	6.2	4.3	7.9	4.2
100-H Area	104	5.2	3.7	7.9	5.0	5.0	3.3	7.9	4.0

Significant increases were observed in the average activity density of beta particle emitters at each of the reactor areas during this quarter. In general, these increases were closely related to increases in the power level at which the reactors were operated. Several other factors which influenced the increase in activity density included water treatment changes at the 100-H area and seasonal increases in certain isotopes such as P^{32}, As^{76}, $Ba^{139-140}$, Sr^{91-92}, and rare earths, determined through isotopic analyses performed by Biophysics Control Laboratory personnel.

The activity density of total uranium and plutonium in reactor effluent water averaged less than 5×10^{-9} μc/cc at all areas. Trace activity was detected at each area except 107 H at some time during the three month period; these positive measurements ranged from 1.2×10^{-8} μc/cc to 8.4×10^{-8} μc/cc. Values in excess of 5×10^{-8} μc/cc were detected in individual samples from the 100-B, 100-DR, and 100-F areas.

Six of 141 samples of reactor effluent which were analyzed for the activity density of uranium showed the concentration of this isotope to be above 2×10^{-9} μc/cc. Three samples obtained from the 100 C basin showed a range of values from 2.7×10^{-9} μc/cc to 6.0×10^{-9} μc/cc. The remaining positive values which were found at the 100-F, 100-H, and 100-DR areas showed values of 2.2×10^{-9} μc/cc, 2.5×10^{-9}, and 1.4×10^{-8} μc/cc, respectively. Although in some cases the amount of uranium detected barely exceeded the sensitivity measurements, the positive findings during this period bear some significance as radiochemical analyses of a comparable number of samples during the previous quarter did not reveal any values above the sensitivity level.

Thirty-four random samples representing all reactor areas were analyzed specifically for the activity density of plutonium. Although 14 of the samples showed detectable activity, none of the values exceeded a factor of 2 above the detection limit of the measurement. Individual results ranged from 3 to 6×10^{-9} μc/cc with the maximum measurement occurring at the 107-DR basin on December 1, 1953.

Polonium was detected in the effluent water from all reactors. The maximum activity was found at the 107-B basin where samples collected on October 6 and October 20 showed values of 2.1×10^{-8} μc/cc and 2.0×10^{-9} μc/cc. The activity density of polonium in individual samples from the remaining reactor areas showed a range of values from 7×10^{-10} to 1.4×10^{-9} μc/cc. The latter values were comparable to those found at the reactor areas during the previous quarter whereas the activity measured at the 100-B area represented a significant increase over previous findings.

The effective retention time of the waste effluent basins in the reactor areas was rechecked at several locations in a manner comparable to that used by Regional Survey forces in the past (HW-28830). Retention times at the 100-F area ranged from 3.7 to 4.7 hours for flow rates between 39,400 g/m to 40,000 g/m. At the 100-D area a holdup time of 2.2 hours was observed for a flow of 49,840 g/m. Two measurements at the 100-C area showed values of 1.6 hours and 2.0 hours for flow rates in the range of 70,000 to 75,000 g/m.

[redacted]

Eighty-seven composite samples collected directly from the sump at the Biology Farm were analyzed for the activity density of I^{131}. The average activity density in these samples was 9.8×10^{-7} μc/cc including a maximum measurement of 3.6×10^{-6} μc/cc found in a sample collected November 24. Based on the metered volume of water used in the flushing operation, an average of 0.06 mc of I^{131} was discharged to the river daily during the quarter; average discharge during October, November, and December was 0.04 mc, 0.08 mc, and 0.07 mc per day, respectively.

Surveys of the burning ground at each of the reactor areas revealed no significant ground contamination during the quarter. In general, instrument readings obtained from GM type meters showed values within 100 c/m of background.

200 AREA WASTES

The activity density of gross alpha and beta particle emitters in 200 area wastes was determined by radiochemical analysis of liquid and solid samples collected directly from the open waste areas. Specific analyses for the activity density of uranium and plutonium were performed on a spot check basis and also were completed on all samples which showed unusually high alpha particle emissions. Table II summarizes the results obtained at locations which were sampled on a repetitive basis.

TABLE II

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS

OCTOBER, NOVEMBER, DECEMBER

1953

Liquid Samples

Location	Samples	Uranium and Plutonium Units of 10^{-8} µc/cc Maximum	Uranium and 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	41	2.0	<0.5	4000	240
U-Swamp	26	26	3.0	820	39
Laundry Ditch	25	17	2.4	12	5.2
231 Ditch	26	300	23	14	5.6
200-E "B" Ditch	37	6.6	1.0	14	2.0
200-E "B" Swamp	22	1.1	<0.5	6.9	1.9
234-35 Ditch	13	41	5.4	9.0	4.0
200-E Retention Pond	16	0.6	<0.5	2.3	1.4
Redox Swamp	6	1400	200	7100	2200
Redox Retention Basin	11	5800	530	4100	910
222-S Swamp	1	4.0	4.0	27	27

Solid Samples

		Units of 10^{-6} µc/g		Units of 10^{-5} µc/g	
T-Swamp	26	84	7.5	4100	370
Laundry Ditch	13	39	15	54	28
200-E "B" Ditch	36	6.7	1.9	140	28
200-E "B" Swamp	25	13	2.5	240	37
234-35 Ditch	13	2000	320	11	6
Redox Swamp	6	1300	320	1,000,000	520,000
222-S Swamp	1	37	37	69	69

[redacted]

Wide fluctuation was noted in the activity density measurements at many of the locations indicated in Table II. The variation noted in the week to week results was partially caused by the time at which the individual sample was collected and by the accessibility of a representative sampling location at the time of the survey. In general, increases noted in the activity density of beta particle emitters at the T-swamp were weighted by one or two high samples which showed the activity density to be on the order of 10^{-4} μc/cc in liquid material and 10^{-2} μc/g in solid material. The activity measured in the T-swamp was from 10 to 100 times greater than expected values. Variations noted in samples collected from the Redox swamp and the 234-5 ditch were consistent with observations found during the past several quarters.

The average activity density of uranium at the B, T, and U-swamps ranged from 4×10^{-9} μc/cc to 1.8×10^{-8} μc/cc. Maximum measurements, noted in the ditch which carries the laundry effluents to the U-swamp, showed values of 1.4×10^{-7} μc/cc at the ditch inlet and 8.6×10^{-8} μc/cc at a location 600 feet downstream from the inlet. Solid samples collected from the edge of the swamps and from the ditches showed trace uranium deposition with a range of average values from 1.6×10^{-6} μc/g to 6.4×10^{-5} μc/g. Again, the maximum measurements were found near the inlet of the laundry ditch where the highest concentration observed was 3.1×10^{-4} μc/g.

Portable instrument surveys using GM type meters were performed weekly at the perimeter of all prominent open waste zones in the separation areas. Counting rates obtained over the mud showed values ranging from several hundred c/m to 50,000 c/m at 200-W area locations. Similar surveys at 200-E area locations showed counting rates less than 1,000 c/m above background with the majority of readings on the order of 200 to 300 c/m. Readings obtained over the water at the edge of the swamps ranged from 300 c/m to 4500 c/m at the 200-W area and from 200 c/m to 600 c/m at the 200-E area. General decreases in the counting rates observed at 200-E area locations during this quarter were largely the results of reduced operation at this facility.

A resurvey of the proposed site of the new Redox swamp was completed on November 9. Instrument readings obtained using GM type meters showed counting rates <300 c/m above background at all locations. The overall accuracy of the survey in this region was somewhat limited due to the influence of radiation emanating from the present Redox swamp; readings as high as 3500 c/m were observed coming from the present swamp at the southwest corner of the proposed site.

300 AREA WASTES

Radioactive contamination in waste in the 300 area was measured in samples collected from each of the two waste ponds and from samples collected directly from the waste line which discharges into the ponds. Table III summarizes the results obtained from the radiochemical analyses for alpha particle emitters, beta particle emitters, and uranium.

TABLE III

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES

OCTOBER, NOVEMBER, DECEMBER

1953

Location	No. Samples	Beta Particle Emitters Units of 10^{-7} μc/cc Max.	Beta Particle Emitters Units of 10^{-7} μc/cc Avg.	Alpha Particle Emitters Units of 10^{-8} μc/cc Max.	Alpha Particle Emitters Units of 10^{-8} μc/cc Avg.	Uranium Units of 10^{-6} μc/cc Max.	Uranium Units of 10^{-6} μc/cc Avg.
Old Pond Inlet Liquid	13	210	20	560	130	10	1.6
New Pond Inlet Liquid	13	42	5.4	270	90	3.0	0.79
300 Area Waste Line	61	1100	41	33000	750	65	1.7
		Units of 10^{-3} μc/g		Units of 10^{-3} μc/g		Units of 10^{-3} μc/g	
Old Pond Inlet Solid	12	13	5.3	41	4.7	44	9.6
New Pond Inlet Solid	12	27	7.7	3.7	0.97	34	11

The average values summarized in Table III were not indicative of a significant departure from those observed during previous quarters in 1953 with the possible exception of the maximum alpha particle emission measured in the 300 area waste line. Sixty of the samples collected from the 300 area waste line were analyzed for the activity density of plutonium. The maximum amount of plutonium detected was 2.9×10^{-7} μc/cc on September 28 and the average activity density over the three month period was 2.0×10^{-8} μc/cc.

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

The extent and magnitude of radioactive contamination in the Columbia River resulting from the addition of reactor cooling water was determined from the results obtained from the radiochemical analysis of nearly 600 samples of river water. Samples were obtained at frequencies varying from daily to weekly at locations between the reactor areas and McNary Dam; samples were obtained on a monthly basis from ten locations between McNary Dam and Portland, Oregon. The volume of samples analyzed was 500 ml. for all locations above McNary Dam and was one gallon for locations below McNary Dam. These measurements were supplemented with background studies directed toward determining the activity density of naturally occurring alpha and beta particle emitters in the Columbia, Snake, and Yakima Rivers.

Table I summarizes the results obtained from analyzing river samples from all locations at which samples were collected at a frequency of at least one sample per week.

TABLE I

AVERAGE CONTAMINATION FROM GROSS BETA PARTICLE EMITTERS IN RIVER WATER

OCTOBER, NOVEMBER, DECEMBER

1953

Units of 10^{-8} μc/cc

Location	October Avg.	November Avg.	December Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch	8	6	5	6	5	12
181-B Area	14	16	19	17	5	39
181-C Area	11	97	11	38	8	370
Allard Station	24	52	830	280	26	3200
181-D Area	510	780	760	690	230	2500
181-H Area	550	670	620	620	390	990
Below 100-H Area	930	1400	860	1100	610	2500
181-F Area	760	870	940	860	460	1200
Below 100-F Area	900	1400	1500	1300	530	1900
Hanford South Bank	1200	1300	1300	1200	590	2100
Hanford Middle	---	1300	1100	1200	---	2100
Hanford North Bank	---	540	640	600	---	1500
300 Area	430	700	490	530	250	1200
Richland	390	420	250	390	230	670
Kennewick Highlands Pumping Station	440	420	340	390	230	950
Pasco Bridge (Kenn. Side)	160	240	190	210	120	390
Pasco Bridge (Pasco Side)	220	280	190	230	160	440
Sacajawea Park	140	99	140	130	80	330
McNary Dam	27	18	30	26	32	57
Patterson	24	15	18	19	26	34
Snake River at Mouth	20	27	16	21	7	61
Yakima River at Prosser	<5	<5	<5	<5	9	10
Yakima River at Mouth	<5	<5	6	<5	<5	18
Yakima Horn	<5	<5	<5	<5	---	<5
Byers Lnading, Pumping Plant	250	270	480	330	---	480

Expected seasonal decreases in the flow rate of the Columbia River during the latter part of the year and the increased concentration of beta particle emitters in the 107 basin effluents caused two to three-fold increases in the activity density of beta particle emitters in river water at locations between the reactor areas and the Pasco-Kennewick bridge. The mean flow rate of the Columbia River was 597,000 gallons per second as compared with an average of 1,305,000 gallons per second during the previous three month period. The average flow rate during the months of October, November, and December was 616,000; 605,000; and 571,000 gallons per second respectively. The maximum flow rate was 698,000 gallons per second measured on October 26 and the lowest flow rate was 413,000 gallons per second measured on November 24. The lower flow rates measured during the latter part of the quarter accounted for the majority of the maximum measurements indicated in Table I. The significance of the decrease in flow rate may be appraised from the graph in Figure 5 which shows the trend of the measured flow rate of the Columbia River for the period of July through December of 1953.

During the latter part of the quarter, studies directed toward determining the distribution of radioactive contamination across the Columbia River were inaugurated at the Hanford Ferry and at McNary Dam. Measurements obtained from the former location during November and December showed that the bulk of the contamination followed the south bank of the river and that the magnitude of the contamination along the north bank of the river was approximately one-half of that found on the south bank. These observations were consistent with the results obtained from a similar study performed during low flow rates of the river during the same period in 1952 (HW-27641). At McNary Dam, samples were obtained from a point approximately in the middle of the river and from points equidistant between the middle and Washington shore and between the middle and Oregon shore. The average activity density of gross beta particle emitters at these three locations in the order mentioned above was 5.3×10^{-7}, 5.1×10^{-7}, and

5.7×10^{-7} μc/cc, respectively. The apparent uniformity in the activity distribution across the surface of the river at McNary Dam was consistent with expected results based on the findings of detailed studies of the distribution and dispersion patterns of activity in the Columbia River during 1951. (HW-22851).

Trace quantities of beta particle emitters were found in all samples collected between McNary Dam and Portland, Oregon. Individual measurements representing samples from 10 representative locations showed values ranging from 5×10^{-8} to 1.3×10^{-7} μc/cc. Except for one isolated case during the month of October when a sample collected at The Dalles, Oregon showed a value of 1.3×10^{-7} μc/cc, the maximum activity was always found in the Arlington, Oregon region. The higher measurements at the latter location were consistent with the results obtained from similar surveys earlier in the year.

The activity density of alpha particle emitters in Columbia River water averaged less than 5×10^{-9} μc/cc at all locations except the 300 area. Samples collected from the river adjacent to the 300 area showed an average activity density of 4×10^{-8} μc/cc including a maximum measurement of 5.6×10^{-7} μc/cc.

The results obtained from the radiochemical analysis of a representative number of river water samples for the activity density of uranium showed that the average activity density from this contaminant was below the sensitivity limit of 3×10^{-9} μc/cc at all locations except the 300 area. Thirteen samples from this location showed an average of 8.2×10^{-8} μc/cc and a maximum of 1.0×10^{-6} μc/cc.

Twenty-seven samples collected from the south bank of the Columbia River at the Hanford Ferry were analyzed specifically for I^{131} to determine the magnitude of this activity in the river resulting from the admission of waste material from the Biology Farm at the 100-F area. The average

activity density in these samples was 2.5×10^{-7} μc/cc including a maximum measurement of 2.2×10^{-6} μc/cc. Each of these values represented an increase over the results obtained during the previous quarter.

Results obtained from the radiochemical analysis of mud samples which were collected from representative locations along the Columbia River were used to evaluate the deposition of radioactive materials from the Columbia River. Similar measurements representing locations above the reactors on the Columbia River and the nearby Yakima and Snake Rivers were used to evaluate the activity density from naturally occurring radioactive materials in river water. Two samples were obtained at each location; one sample represented the point where the water joined the shore and the other sample represented a location approximately 5 feet removed from the shoreline. Table II summarizes the results obtained from analyzing these samples for the activity density of gross beta particle emitters.

TABLE II

RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES
OCTOBER, NOVEMBER, DECEMBER
1953

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

Location	October Avg.	November Avg.	December Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch						
Shore	3.9	4.1	2.9	3.6	3.7	4.5
5' Out	3.0	3.4	2.8	3.1	3.5	5.5
Allard Station						
Shore	3.3	6.1	3.4	4.3	4.3	13
5' Out	3.7	3.8	4.3	3.9	4.3	7.8
100-H Area						
Shore	13	9.4	5.7	9.4	5.6	29
5' Out	7.1	13	13	11	5.8	21
Below 100-F						
Shore	19	9.0	7.9	12	11	38
5' Out	14	9.9	12	12	10	30

TABLE II (contd.)

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

Location	October Avg.	November Avg.	December Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Hanford Ferry						
Shore	14	17	14	15	10	27
5' Out	21	27	13	20	13	39
300 Area						
Shore	7.7	12	3.6	7.7	9.4	22
5' Out	6.4	12	5.6	7.9	11	24
Byers Landing, Pump. Plant						
Shore	--	23	4.5	17	4.2	40
Richland Dock						
Shore	8.5	5.1	5.8	6.4	4.8	14
5' Out	9.3	6.7	5.4	7.0	8.0	18
Kennewick Highland Pump Plant						
Shore	4.5	3.0	3.5	3.7	3.4	6.3
5' Out	3.6	6.5	4.4	4.8	5.3	14
P. K. Bridge (Pasco)						
Shore	4.2	--	--	4.2	3.9	5.3
5' Out	4.7	--	--	4.7	4.0	8.6
P. K. Bridge (Kennewick)						
Shore	3.5	3.3	3.6	3.4	3.7	4.8
5' Out	5.1	3.8	3.8	4.2	4.0	6.8
Sacajawea Park						
5' Out	6.7	3.0	4.4	4.6	12	11
McNary Dam						
5' Out	2.6	3.6	3.0	3.1	3.0	6.2
Patterson						
5' Out	4.3	2.9	3.9	3.7	5.3	6.4
Snake River Mouth						
5' Out	4.2	2.6	2.6	3.0	4.0	4.5
Yakima River Horn						
Shore	2.2	2.6	3.0	2.6	2.8	4.6
5' Out	3.0	3.2	2.8	3.0	2.7	4.8
Yakima River - Prosser						
5' Out	1.8	2.3	2.0	2.0	2.6	3.5
Clover Island	3.4	--	--	3.4	--	4.8

A review of the data summarized in Table II shows that the activity density of beta particle emitters in mud at all Columbia River locations except those between the 100-H area and the 300 area was comparable to the natural background measured in the upstream Columbia and the nearby tributaries. Trace beta particle emission found in mud collected immediately below the reactors was comparable in magnitude to that observed during the previous quarter and the locations at which it was found were nearly identical to those which the river water sampling program defined as the region of maximum activity in the Columbia River. A comparison of the shoreline samples with those which were collected 5 feet removed from the shore showed no significant differences between the two locations.

Nearly all mud samples were analyzed for the activity density of gross alpha particle emitters. The average activity density was less than 3×10^{-6} μc/g at all locations shown in Table II except Allard station and the 300 area. Samples collected from Allard station showed an average of 4×10^{-6} μc/g and a maximum of 3.4×10^{-5} μc/g at the point 5 feet removed from the shore. At the 300 area, the average activity density of 6×10^{-6} μc/g was identical for the on and off shore locations; the maximum measurement was 2.3×10^{-5} μc/g along the shoreline.

The activity density of alpha and beta particle emitters in raw water at the HAPO manufacturing areas was determined by analyzing samples collected at the 183 and 283 buildings in the reactor and separation areas. The results obtained from analyzing these samples for the activity density of gross beta particle emitters are summarized in Table III.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER

RIVER EXPORT LINE

OCTOBER, NOVEMBER, DECEMBER

1953

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

Location	October Avg.	November Avg.	December Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
183 Bldg. - 100-B Area	<5	<5	<5	<5	<5	8
183 Bldg. - 100-C Area	5	<5	<5	<5	<5	14
183 Bldg. - 100-D Area	110	90	100	100	40	150
183 Bldg. - 100-DR Area	100	100	90	98	46	190
183 Bldg. - 100-H Area	75	110	130	110	53	190
183 Bldg. - 100-F Area	130	150	140	140	68	210
283 Bldg. - 200-E Area	26	64	63	52	<5	120
283 Bldg. - 200-W Area	61	82	76	73	9	120

[redacted]

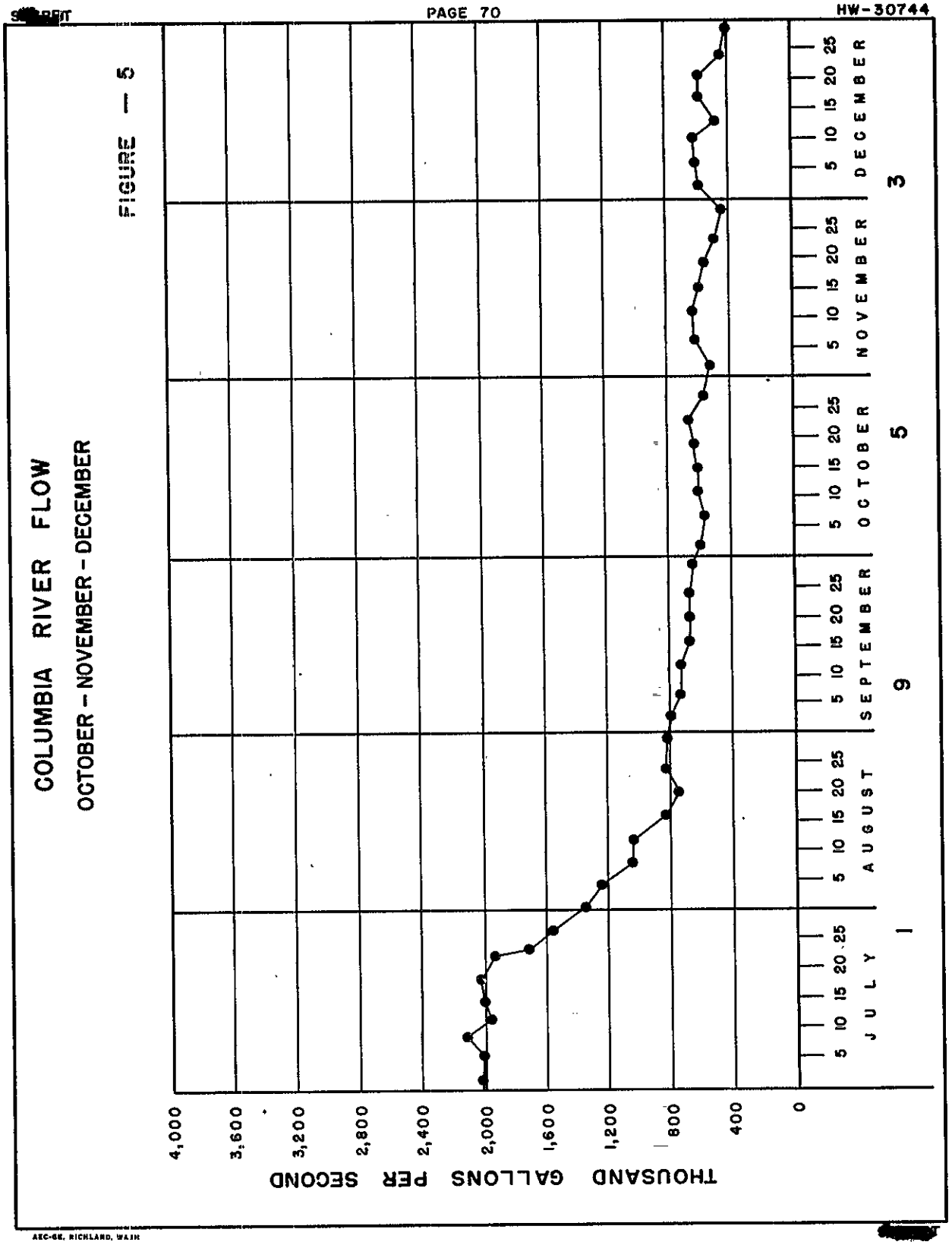
The increase in the activity density noted when comparing current averages to those of the previous quarter was expected due to the significant decrease in the flow rate of the Columbia River and the increase in the activity density of beta particle emitters in reactor effluent water. The raw water represented in Table III originates from river water and after chlorination and filtration, becomes the sanitary water consumed in the manufacturing facilities. Again, the increase noted is a seasonal occurrence and the observed trend was in good agreement with measurements obtained during the same period in previous years.

Radiochemical analyses of raw water samples for the activity density of gross alpha particle emitters showed that this activity was less than 5×10^{-9} μc/cc in all samples analyzed.

FIGURE — 5

COLUMBIA RIVER FLOW

OCTOBER – NOVEMBER – DECEMBER



AEC-GE, RICHLAND, WASH

SECRET

SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

Radiochemical analyses of 217 rain samples collected from 27 representative locations throughout the environs was directed toward qualitatively estimating the activity density of beta particle emitters in rainfall. Although, sampling collection gauges were maintained at all locations over the three month period, the majority of samples were collected during the month of November in which period nearly 60 per cent of the rainfall occurred. Rainfall totaling 1.65 inches during the quarter was ample to allow representative monitoring over most of the period. Table I summarizes the precipitation measurements obtained at the Meteorology Tower near the 200 West Area by the Synoptic Meteorology group.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS
OCTOBER, NOVEMBER, DECEMBER
1953

Units - Inches

Year	October	November	December	Quarterly Total
1950	2.46	0.55	0.97	3.98
1951	0.71	0.82	0.70	2.23
1952	0.04	0.20	0.77	1.01
1953	0.20	0.96	0.49	1.65

The results obtained from radiochemical analysis of rain samples for the activity density of gross beta particle emitters are presented in Table II.

TABLE II

ACTIVITY DENSITY OF GROSS BETA PARTICLE EMITTERS IN RAIN

OCTOBER, NOVEMBER, DECEMBER

1953

Location	No. Samples	Units of 10^{-6} µc/cc Maximum	Average
In 200 East Area	15	1	<1
250' E of stack	6	1	<1
2000' E of stack	2	<1	<1
750' SE of stack	0	-	-
3500' SE of stack	7	<1	<1
In 200 West Area	41	53	4
1000' E of stack	8	5	1
7000' E of stack	8	3	1
4900' SE of stack	8	5	1
8000' SE of stack	8	4	2
Redox Area	9	53	13
100 Area Environs	54	11	<1
100-B SE	7	2	<1
100-D SW	8	<1	<1
100-H SW	6	11	2
100-F SW	7	<1	<1
Hanford 614	10	3	<1
Hanford 101	9	2	<1
White Bluffs	7	<1	<1
Perimeter Locations	41	8	<1
Richland	8	<1	<1
Pasco H and R	8	<1	<1
Benton City	9	3	<1
Riverland	8	8	1
3000 Area North	8	3	<1
Intermediate Locations	66	7	<1
Route 4S, Mile 6	9	7	2
300 Area 614	9	5	1
200 North 614	8	4	<1
Gable Mountain	8	3	<1
Batch Plant	6	1	<1
622 Building	26	4	<1

Significant decreases in the activity density of beta particle emitters in rainfall were observed at all locations during this period. The decrease noted correlated favorably with decreases in the activity density of filterable beta particle emitters in the air (Section III), decrease in the number of radioactive particles in the atmosphere (Section III), and decreases in the activity density of non-volatile beta particle emitters deposited on the ground (Section II). With the possible exception of one sample collected at the Redox area which showed 5.3×10^{-5} μc/cc, the activity density of beta particle emitters in rainfall was comparable to that observed during the first quarter of 1953 when the amount of contamination in the atmosphere was not influenced by radioactive debris from nuclear detonations.

Twenty-six rain samples were collected at the Meteorology Tower where a sample is obtained each time that a measurable amount of rain falls. Analysis of the results from the individual samples show negligible amounts of contamination in all cases with the maximum measurement being only a factor of 4 above the detection limit of the measurement.

Several of the evaporated rain samples were radioautographed in an effort to determine the number of radioactive particles collected in rain. Contrary to previous observations which indicated radioactive particles in each rain sample, there were no evidence of particulate contamination in rain samples obtained during this three month period.

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

The activity density of gross alpha and beta particle emitters in drinking water supplies and test wells was determined from the results obtained from the radiochemical analysis of over 1200 samples. Nearly 1000 of these samples represented drinking water sources and the remainder were collected from test wells at project locations. Sampling frequencies varied from daily to monthly and the volume of the sample analyzed was either 500 ml or 11.7 liters. The smaller volume was used for gross alpha and gross beta determinations and the larger volume was used when increased sensitivity was desired or when specific isotopic identification became necessary. Data obtained from analyzing weekly samples collected from various stages of the filtration process at the Pasco filter plant and from several random locations at which the drinking water was treated prior to consumption supplemented the above measurements.

Table I summarizes the locations at which the average activity density of alpha particle emitters exceeded the individual sample detection limit of 5×10^{-9} μc/cc during the quarter.

TABLE I

CONTAMINATION FROM ALPHA PARTICLE EMITTERS IN DRINKING WATER

OCTOBER, NOVEMBER, DECEMBER

1953

500 ml Samples

Location	Alpha Particle Emitters, Units of 10^{-9} µc/cc			Uranium, Units of 10^{-9} µc/cc		
	No. Samples	Max.	Avg.	No. Samples	Max.	Avg.
Richland Well #4	16	32	6	16	13	4
Richland Well #12	13	9	5	11	8	6
Richland Well #15	12	8	6	12	9	6
Benton City Store	13	20	9	13	15	10
Benton City Water Co. Well	9	15	10	9	11	11
Redox Sanitary	13	73	7	--	--	--
Pasco Improvement Farm	2	6	6	--	--	--

The presence of detectable quantities of alpha particle emitters at three of the Richland wells and at the two Benton City sources of water was consistent with the findings during the first 9 months of 1952. Uranium was identified as the contaminant at these locations and the amounts measured were consistent with previous data and were not indicative of any significant trend within the period. Several drinking water sources in the Richland - North Richland area other than those listed in Table I showed trace alpha particle emission in individual samples collected at some time during the quarter. Although the average activity density at these random locations was below the detection limit of 5×10^{-9} µc/cc, several of the individual results tend to confirm the findings which are listed in Table I. Table II summarizes the later data and includes a tabulation of the results found at all locations sampled repetitively during the quarter.

[redacted]

TABLE II

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN WATER SUPPLIES

OCTOBER, NOVEMBER, DECEMBER

1953

500 ml samples

Location	Samples	Alpha Particle Emitters Units of 10^{-9} µc/cc Max.	Alpha Particle Emitters Units of 10^{-9} µc/cc Avg.	Beta Particle Emitters Units of 10^{-8} µc/cc Max.	Beta Particle Emitters Units of 10^{-8} µc/cc Avg.
Richland Well #2	12	9	<5	7	<5
Richland Well #4	16	32	6	22	<5
Richland Well #5	14	25	<5	<5	<5
Richland Well #12	13	9	5	<5	<5
Richland Well #14	42	14	<5	<5	<5
Richland Well #15	13	8	6	6	<5
Tract House J-685	12	<5	<5	<5	<5
3000 Area Well "A"	9	<5	<5	9	<5
3000 Area Well "B"	10	<5	<5	6	<5
3000 Area Well "C"	10	<5	<5	<5	<5
3000 Area Well "D"	6	<5	<5	33	<5
3000 Area Well "L"	1	<5	<5	<5	<5
Durand Well #5	11	<5	<5	<5	<5
Columbia Field Well "A"	12	20	<5	<5	<5
Columbia Field Well "B"	12	<5	<5	<5	<5
Columbia Field Well "C"	12	<5	<5	<5	<5
Headgate Well	13	8	<5	<5	<5
1100 Area Well #8	12	8	<5	6	<5
Midway	11	39	<5	<5	<5
Riverland	13	6	<5	<5	<5
Lower Knob	13	<5	<5	12	<5
Wills Ranch	14	20	<5	15	<5
Pistol Range	13	9	<5	7	<5
White Bluffs Fire Hall	12	8	<5	44	24
White Bluffs Tele. Exchange	10	7	<5	22	6
Benton City Store	13	20	9	<5	<5
Benton City Water Co. Well	9	15	10	32	5
Cobb's Corner (Kiona)	13	26	<5	10	<5
Enterprise Well	13	<5	<5	<5	<5

TABLE II (contd.)

500 ml samples

Location	Samples	Alpha Particle Emitters Units of 10^{-9} μc/cc Max.	Alpha Particle Emitters Units of 10^{-9} μc/cc Avg.	Beta Particle Emitters Units of 10^{-8} μc/cc Max.	Beta Particle Emitters Units of 10^{-8} μc/cc Avg.
Kennewick Standard Station	13	15	<5	44	23
Kennewick Reservoir	8	<5	<5	55	26
Pasco H and R Depot	9	<5	<5	38	12
Hanford Well #7	6	19	<5	20	<5
100-B Sanitary	13	<5	<5	<5	<5
100-C Sanitary	13	<5	<5	<5	<5
100-D Sanitary	13	<5	<5	69	28
100-DR Sanitary	12	<5	<5	82	30
100-H Sanitary	13	<5	<5	86	31
100-F Sanitary	13	<5	<5	68	36
100-K #1 Sanitary	12	<5	<5	6	<5
200 East Sanitary	13	<5	<5	40	16
200 West Sanitary	13	<5	<5	55	26
300 Area Sanitary	11	6	<5	7	<5
251 Bldg. Sanitary	13	<5	<5	27	6
Byers Landing Sanitary	1	<5	<5	12	12
Redox Sanitary	13	72	7	14	8
Sacajawea Park	12	8	<5	40	<5
McNary Dam	12	<5	<5	<5	<5
Patterson	12	7	<5	11	<5
Plymouth	10	8	<5	<5	<5
Prosser	12	<5	<5	<5	<5
Pasco Improvement Farm	2	6	6	<5	<5

In general, the results obtained from the analyses for the activity density of alpha particle emitters at the locations shown in Table II were consistent with previous findings. Several of the locations at which trace alpha particle emission were detected showed values barely exceeding the sensitivity limit of this type of measurement and in order to confirm the significance of the individual measurements these locations were re-sampled using a larger volume of water (11.7 liters) to increase the sensitivity from a value of 5×10^{-9} μc/cc to a value of 2×10^{-10} μc/cc. Table III summarizes the results obtained from analyzing the larger volume samples.

TABLE III

ACTIVITY DENSITY FROM ALPHA PARTICLE EMITTERS

MEASURED IN DRINKING WATER

OCTOBER, NOVEMBER, DECEMBER

1953

11.7 liter samples

Location	No. Samples	Units of 10^{-10} µc/cc Maximum	Average
Richland Well #2	5	75	30
Richland Well #4	3	34	26
Richland Well #5	7	20	17
Richland Well #12	7	63	37
Richland Well #14	5	29	24
Richland Well #15	6	54	33
Tract House J-685	5	15	12
Columbia Field Well "A"	4	10	7
Columbia Field Well "B"	6	21	10
Columbia Field Well "C"	5	28	21
1100 Area Well #8	6	24	19
3000 Area Well "A"	4	17	15
3000 Area Well "B"	5	22	14
3000 Area Well "C"	4	21	13
3000 Area Well "D"	2	14	10
3000 Area Durand #5	5	19	15
Benton City Store	5	110	52
Benton City Water Co. Well	4	100	71
Cobb's Corner	6	40	20
Enterprise Well	6	8	4
Headgate Well	6	10	7
Kennewick Reservoir	2	10	8
Kennewick Standard Station	4	7	7
Riverland	6	9	4
Midway	5	8	3
Lower Knob	6	7	<2
Will's Ranch	5	11	6
White Bluffs Fire Hall	6	20	16
Pistol Range	6	14	11
B-Y Well	6	35	25
McGee Well	6	3	<2
Ford Well	6	3	<2
Meeker Well	6	3	<2
251 Bldg.	4	5	2
Clover Island Pumping Station	3	6	5
3000 Pond Inlet (Raw)	2	15	15

[redacted]

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Again, the values found at Richland, North Richland, and Benton City locations appear significantly higher than those found at more remote locations and tend to confirm the results obtained from analyzing the smaller volume samples (Table I and II) which showed detectable alpha particle emission and trace quantities of uranium in the water below the Richland-Benton City area.

Small increases which were not significant were observed in the activity density of gross beta particle emitters in sanitary water consumed at the HAPO manufacturing areas and at Pasco and Kennewick. This trend is a seasonal occurrence which is related to the decreasing flow rate of the Columbia River during the three month period; increases were found only at stations which use the Columbia River as a source of water and the trend was not indicative of any significant departure from observations made during this same three month period in previous years.

In addition to those locations which were sampled repetitively during the quarter, a number of individual drinking water samples were obtained at remote locations. These included samples from the various military positions on the project and from wells on the Wahluke slope. In all cases, the activity density of gross alpha and gross beta particle emitters was below the respective detection limits of 5×10^{-6} μc/cc and 5×10^{-8} μc/cc.

Initial samples were obtained from the Kennewick Water Department Reservoir in the Kennewick Highlands. Radiochemical analyses of eight samples collected over a 2 month period showed that the average activity density in the Kennewick Highland water (2.6×10^{-7} μc/cc) was not significantly different than the average activity density measured at a commercial facility in downtown Kennewick where an average of 2.3×10^{-7} μc/cc represented the results from 13 analyses.

Table IV summarizes the results obtained from analyzing various types of filtering media and water collected from the Pasco Filter plant and analyzed for the activity density of gross beta particle emitters.

TABLE IV

RADIOACTIVE CONTAMINATION MEASURED AT PASCO FILTER PLANT

OCTOBER, NOVEMBER, DECEMBER

1953

Type Sample	Number Samples	Activity Density Gross Beta Particle Emitters	
		Maximum	Average
Water Entering Plant from River	28	4.4×10^{-6} μc/cc	2.3×10^{-6} μc/cc
Sand (Surface of sand filter)	10	2.5×10^{-4} μc/g	1.1×10^{-4} μc/g
First Backwash Material (Liquid)	9	2.2×10^{-6} μc/cc	7.8×10^{-7} μc/cc
First Backwash Material (Solid)	9	0.16 μc/g	7.7×10^{-2} μc/g
Coal (Surface of coal filter)	2	4.7×10^{-4} μc/g	2.7×10^{-4} μc/g
First Backwash Material (Liquid)	3	5.9×10^{-7} μc/cc	3.5×10^{-7} μc/cc
First Backwash Material (Solid)	3	6.7×10^{-2} μc/g	3.4×10^{-2} μc/g
Water Leaving Plant	13	6.2×10^{-7} μc/cc	2.9×10^{-7} μc/cc

All samples except those representing the surface of the sand filter and the liquid backwash material from the coal filter showed increases in the activity density of beta particle emitters during this quarter. These increases were expected and resulted from decreased dilution ratios of river water to reactor effluent. The decreases noted in the activity on the surface of the sand filter and in the liquid portion of the first backwash material were not significant when compared to the results obtained during the previous three month period.

One sample of foam-like material collected from the surface of the coal filter showed an activity density of 1.2×10^{-2} μc/g in the solid material in the sample. This value was comparable in magnitude to the activity density found in the solid fraction of backwash material from the filter beds.

A number of samples collected from the Pasco Filter plant were also analyzed for the activity density of gross alpha particle emitters. The average activity density in all liquid samples was less than 5×10^{-9} μc/cc whereas solid samples of backwash material showed an average of 5.7×10^{-5} μc/g at the sand filter and 9×10^{-6} μc/g at the coal filter. The maximum measurement was 2.3×10^{-4} μc/g in a sample of backwash material from the sand filter.

Table V summarizes the results obtained from analyzing water samples collected from test wells on the project.

TABLE V

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS

MEASURED IN TEST WELLS

OCTOBER, NOVEMBER, DECEMBER

1953

500 ml samples

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
300 Area Well #1	23	12	<5	15	<5
300 Area Well #3	29	170	98	7	<5
300 Area Well #4	23	210	140	15	<5
300 Area North Well	3	1300	1100	10	7
McGee Well	12	210	18	9	<5
1.9 - 3.4	1	6	6	<5	<5
6.7 - 34.2	1	10	10	<5	<5
12.3 - 2.7	1	30	30	<5	<5
18.8 - 43.2	1	<5	<5	15	15
32 - 77	1	<5	<5	18	18
34 - 51.5	1	<5	<5	13	13
43 - 88.5	1	<5	<5	9	9
45 - 69.5	1	<5	<5	6	6
47.5 - 60.5	1	46	46	<5	<5
54 - 42.5	1	13	13	<5	<5
55 - 50	1	8	8	<5	<5
60 - 60	1	27	27	<5	<5
62.5 - 90	1	5	5	<5	<5
303 - 1	7	550	190	<5	<5
303 - 2	7	670	260	13	6
303 - 3	6	1600	1200	38	17
303 - 4	7	1100	580	23	9
303 - 5	4	140	81	<5	<5
303 - 6	7	290	250	7	<5
303 - 7	4	410	160	14	6
303 - 9	4	180	140	<5	<5
303 - 10	4	550	390	28	10
303 - 12	4	82	59	<5	<5
3000 - 7	3	180	68	<5	<5

Significant decreases were observed in the activity density of alpha particle emitters at the three 300 area wells. Again, this decrease was expected as similar measurements obtained during this same period in previous years indicates that this activity decreases when the flow rate of the Columbia River recedes. A two-fold increase noted in the alpha particle emission in water from the 300 area North well was not associated with river flow and was not statistically different due to the large variation observed in individual samples from this location.

Uranium was detected in each of the 300 area wells. Average values of Wells #1, #2, and #3 were 5×10^{-9} μc/cc, 1.1×10^{-7} μc/cc, and 1.5×10^{-7} μc/cc, respectively.

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