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HW-31818

BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRIONS

FOR THE PERIOD

JANUARY, FEBRUARY, MARCH

1954

HANFORD TECHNICAL RECORD

May 10, 1954

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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD JANUARY, FEBRUARY, MARCH 1954

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ABSTRACT

SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

I^{131} emission from separation facilities averaged 1.7 curies/day; a maximum daily emission of 11 curies from the Redox facility weighted the daily average of 1.6 curies from this facility. Ruthenium emitted from the Redox facility averaged 6.3 curies/day; emission of over 300 curies of ruthenium during the first week in January represented the highest measurements observed since the startup of this facility. Radiochemical analyses of selected samples from the Redox effluent showed an average emission of 0.12 curie/day for rare earths and 0.1 curie/day for zirconium. Daily samples from the reactor stacks showed an average of 1.1 curies of tritium oxide emitted daily; maximum emission was measured at the 100-F area where 2.5 curies were discharged on January 28. Although several positive measurements were obtained for C^{14} and S^{35}, the average emission of these contaminants in reactor gaseous effluent was comparable to those previously noted.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION

Radiochemical analyses of vegetation samples showed negligible change in the amount of I^{131} deposited and showed a significant increase in the activity density of non-volatile beta particle emitters. The latter increase which was related to the ruthenium emission during early January was noted over a narrow trajectory which extended in a northeast direction from the 200 West area. Maximum measurements in the range of 0.1 to 0.5 $\mu c/g$ were observed at several locations and an isolated sample from inside the 200 West area showed a value of 2.3 $\mu c/g$. Vegetation samples collected from remote locations showed significant non-volatile beta particle emission at locations as far distant as Davenport and Spokane where values on the order of 10^{-4} $\mu c/g$ were detected. I^{131} on vegetation at remote locations averaged less than 3×10^{-6} $\mu c/g$ at nearly all stations. The average activity density of alpha particle emitters on vegetation ranged from 7×10^{-8} $\mu c/g$ at residential locations to 4.3×10^{-6} $\mu c/g$ adjacent to the 200 West area. The maximum measurement was 1.3×10^{-5} $\mu c/g$ near the 200 West area gatehouse.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dosage rates measured by Victoreen Integrons were less than 10.6 mrad/day at all locations except those inside the 200 West area where the values ranged from 1.8 to 2.5 mrads/day. Measurements obtained from detachable ionization chamber readings showed a significant increase

in dosage rates at locations within a 5 mile radius of the separation facilities. Maximum measurements were obtained near the Redox perimeter fence where the mean dosage rate was 19 mrads/day during the quarter. The activity density from filterable beta particle emitters in the atmosphere averaged between 2.3×10^{-13} and 2.9×10^{-13} μc/cc at residential locations and between 5×10^{-13} μc/cc and 2.3×10^{-12} μc/cc near the separation areas; the maximum activity measured over a one week period was 5.1×10^{-12} μc/cc near the Redox area. The number of radioactive particles in the atmosphere decreased from last quarter's average at nearly all locations although the emission of significant quantities of ruthenium influenced the higher than normal measurements obtained during the period. Maximum average concentrations observed inside the 200 West area were on the order of 0.2 ptle/cubic meter with some values on the order of 10^{-2} ptle/cubic meter at residential areas near the plant perimeter. I^{131} was detected in the atmosphere at nearly all monitoring stations during the period; average values showed an activity density on the order of 1×10^{-13} μc/cc at outlying stations and from 1×10^{-13} μc/cc to 9×10^{-13} μc/cc at locations near the separation areas.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The average activity density of gross beta particle emitters at the six reactor areas ranged from 3.5×10^{-3} μc/cc to 6.5×10^{-3} μc/cc. Beta particle emitters discharged to the river averaged between 12,000 and 21,000 μc/second; the maximum discharge occurred at 100-C area where the average values were 20,000; 20,000; and 22,000 μc/second during January, February, and March, respectively. The maximum individual sample was collected from the 100-DR area coincident with a double rupture. The activity density of alpha particle emitters in reactor effluent averaged less than 5×10^{-9} μc/cc at all reactors. Uranium was detected in about 10 per cent of the effluent samples; positive values ranged from 2×10^{-9} μc/cc to 7.4×10^{-9} μc/cc. Trace plutonium was detected in 7 out of 39 samples analyzed. I^{131} discharged to the river from the animal farm averaged 40 μc/day. Ground contamination surveys with portable instruments revealed excessive contamination inside the 100-B area during late March; dosage rates ranged up to 50 mrads/hr and isotopic analyses indicated that over 50 per cent of the beta particle emission was from rare earths. Similar surveys following the emission of over 300 curies of ruthenium from the Redox facility during early January defined a contamination pattern which extended from the Redox facility in s northeast direction as far as the Davenport-Spokane area. Dosage rates ranging from 100 to 500 mrads/hr were found in and near the 200 West area and counting rates on the order of several hundred c/m were detected in the Ritzville, Moses Lake, and Spokane areas. Estimated deposition maps showing the trajectory followed by this emission may be referred to in the text.

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

Except for isolated locations, the activity density of beta particle emitters in the Columbia River remained on the same order of magnitude as previously observed. Maximum measurements were found directly below the reactors where individual samples showed values ranging from 2×10^{-5} μc/cc to 4×10^{-5} μc/cc and average values were on the order of 1.2×10^{-5} μc/cc. The activity density in samples collected between McNary Dam and Portland, Oregon, ranged from 2.6×10^{-8} to 1.4×10^{-7} μc/cc with trace activity being detected in all samples analyzed. Alpha particle emitters in river water averaged less than 5×10^{-9} μc/cc at nearly all locations. I^{131} in the Columbia River at the Hanford ferry averaged 3.5×10^{-7} μc/cc. No significant change was noticed in the activity density of beta particle emitters in mud samples. Uranium and plutonium in mud was negligible in all cases. Small increases in the activity density of beta particle emitters in raw water were noted; average values ranged from 5.2×10^{-7} μc/cc in the separation areas to 1.4×10^{-6} μc/cc at the 100-F area.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN

The activity density of beta particle emitters in rain samples averaged less than 1×10^{-6} μc/cc at all locations except those which were in and adjacent to the region in which significant ruthenium deposition occurred during early January. Samples collected near the Redox area showed values of 7×10^{-4} and 2.1×10^{-4} μc/cc. Alpha particle emission in rain samples was below the detection limit in all samples analyzed. Snow samples collected inside the 200 West area showed a range of activity densities from 2.5×10^{-7} μc/cc to 3.8×10^{-5} μc/cc.

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

Drinking water supplies which showed the average activity density of alpha particle emitters to exceed 5×10^{-9} μc/cc were essentially confined to the Richland, North Richland, Benton City region. Maximum measurements were found in two Benton City wells at which the average activity density was 1.0×10^{-9} and 1.4×10^{-9} μc/cc. Five Richland wells showed detectable uranium throughout the period. Increases were noted in the activity density of beta particle emitters in drinking water at HAPO manufacturing areas. One sample collected from the White Bluff Fire Hall which showed a value of 1.7×10^{-6} μc/cc represented the highest beta

particle emission noted for HAPO drinking water during the past 6 months. Beta particle emitters in drinking water and in various media collected from the filtration plant at Pasco remained on the order of magnitude previously observed. A decontamination factor of 10 in the filtration processes was consistent with that observed during the previous quarter. The results obtained from test well samples were not indicative of a significant trend in alpha particle emission; however, several increases were noted in the activity density of beta particle emitters at locations which previously had not indicated detectable activity.

INTRODUCTION

Radioactive contamination in the HAPO environs was determined from the results of nearly 25,000 samples and surveys obtained by the Regional Survey forces of the Radiological Sciences Department. Samples of various media were collected from representative locations throughout the Pacific Northwest according to procedures and techniques described in previous publications of this series (HW-30744, HW-30174, and HW-29514). Radiochemical analysis were performed by the Control Laboratory of the Biophysics Section according to procedures outlined in HW-20136. The counting rates were corrected by Control Services personnel for geometry, backscatter, air-window absorption, source size, self-absorption, chemical yield, and collection efficiency by factors shown in HW-22682, HW-23769, HW-27854, HW-30492. Decay correction factors were applied to counting rates representing specific isotopes and to gross beta particle measurements which included short half-life emitters.

Supplementary information was obtained from portable instrument surveys by Regional Survey personnel and from readings obtained from the operation of fixed and portable instrumentation. Maps showing the locations of the various monitoring and sampling stations referred to in this report may be referred to in HW-29514. Drawings prepared by the Atomic Energy Commission (SK-7-414) were used to define project boundaries.

Sections I through VII summarize the results obtained from measuring the amounts of contamination discharged from HAPO and their effect on the contamination of vegetation, air, soil, and water in the environs.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

Effluent gases from the reactor and separation area stacks at HAPO were sampled at the stacks on a daily basis. Continuous scrubber and filter samples operated at the separation areas stacks were analyzed for I^{131} and ruthenium. Daily filter samples of the gases entering and leaving the Redox sand filter were collected and analyzed for gross beta particle emitters and radioactive particle concentration. Monitoring at the reactor areas included operation of several types of samplers and specific analysis for various contaminants. The results obtained from these sampling programs are summarized for each of the manufacturing areas.

SEPARATION AREAS

200 EAST AREA

The extended shutdown of the Semi-works facility continued throughout the present period. Continuous filter monitoring was maintained at the Semiworks stack and the collection period was increased from daily to weekly. This increased collection period lowered the detection limit to a value more nearly corresponding to the lower activity density of the effluent gases noted during this quarter. Table I is a summary of the results obtained from these filter samples.

TABLE I

SUMMARY OF RESULTS FROM STACK MONITORING

SEMIWORKS STACK

JANUARY, FEBRUARY, MARCH

1954

Month	Curie of Gross Beta Particle Emitters Emitted Daily	
	Maximum	Average
January	1.2×10^{-3}	$<3.5 \times 10^{-4}$
February	6.5×10^{-3}	8.5×10^{-5}
March	5.4×10^{-6}	3.1×10^{-6}
Quarter	6.5×10^{-3}	$<9.1 \times 10^{-5}$
Last Quarter	1.4×10^{-2}	$<2.9 \times 10^{-4}$

200 WEST AREA T-PLANT

A summary of the results obtained from monitoring at the fifty foot level of the T-plant stack is presented in Table II.

TABLE II

SUMMARY OF RESULTS FROM I^{131} MONITORING

T-PLANT STACK

JANUARY, FEBRUARY, MARCH

1954

Month	Curie of I^{131} Emitted Daily	
	Maximum	Average
January	0.58	0.12
February	0.20	8.4×10^{-2}
March	0.60	4.6×10^{-2}
Quarter	0.60	8.9×10^{-2}
Last Quarter	3.7	0.28

The dissolution of several mixed batches of irradiated metal from different reactor areas and after different cooling periods, precluded any accurate calculation of the activity of I^{131} in the metal dissolved this quarter. Estimation of the activity of I^{131} revealed no significant change from the average of 130 curies/day noted last quarter. Absence of any silver reactor failures since November, 1953, was responsible for the low average I^{131} emission rate of 0.09 curie/day during this quarter.

200 WEST AREA S-PLANT

Table III presents a summary of the results obtained from I^{131} monitoring at the S-plant stack.

TABLE III

SUMMARY OF RESULTS OF I^{131} MONITORING

S-PLANT STACK

JANUARY, FEBRUARY, MARCH

1954

Month	Curie of I^{131} Emitted Daily	
	Maximum	Average
January	5.2	1.0
February	0.60	0.18
March	11	3.7
Quarter	11	1.6
Last Quarter	10	1.4

Estimation of the amounts of I^{131} available in the mixed batches of irradiated metal processed at the S-plant facility revealed that an average of about 110 curies of I^{131}/day were available in the dissolvers during the quarter, compared to an average of 210 curies/day the previous quarter. There were no significant changes in the maximum and average I^{131} emission rate this quarter when compared to the values for the previous quarter (Table III), even though the amount of I^{131} available in the dissolvers decreased this quarter.

Several periods of I^{131} emission which averaged greater than 1 curie/day were noted during the quarter. On these occasions, the I^{131} activity density of the stack effluent remained high throughout the sampling periods with only a small additional increase in activity density during dissolver operation; no specific silver reactor failure could be found to account for the high I^{131} emission rate.

The results obtained from ruthenium monitoring at the S-plant stack are summarized in Table IV.

TABLE IV

SUMMARY OF RESULTS FROM RUTHENIUM MONITORING
S-PLANT STACK
JANUARY, FEBRUARY, MARCH
1954

Ruthenium Emission
Units of Curies Per Day

Month	Filter Collection		Scrubber Collection		Total	
	Maximum	Average	Maximum	Average	Maximum	Average
January	210	9.4	130	6.0	230	15
February	3.9	0.59	0.41	8.3×10^{-2}	3.9	0.67
March	10	1.0	1.9	0.43	12	1.4
Quarter	210	3.9	130	2.3	230	6.3
Last Quarter	3.2	0.70	1.3	<0.24	3.2	<0.94

Unusually high ruthenium emission from the S-plant stack was noted during January. The emission of 260 curies on the night of January 2 and morning of January 3 represents the highest daily emission of ruthenium since start-up of this facility in January, 1952. Failure of the caustic scrubber in the H-cell, 202-S Building was responsible for this high emission. During the period from 1000, January 5 to 1030, January 6, approximately 100 curies of ruthenium were emitted to the atmosphere. Since the S-plant stack was washed down with water during this period, the flushing operation may have caused this second emission. The exact value of the ruthenium emission for this period was not measureable because it was not known whether the ruthenium was emitted during the flushing operation, when the air flow rate in the stack was reduced by a factor of one-half to one-third, or after the flushing operation when the flow rate was returned to its normal value.

The average of 6.3 curies/day for this quarter was weighted by these two unusually high measurements. If these two were omitted, the quarterly average would be 2 curies/day, an increase over the previous quarterly average by a factor of approximately 2.

Daily measurement of filterable radioactive strontium in the S-plant stack effluent gases was initiated during the latter part of January. The results of these measurements indicated that average daily emission of strontium was 0.02 curie/day during February and March with very little deviation of the individual results from the average values. Spot measurements of filterable radioactive rare earth and zirconium materials were also initiated during the latter part of January. The average radioactive rare earth emission rate based on 33 measurements during February and March was 0.12 curie/day with a maximum measurement of 0.3 curie/day obtained on March 9, 1954. Results of 19 measurements for radioactive zirconium averaged 0.1 curie per day with a maximum of 0.4 curie per day on March 23, 1954.

Monitoring of the inlet to the Redox sand filter by drawing an aliquot of the incoming gases through a CWS type filter paper, was maintained on a daily basis throughout the quarter in order to evaluate the effect of the sand filter in reducing emission of contaminants in stack effluent. A summary of the results obtained from these filter measurements is presented in Table V.

TABLE V

SUMMARY OF FILTER MEASUREMENTS
S-PLANT SAND FILTER INLET
JANUARY, FEBRUARY, MARCH
1954

	Gross Beta Particle Emitters			
	Units of 10^{-3} $\mu c/ft^3$		Units of Curies/Day into Sand Filter	
Month	Maximum	Average	Maximum	Average
January	29	6.0	1.7	0.35
February	86	9.4	5.0	0.54
March	5600	210	320	12
Quarter	5600	83	320	4.8
Last Quarter	541	35	31	2.0

The average value for the present quarter was weighted by the one unusually high measurement of 5.6 $\mu c/ft^3$ obtained from the filter operated February 26 to 27. During this period highly contaminated equipment was removed from the H-cell in the 202-S Building and transported to the burial ground. The activity contained on this filter was estimated from the CP meter reading of 6 rads/hr at 2' to be 18,000 μc of gross beta particle emitters. Gamma ray spectrometer measurements on a small portion of the filter revealed that greater than 95 per cent of the radioactive material consisted of the ruthenium isotopes 103 and 106. If

this one unusually high measurement were omitted, the monthly average for March would be 0.022 $\mu c/ft^3$ and 1.3 curies/day to the sand filter; the quarterly average would then be 0.012 $\mu c/ft^3$ and 0.68 curie/day.

Measurements of the radioactive material leaving the Redox sand filter were made in a manner similar to those of the gases entering the sand filter. The filters were radioautographed and the concentration of radioactive particles in the gas leaving the sand filter was calculated. Table VI is a summary of the results of these filter samples.

TABLE VI

SUMMARY OF FILTER MEASUREMENTS
S-PLANT SAND FILTER OUTLET
JANUARY, FEBRUARY, MARCH
1954

	Radioactive Particles			
	Units of 10^{-3} particle/ft^3		Units of 10^5 particles/day	
Month	Maximum	Average	Maximum	Average
January	9.5	2.5	5.5	1.4
February	48	8.2	28	4.7
March	>1000	>72	>580	>42
Quarter	>1000	>24	>580	>14

The studies initiated during the previous quarter for determining the activity density of gross beta particle emitters were discontinued as comparative data indicated no direct correlation between inlet and outlet measurements. Because the concentrations of radioactive particles in the gases leaving the sand filter were deemed more significant, this measurement was resumed during the present quarter.

Estimation of the activity density of gross beta particle emitters in the gases leaving the sand filter can be made from the portable instrument surface readings obtained on these filters at the time they were collected. Such estimations indicate that the average and maximum values would be 3×10^{-4} and 2×10^{-3} curie/day, respectively, exclusive of the one high measurement on February 27. These values were about 30 per cent of the values noted during the previous quarter when the average and maximum were 9.2×10^{-4} and 6.1×10^{-3} curie/day, respectively. This decrease compared favorably with the decrease noted in the activity density of the inlet gases when the one high result was deleted.

Radioactive particle concentrations this quarter were comparable to those noted during the third quarter of 1953 if the one high measurement of greater than 1 particle/ft^3 obtained February 27 is again deleted.

200 WEST AREA U-PLANT

The results of the filter samples collected from the ten foot level of the U-plant stack are summarized in Table VII.

TABLE VII

SUMMARY OF FILTER MEASUREMENTS

U-PLANT STACK

JANUARY, FEBRUARY, MARCH

1954

	Curie Emitted Per Day				Radioactive Particles	
	Gross Alpha Particle Emitters		Gross Beta Particle Emitters		Units of	
	Units of 10^{-8} curie		Units of 10^{-5} curie		10^4 particles/day	
Month	Maximum	Average	Maximum	Average	Maximum	Average
January	1.3	0.62	5.2	1.2	20	3.6
February	4.8	1.8	4.4	1.7	26	5.1
March	7.2	2.2	7.3	2.9	14	6.2
Quarter	7.2	1.5	7.3	1.9	26	5.0
Last Quarter	20	2.9	42	4.0	>64	>39

The downward trend in activity density of the U-plant effluent gases noted last quarter continued into the month of January. During February and March this trend was reversed; the average values for March were below the corresponding average values for the previous quarter.

The concentration of radioactive particles followed the same trends as the activity densities. The average values for these three measurements have fluctuated widely and several increasing and decreasing trends have been noted since sampling was initiated at this facility in August, 1952.

REACTOR AREAS

Samples of the effluent gases from the reactor areas stacks were collected from sampling lines located near the stack breeching. Fractions of the gas samples were passed through various types of sampling equipment, which filtered and scrubbed the radioactive materials from the gases. Specific analyses of the collected materials were performed to determine the activity density of tritium oxide, C^{14}, S^{35}, filterable gross alpha and gross beta particle emitters, and the concentration of radioactive particles in the effluent gases. The results of these analyses are discussed below and are summarized for each area in Tables VIII through XIII.

TABLE VIII

SUMMARY OF STACK MONITORING RESULTS

105-B STACK

JANUARY, FEBRUARY, MARCH

1954

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
January						
Maximum	0.37	<4.5	5.6	2.3	160	<0.65
Average	0.21	<4.5	<4.5	1.4	160	<0.18
February						
Maximum	0.31	<4.5	22	1.5	250	0.50
Average	0.21	<4.5	10	0.70	180	0.50
March						
Maximum	0.81	<4.5	<4.5	4.0	190	0.86
Average	0.23	<4.5	<4.5	2.2	81	0.58
Quarter						
Maximum	0.81	<4.5	22	4.0	250	0.86
Average	0.22	<4.5	4.6	1.4	140	0.39

TABLE IX

SUMMARY OF STACK MONITORING RESULTS

105-C STACK

JANUARY, FEBRUARY, MARCH

1954

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
January						
Maximum	0.15	5.8	8.2	5.2	760	18
Average	0.05	<4.5	6.5	1.3	88	13
February						
Maximum	0.16	<4.5	31	2.7	23	26
Average	0.10	<4.5	14	1.5	8.2	17
March						
Maximum	0.86	<4.5	14	12	1800	8.3
Average	0.15	<4.5	5.6	4.9	730	5.9
Quarter						
Maximum	0.86	5.8	31	12	1800	26
Average	0.10	<4.5	8.6	2.4	240	12
Last Quarter						
Maximum	0.79	<4.5	44	92	96	100
Average	0.07	<4.5	12	4.6	13	40

TABLE X

SUMMARY OF STACK MONITORING RESULTS

105-D STACK

JANUARY, FEBRUARY, MARCH

1954

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day*
January						
Maximum	0.41	7.9	10	2.3	580	
Average	0.21	<4.5	5.4	0.63	200	
February						
Maximum	0.54	5.9	34	1.2	380	
Average	0.26	<4.5	14	0.64	250	
March						
Maximum	1.1	5.2	5.9	1.8	240	
Average	0.30	<4.5	<4.5	0.97	180	
Quarter						
Maximum	1.1	7.9	34	2.3	580	
Average	0.26	<4.5	8.4	0.74	210	
Last Quarter						
Maximum	0.42	<4.5	26	7.7	870	
Average	0.11	<4.5	6.9	2.4	340	

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

TABLE XI

SUMMARY OF STACK MONITORING RESULTS

105-DR STACK

JANUARY, FEBRUARY, MARCH

1954

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
January						
Maximum	0.17	<4.5	<4.5	2.3	0.33	<0.26
Average	0.06	<4.5	<4.5	0.50	0.28	0.04
February						
Maximum	0.21	<4.5	23	0.81	1.1	0.43
Average	0.09	<4.5	11	0.45	0.53	0.14
March						
Maximum	1.5	<4.5	45	1.5	2.0	<0.26
Average	0.19	<4.5	20	0.58	1.1	0.11
Quarter						
Maximum	1.5	<4.5	45	2.3	2.0	<0.43
Average	0.12	<4.5	<11	0.50	0.61	0.09
Last 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

TABLE XII

SUMMARY OF STACK MONITORING RESULTS

105-F STACK

JANUARY, FEBRUARY, MARCH

1954

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Particle Emitters Measured on Air Filters: Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day*
January						
Maximum	0.52	4.8	26	2.5	780	
Average	0.16	<4.5	11	1.2	300	
February						
Maximum	2.5	6.2	17	2.5	240	
Average	0.45	<4.5	8.4	1.6	130	
March						
Maximum	0.33	<4.5	84	9.3	290	
Average	0.21	<4.5	41	6.5	180	
Quarter						
Maximum	2.5	6.2	84	9.3	780	
Average	0.27	<4.5	21	2.9	190	
Last Quarter						
Maximum	0.27	14.2	30	19	350	
Average	0.08	<4.5	14	5.8	220	

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

TABLE XIII

SUMMARY OF STACK MONITORING RESULTS

105-H STACK

JANUARY, FEBRUARY, MARCH

1954

Curies Emitted Per Day

Month	Tritium Oxide	C^{14} Units of 10^{-3}	S^{35} Units of 10^{-4}	Particle Emitters Measured on Air Filters: Gross Alpha Units of 10^{-7}	Gross Beta Units of 10^{-5}	Radioactive Particles Units of 10^{5} particles/day
January						
Maximum	0.16	<4.5	<4.5	5.1	230	<0.50
Average	0.08	<4.5	<4.5	1.9	52	0.18
February						
Maximum	0.19	<4.5	8.1	1.1	8.7	9.4
Average	0.11	<4.5	<4.5	0.51	3.1	3.5
March						
Maximum	0.62	<4.5	<4.5	5.1	57	<0.25
Average	0.20	<4.5	<4.5	3.4	19	0.09
Quarter						
Maximum	0.62	<4.5	8.1	5.1	230	9.4
Average	0.13	<4.5	<4.5	1.7	22	0.95
Last Quarter						
Maximum	3.8	6.7	36	11	33	>200
Average	0.17	<4.5	8.1	3.5	11	>62

Sampling of the 105-B area reactor stack was started near the end of the previous quarter and no monthly and quarterly averages were available for comparison with the values obtained during this quarter. The quarterly averages for the various types of radioactive material sampled at 105-B stacks were comparable to, but slightly lower than those found at the two similar reactor areas, 105-F and 105-D.

Average tritium oxide emission from the six reactor area stacks monitored was 1.1 curies/day during the quarter. This value would be 0.88 curie/day if 105-B were omitted, compared to an average of 0.48 curie/day for the five reactor stacks monitored during the previous quarter. Increases by factors of two to three were noted in the quarterly average values at 105-F, 105-D, and 105-DR reactor stacks this quarter. No significant changes over the previous quarterly average values were noted at the 105-H and 105-C reactor stacks. Analysis of the trends shown by the monthly average tritium oxide emission rates reveals an increasing trend at all reactor areas except 105-F where the maximum emission rate occurred during the February reporting period. On January 28, 2.5 curies/day were emitted to the atmosphere from this reactor stack.

The C^{14} emission rate from all six reactor stacks averaged below the detection limit of 4.5×10^{-3} curie/day throughout the quarter. Occasional positive values were noted at the 105-F, 105-D, and 105-C reactor area stacks. The maximum C^{14} emission of 7.9×10^{-3} curie/day occurred on January 12 from the 105-D stack.

Several positive S^{35} measurements were noted this quarter at all reactor area stacks. Increases in the average values this quarter were noted at 105-F, 105-D, and 105-DR. The present quarterly average increased by factors of one and one-half to two over the average values obtained during the previous quarter at these three reactor areas.

Decreases from previous quarterly averages were noted at 105-H and 105-C reactor stacks. Maximum S^{35} emission rates occurred at 105-F this quarter when 8.4×10^{-3} and 6.7×10^{-3} curie/day were emitted to the atmosphere on March 9 and March 23, respectively.

Significant decreases in the average emission rate of gross alpha particle emitters collected on air filter samples were noted at five reactor area stacks this quarter. Decreases to 1/2 of the previous quarter's averages were noted at four of the reactor stacks, while the average value obtained at the 105-D reactor stack decreased to 1/3 of the previous quarterly average.

The average activity density of gross beta particle emitters in the effluent gases from 105-F, 105-DR, and 105-H reactor stacks increased by factors of approximately 2 this quarter compared to the previous quarter. There was a very significant increase in the activity density of gross beta particle emitters during January and March in the 105-C stack gases. During March the highest activity density ever recorded for this stack was noted when an average of 1.8×10^{-2} curie/day of gross beta activity was emitted during the week ending March 8, 1954. This filter contained a large amount of gaseous or finely divided radioactive material which yielded a radioautograph too dense to count.

Several other particle filters radioautographed during the quarter produced films which were too dense to count accurately. These radioautographs were obtained from the filters operated at the older reactor area stacks (105-B, 105-D, and 105-F). The darkened spots in these instances were due to a very finely divided material having either a low specific activity or a low energy beta particle emission. This material could be condensed on the filters from the gaseous state and would not necessarily be particulate matter. The majority of the filters collected from the 105-F and 105-D gave radioautographs too dense to measure accurately. In a few instances where radioautographs from these filters

could be counted, the results revealed only a small number of darkened spots per filter and the concentration of radioactive particles averaged between 2×10^4 and 2×10^5 particles/day.

There was no significant change in the concentration of radioactive particles in the effluent gases from the 105-DR reactor stack. Significant decreases in the concentration of radioactive particles in the stack gases emitted from the 105-H and 105-C areas were noted this quarter when compared with the values for the previous quarter. Approximately 1/2 of the radioautographs of the filters obtained from the 105-B reactor stack were too dense to count this quarter. These radioautographs which could be counted contained only a few darkened spots per filter and the average particle concentrations during the present quarter, 3.9×10^4 particles/day, was calculated using these later filters only.

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Radioactive contamination deposited in the HAPO environs was measured by analyzing nearly 2400 samples of vegetation for the activity densities of I^{131} and non-volatile beta particle emitters. Over 1700 samples were collected from locations on the project and the remaining samples were collected within a radius of 200 miles from the separation area stacks.

A summary of the results obtained from analyzing samples from grouped locations is presented in Table I; average values for the previous quarter are included for comparison.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

JANUARY, FEBRUARY, MARCH

1954

Location	I^{131} Units of 10^{-6} μc/g No. Samples	Max.	Avg.	Last Qtr. Avg.	Non-Volatile Emitters Units of 10^{-6} μc/g Max.	Avg.	Last Qtr. Avg.
North of 200 Areas	196	25	4	<3	23000	1200	120
Near the 200 Areas	115	47	8	<3	240000	12000	120
Route 3	4	35	18	13	1400	490	---
200 West Gate	51	77	49	20	2400	560	160
200 East Tower #16	61	49	12	4	450	78	98
Batch Plant	39	140	47	6	370000	33000	120
Meteorology Tower	9	64	31	8	250	160	---
South of 200 Areas	330	37	5	<3	270	56	81
Richland	168	17	4	<3	140	41	98
Pasco Environs	132	12	<3	<3	71	31	50
Kennewick Environs	168	19	<3	<3	95	29	56
Benton City-Kiona	39	14	<3	<3	270	49	63
Richland "Y"	13	11	4	<3	---	--	---
Hanford	13	26	6	<3	---	--	---
200 East Area	40	29	9	3	9000	450	120
200 West Area	65	--	-	10	2300000	22000	250
Wahluke Slope	120	9	<3	<3	14000	270	96
Goose Egg Hill	51	65	9	8	950	120	91
Rattlesnake Mountain	6	29	12	<3	140	52	89
PSN-300-310-330	36	65	11	7	190	71	110
Redox Construction	46	110	55	9	460000	14000	---
Off Area Sampling							
Pasco to Ringold	86	23	3	<3	180	50	110
Prosser to Patterson-McNary	190	9	<3	<3	170	52	55
Eastern Washington	206	24	3	<3	1200	58	37
So. Washington and No. Oregon	200	19	<3	<3	86	26	49

A review of the data summarized in Table I shows that the activity density of I^{131} remained on the lower order of magnitude previously observed at nearly all locations. Significant increases were observed in the activity density of non-volatile beta particle emitters at a large number of locations. This increase was observed early in January immediately following the emmission of significant quantities of ruthenium (Section I) from the Redox facility. Samples which were collected from inside the region designated by the trajectory indicated in Figure 7, page 67, showed isolated activity densities in excess of 1 μc/g during the quarter. The significant deposition of non-volatile beta particle emitters in this region tended to influence the accuracy of the I^{131} measurements for samples collected in the same zone, and after the middle of January, a number of the I^{131} analyses of samples from this area were temporarily deleted from the program. The small increase noted in the activity density of I^{131} at locations such as the 200 West gate and the Redox construction area may have been influenced by the interference of non-volatile beta particle emitters with the analyses for I^{131}. This assumption appears valid as the gross emission of I^{131} from separation facilities decreased during this period.

Average values for I^{131} deposition based on all samples collected during the quarter show a mean of 1.5×10^{-5} μc/g inside the project perimeter and 3×10^{-6} μc/g in residential areas neighboring the plant. For non-volatile beta particle emitters, the average deposition on the project ranged from 5×10^{-5} μc/g at perimeter locations to 3.3×10^{-2} μc/g near the 200 West area. In residential areas the average deposition from these emitters was 3×10^{-5} μc/g.

Table II and III summarizes the results obtained from the vegetation measurements on a monthly basis.

TABLE II

ACTIVITY DENSITY FROM I^{131} ON VEGETATION

JANUARY, FEBRUARY, MARCH

1954

Units of 10^{-6} μc/g

Location	January		February		March	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	25	5	18	5	13	3
Near the 200 Areas	47	12	30	8	27	4
Route 3	35	18	--	-	24	17
200 West Gate	77	49	--	-	--	--
200 East Tower #16	49	22	44	10	23	6
Batch Plant	140	47	--	--	--	--
Meteorology Tower	44	33	43	27	64	38
South of 200 Areas	26	5	37	6	20	4
Richland	8	<3	13	4	17	4
Pasco Environs	9	<3	8	<3	12	<3
Kennewick Environs	7	<3	11	<3	19	<3
Benton City - Kiona	3	<3	12	3	14	5
Richland "Y"	9	6	11	6	8	3
Hanford	6	3	26	8	11	8
200 East Area	19	6	17	10	29	12
Wahluke Slope	7	<3	6	<3	9	<3
Goose Egg Hill	27	11	14	6	65	13
Rattlesnake Mountain	--	--	--	-	29	12
PSN-300-310-330	65	19	18	7	40	10
Redox	110	63	34	24	--	--
Off Area Sampling						
Pasco to Ringold	10	<3	5	<3	23	6
Prosser to Patterson - McNary	9	<3	8	<3	9	<3
Eastern Washington	24	8	5	<3	17	4
So. Washington and No. Oregon	19	<3	14	<3	7	<3

TABLE III

ACTIVITY DENSITY FROM NON-VOLATILE BETA PARTICLE EMITTERS ON VEGETATION

JANUARY, FEBRUARY, MARCH

1954

Units of 10^{-6} μc/g

Location	January		February		March	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	23000	2200	400	130	15000	1500
Near the 200 Areas	100000	9200	240000	21000	58000	3900
Route 3	---	---	1400	610	270	250
200 West Gate	2400	660	1400	510	2100	540
200 East Tower #16	330	110	450	110	93	45
Batch Plant	370000	73000	170000	24000	27000	11000
Meteorology Tower	---	---	---	---	250	160
South of 200 Areas	270	85	160	57	170	42
Richland	140	54	130	42	140	28
Pasco Environs	69	36	60	28	71	29
Kennewick Environs	95	34	77	30	80	24
Benton City - Kiona	270	87	100	36	46	19
200 East Area	1500	260	9000	780	1800	220
200 West Area	240000	13000	2300000	220000	2100000	130000
Wahluke Slope	14000	470	9600	250	950	63
Goose Egg Hill	280	120	950	150	80	42
Rattlesnake Mountain	---	---	---	---	140	52
PSN-300-310-330	190	78	190	86	100	47
Redox Construction	---	---	62000	5100	460000	24000
Off Area Sampling						
Pasco to Ringold	180	57	75	50	60	35
Prosser to Patterson - McNary	170	42	81	29	61	26
Eastern Washington	1200	110	120	28	93	26
So. Washington and No. Oregon	84	25	86	30	46	22

Although the values summarized in Table II and III reflect a decreasing trend between January and March, several of the maximum measurements obtained during the quarter represented samples collected during the month of March. In general, the March values which appear significantly high represent sample locations inside the region in which significant deposition occurred in the quarter (Figure 7).

Figures 1 through 4 show the estimated deposition of I^{131} based on the values summarized in Tables I and II. A comparison of these maps with those which represent deposition during the last quarter of 1953 shows that trace amounts of I^{131} were detected over a much larger area during this period. The deposition pattern tends to follow that which was indicated during the previous quarter when trace contamination was concentrated in an elongated area extending in a northeast direction from the separation facilities.

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

TABLE IV

RADIOACTIVE CONTAMINATION ON VEGETATION

OFF-AREA LOCATIONS

JANUARY, FEBRUARY, MARCH

1954

Units of 10^{-6} µc/g

Location	I^{131} No. Samples	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters No. Samples	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Wallua	5	7	4	6	49	32
Touchet	4	<3	<3	6	30	16
Lowden	4	4	<3	6	47	26
Walla Walla	10	17	5	12	62	34
Dixie	5	7	<3	6	88	32
Waitsburg	9	8	<3	10	54	25
Dayton	9	11	<3	12	41	22
Pomeroy	9	17	7	12	120	42
Lewiston	9	24	4	12	49	29
Uniontown	5	9	4	6	25	19
Pullman	9	9	<3	12	140	29
Colfax	5	6	<3	6	44	25
Steptoe	4	17	4	5	39	25
Rosalia	4	5	<3	6	42	26
Spangle	5	6	<3	6	88	35
Spokane	10	7	4	12	140	61
Cheney	8	<3	<3	8	41	51
Spokane to Davenport	3	5	3	7	1200	520
Davenport	1	6	6	1	200	200
Davenport to Harrington	1	7	7	2	280	170
Harrington	1	4	4	1	160	160
Harrington to Sprague	1	6	6	4	750	360
Sprague	9	6	<3	12	66	38
Ritzville	9	8	<3	12	180	42
Lind	9	6	<3	12	98	43
Connell	9	12	<3	12	53	28
Moxee	10	3	<3	12	24	12
Union Gap	5	5	<3	6	43	22
Wapato	10	14	<3	12	84	32
Toppenish	10	11	<3	12	67	31
Toppenish to Goldendale	19	7	<3	23	86	31

TABLE IV (contd.)

Location	Units of 10^{-6} µc/g I^{131} No. Samples	I^{131} Max.	I^{131} Avg.	Non-Volatile Beta Emitters No. Samples	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Goldendale	10	3	<3	12	38	24
Goldendale to Wishram	6	3	<3	9	50	31
Lyle	5	5	<3	6	38	34
Bingen	5	<3	<3	6	53	32
Camas	10	<3	<3	12	35	23
Vancouver	10	<3	<3	12	34	20
Portland	10	6	<3	12	41	27
Troutdale	5	3	<3	6	33	28
Bonneville	5	3	<3	6	40	28
Hood River	5	5	<3	6	42	28
Dalles	10	4	<3	12	52	21
Moody	5	5	<3	6	64	27
Rufus	5	<3	<3	6	34	18
Blalock	5	3	<3	6	34	26
Arlington	5	<3	<3	6	32	22
Heppner Junction	5	19	<3	6	84	39
Boardman	5	<3	<3	6	39	20

Average values of less than 3×10^{-6} µc/g for I^{131} and on the order of 3×10^{-5} µc/g for non-volatile beta particle emitters were found at all remote locations except those which were located inside the trajectory followed by the ruthenium emission in January. Samples collected in the Spokane-Davenport-Sprague region in January showed values ranging from 1×10^{-4} to 1.2×10^{-3} µc/g for non-volatile beta particle emitters. Trace amounts of I^{131} detected at these same locations appeared to be related to the ruthenium incident. No other significant changes were noted in reviewing data representing remote locations.

Over 50 samples of vegetation collected from the immediate environs were analyzed specifically for the activity density of alpha particle emitters. Table V summarizes the results obtained from these measurements.

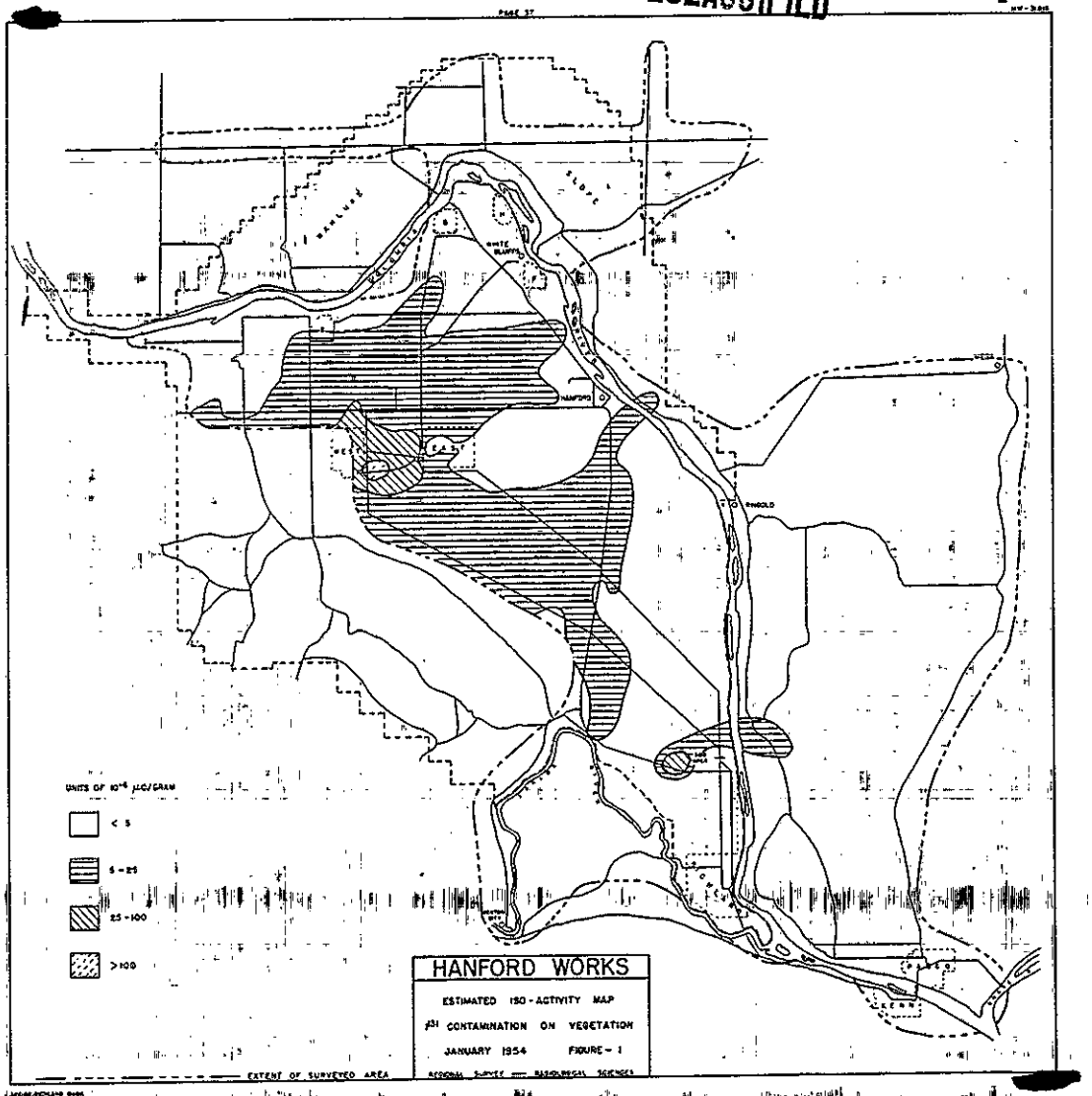
TABLE V

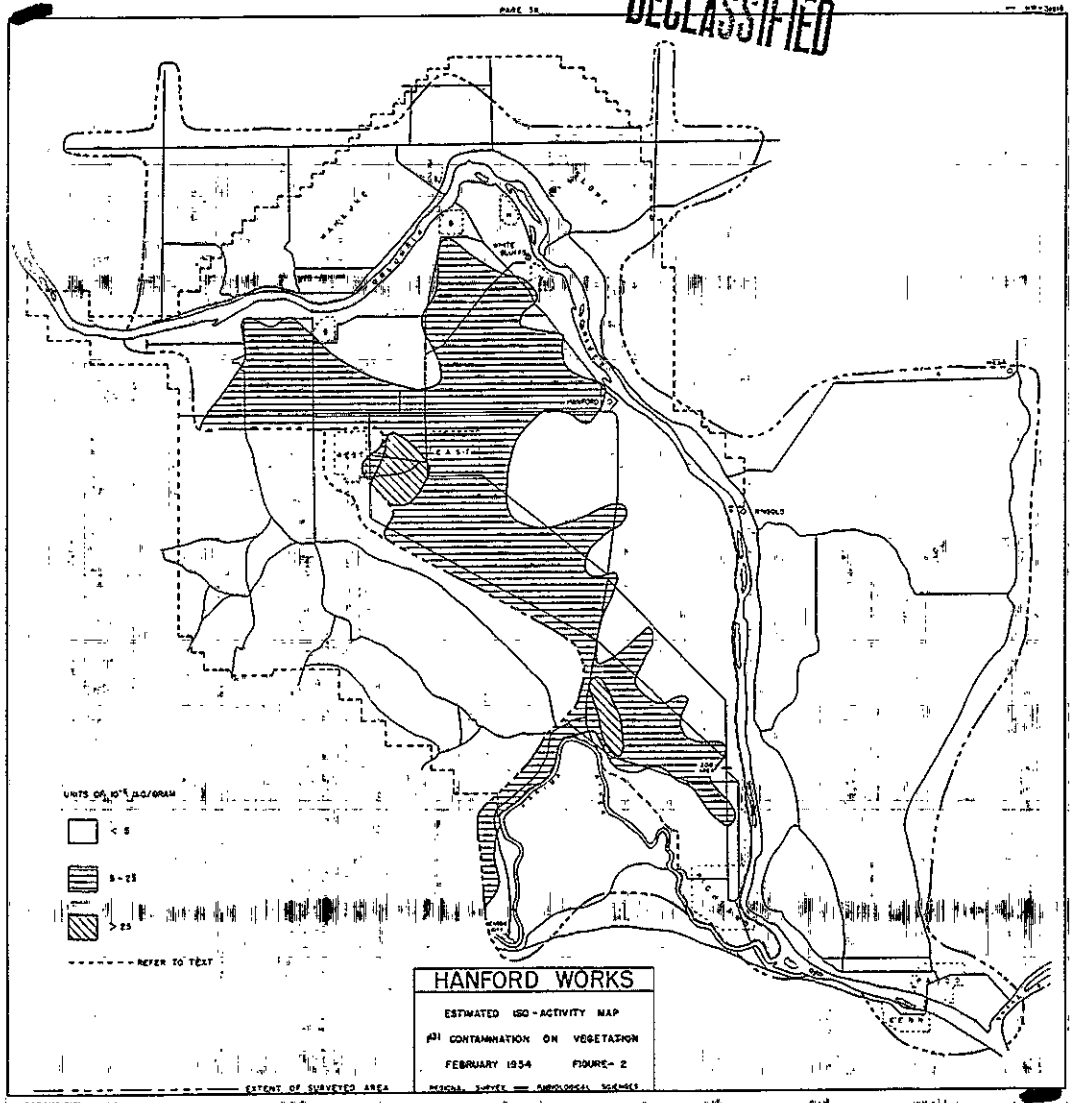
ACTIVITY DENSITY OF GROSS ALPHA PARTICLE EMITTERS ON VEGETATION JANUARY, FEBRUARY, MARCH 1954

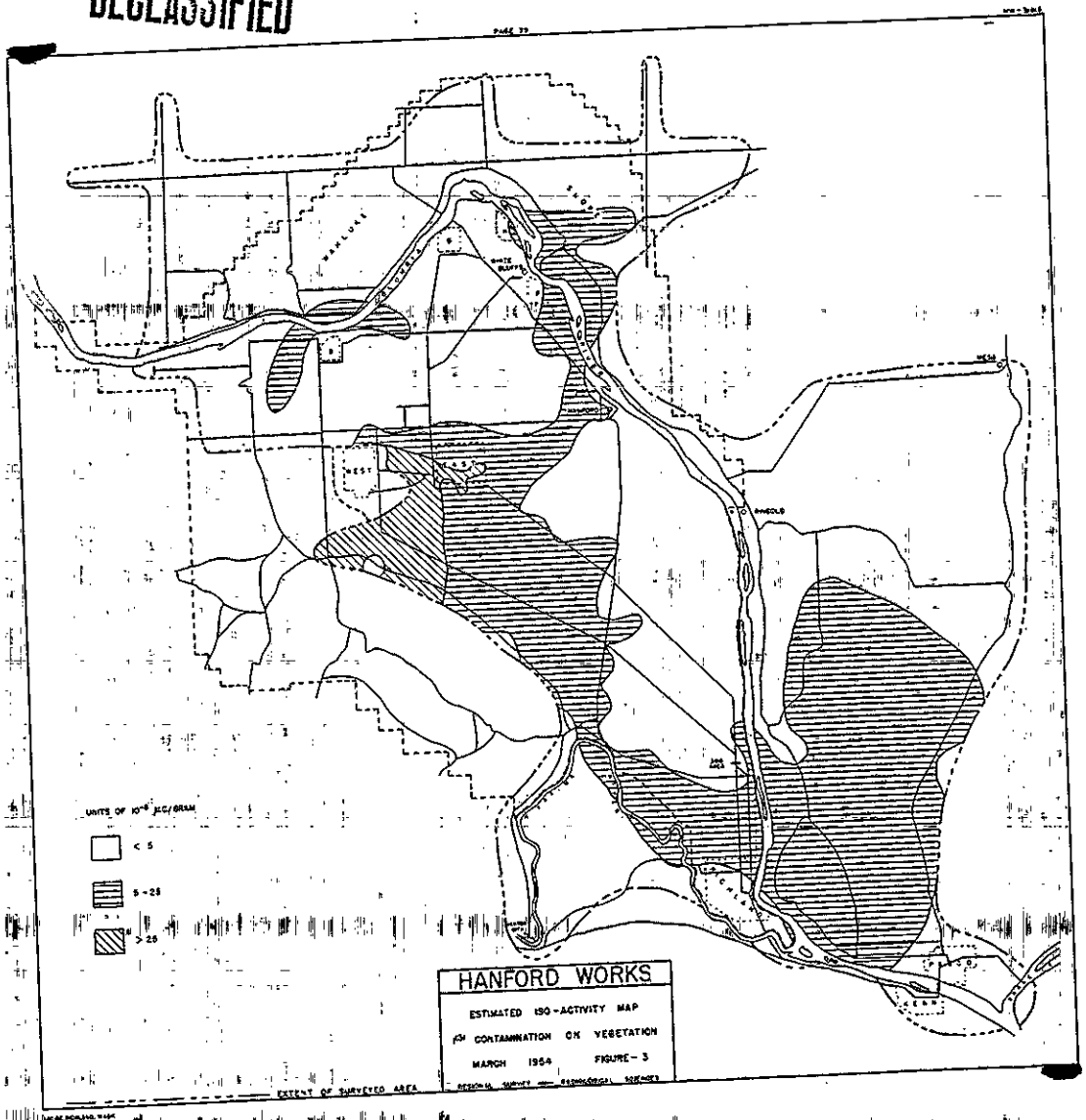
Units of 10^{-8} μc/g

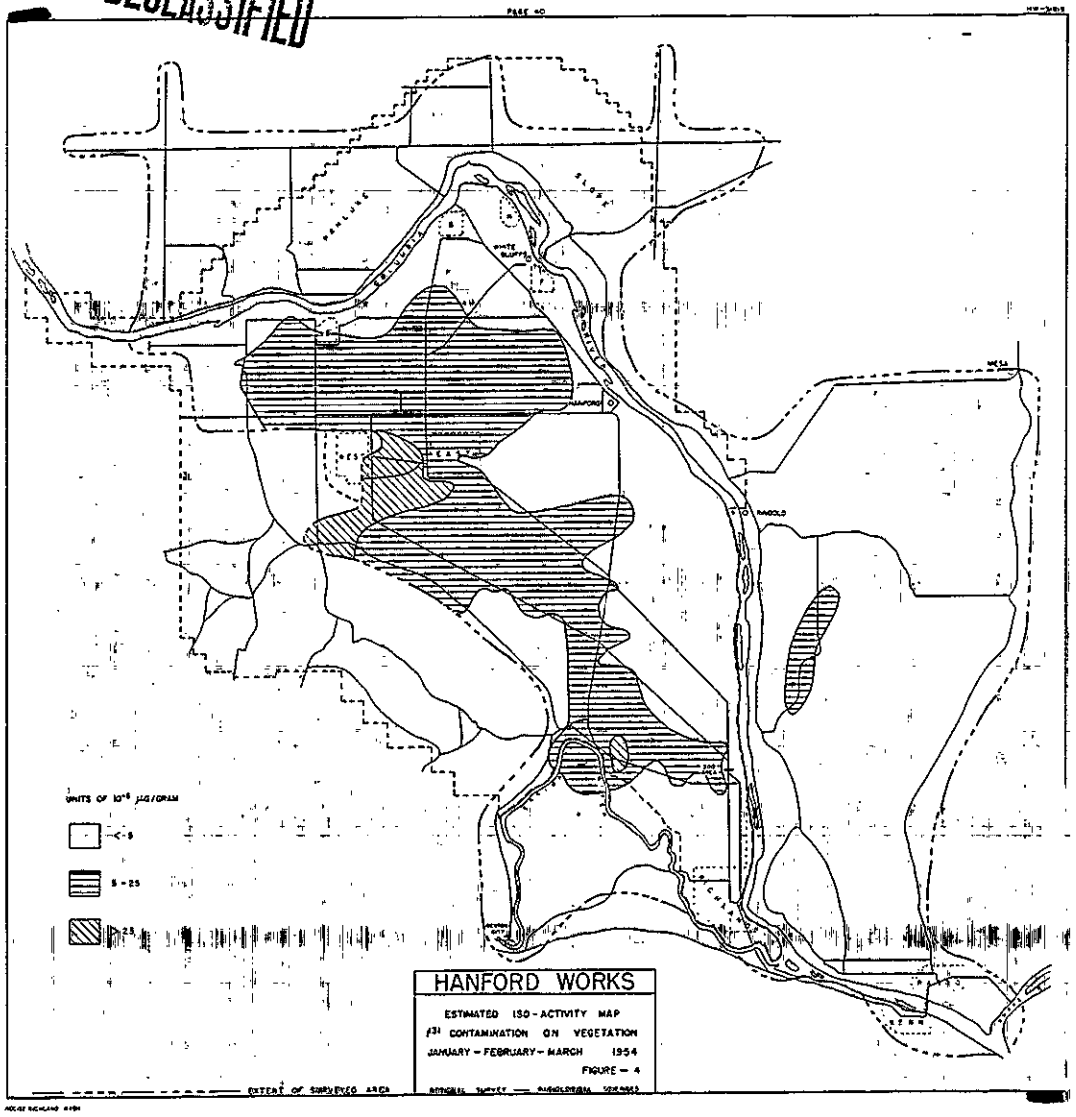
Location	January	February	March	Quarterly Average	Max. Result
Near 200 Areas					
200 West Gatehouse	780	290	300	430	1300
Batch Plant	240	100	100	150	300
Rt. 4S, Mile 4	45	58	83	65	84
Meteorology Tower	160	240	170	190	350
Rt. 4S, Mile 6	49	55	24	42	68
300 Area	75	37	30	42	75
Outlying					
Richland	4	17	38	20	45
Pasco	7	9	4	7	11
Benton City	15	6	53	25	100

Apparent increases in the average activity density noted when comparing the results summarized in Table V with the results obtained from similar measurements during the previous quarter were not statistically significant. An increase similar to the one observed during this period was noted during the same three month period in 1953 although the present average values are several orders of magnitude higher than those measured a year ago.









SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

The magnitude and extent of airborne contamination in the Hanford environs were determined from results obtained from analyzing filter and scrubber samples and from the readings obtained by various types of fixed and portable instrumentation. The following tables summarize the results obtained from each of the monitoring methods which were employed during the quarter.

Victoreen Integrons were operated continuously at the air monitoring stations located at the perimeter of the manufacturing areas and in residential communities neighboring the plant. Total dosage rates were tabulated for each 8 hour interval during the period and the averages obtained from these accumulated readings are presented in Table I.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JANUARY, FEBRUARY, MARCH

1954

Units of mrads per 24 hours

Location	No. of Units	January	February	March	Quarterly Average
100-B Area	3	0.6	0.3	0.4	0.4
100-D Area	3	0.6	0.4	0.7	0.6
100-F Area	3	1.4	<0.1	0.3	≤0.6
100-H Area	3	0.5	0.4	0.5	0.5
200 West Area	2	0.9	5.3	1.4	2.5
200 East Area	2	<0.1	0.1	0.4	≤0.2
Riverland	1	<0.1	<0.1	<0.1	<0.1
300 Area	1	0.5	0.4	0.2	0.4
Richland	1	0.2	0.1	<0.1	≤0.1
Pasco	1	0.3	<0.1	0.1	≤0.2
Benton City	1	0.2	0.1	<0.1	≤0.1
North Richland North	1	0.1	<0.1	<0.1	≤0.1
Hanford	1	<0.1	<0.1	<0.1	≤0.1
Kennewick	1	0.4	<0.1	0.1	≤0.2
Redox	1	0.5	1.8	3.2	1.8
200 East Semi-Works	1	<0.1	<0.1	<0.1	<0.1

Two and four-fold increases in dosage rates observed at the 200-W area stations and at the Redox station represented the only significant change in mean dosage rate during this period. Increases were expected at these stations as they are located inside and adjacent to the region in which exceptionally high ruthenium deposition prevailed during this period.

Detachable C-type ionization chambers were used for measuring the dosage rates which were located around the perimeter of the manufacturing areas. Duplicate instruments were employed at each location and the dosage rates tabulated in Table II represent the readings obtained from the ionization chamber which showed the minimum discharge.

TABLE II

DOSAGE RATES MEASURED WITH
"C" TYPE DETACHABLE IONIZATION CHAMBERS
JANUARY, FEBRUARY, MARCH
1954

Units of mrads per 24 hours

Location	January	February	March	Quarterly Average
100-B Area	0.8	0.8	0.8	0.8
100-D Area	0.6	0.6	0.5	0.6
100-F Area	0.4	0.4	0.4	0.4
100-H Area	0.7	0.8	0.6	0.7
200 West Area	0.4	0.4	0.5	0.4
200 East Area	0.5	0.5	0.5	0.5
200 East Semi-Works	0.6	0.5	0.5	0.5

A comparison of the above data with previous measurements showed no significant change when comparing average values for the individual manufacturing areas and when comparing the average dosage rate for the entire group of areas. Examination of the data on a month to month basis was not indicative of any trend within the period.

Detachable M and S type ionization chambers were used to measure the dosage rates at intermediate locations around the project and were also used as a supplementary type of measurement at monitoring stations where confirming data appeared desirable. Readings were obtained from these instruments at frequencies varying from 1 to 3 times a week and, similar to the method previously described, the dosage rates were tabulated from the ionization chamber which showed minimum discharge at a given location. Table III summarizes the results obtained from these measurements.

TABLE III

RADIATION LEVELS OBSERVED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
JANUARY, FEBRUARY, MARCH
1954

Units of mrads per 24 hours

Location	January	February	March	Quarterly Average	Group Average
100 Areas and Environs					
Route 1, Mile 8	0.86	0.76	0.77	0.80	
Route 2N, Mile 10	0.65	0.85	0.57	0.69	
Route 2N, Mile 5	0.72	1.08	0.86	0.87	
At White Bluffs	0.62	0.52	0.47	0.54	
Route 11A, Mile 1	0.78	1.02	1.22	1.01	
Hanford 614 Bldg.	0.49	0.51	0.48	0.49	
Intersection Rt. 1 and Rt. 4N	0.65	0.52	0.58	0.58	
At Hanford 101 Bldg.	0.50	0.52	0.41	0.48	
P-11 Area	0.61	0.68	0.52	0.60	0.67

TABLE III (contd.)

Location	January	February	March	Quarterly Average	Group Average
Within 5 miles of 200 East Area					
Route 4S, Mile 6	0.98	2.25	1.24	1.49	
Batch Plant	0.82	0.72	9.86	3.80	
Route 11A, Mile 6	1.94	2.12	1.15	1.74	
Route 3, Mile 1	0.93	1.35	0.85	1.04	
Route 4S, Mile2.5	1.12	4.03	0.75	1.97	
Redox Area	0.88	2.00	1.97	1.62	
Route 4S, Mile 4.5	1.65	1.42	1.56	1.54	
Military Camp PSN 300	0.69	1.66	2.38	1.58	
PSN 310	2.66	2.42	1.42	2.17	
PSN 320	2.14	5.83	1.23	3.07	
PSN 330	0.76	1.23	1.27	1.09	
Redox Perimater	7.95	18.59	31.57	19.37	3.37
Within 10 Miles of 200 East					
Route 4S, Mile 10	0.70	1.38	0.42	0.83	
Route 10, Mile 1	0.69	0.82	0.47	0.66	
Route 10, Mile 3	0.59	0.40	0.87	0.62	
Route 2S, Mile 4	0.79	1.94	1.00	1.24	0.84
300 Area and Environs					
Route 4S, Mile 16	0.68	1.39	0.42	0.83	
Route 4S, Mile 22	2.30	0.45	0.78	1.18	
North Richland North	0.84	0.59	0.68	0.70	
300 Area	0.69	0.67	1.33	0.90	0.90
Outlying					
Richland	0.68	0.49	0.73	0.63	
Benton City	0.75	0.45	0.44	0.55	
Pasco	0.40	0.33	0.35	0.36	
Kennewick	0.38	0.60	0.34	0.44	0.50

The average dosage rates at grouped locations in the environs of the reactor areas, within a radius of 10 miles from the separation areas, in the immediate environs of the 300 area and in the outlying residential areas were not significantly different from those observed during the previous quarter. A significant increase was found at monitoring stations located within a radius of 5 miles of the separation areas. This increase was greatly weighted by measurements obtained at a location near the Redox perimeter fence where the mean dosage rate increased from an average of 3.6 mrads/day during the previous quarter to an average of 19 mrads/day during this period. Dosage rates increased by a factor of 7 at the Batch Plant and by factors on the order of 2 at the remaining stations within the 5 mile radius. As previously indicated for other types of monitoring, the increase in dosage rate was caused by the emission of over 300 curies of ruthenium from the Redox facility during the early part of the quarter. A large number of these stations were located inside the area in which ruthenium deposition occurred.

Air filter samples through which a flow of 2 to 2.5 cfm was passed for daily or weekly periods were measured to determine the activity density of beta particle emitters in the atmosphere. These samples were analyzed several days after the removal from the sample location to allow decay of the daughter products from natural emitters. Table IV summarizes the results obtained from these measurements during the period.

TABLE IV

AIRBORNE BETA PARTICLE EMITTERS MEASURED ON AIR FILTERS

JANUARY, FEBRUARY, MARCH

1954

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

Location	January	February	March	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-D Area	37	43	36	39	50
100-H Area	84	24	88	62	200
Hanford 614 Bldg.	7	17	12	12	35
White Bluffs	26	41	52	39	97
200 Areas and Vicinity					
200 East Semi-Works	42	45	55	47	100
200 West, Tower #4	97	190	110	130	280
200 West, Redox Area	240	130	330	230	510
Gable Mountain	35	63	60	54	99
PSN 320	98	120	--	110	270
Redox Experimental Unit	49	92	180	130	310
300 Area 614 Bldg.	17	26	43	28	79
Outlying Areas					
North Richland	15	25	28	23	55
Pasco	17	46	15	25	150
Benton City	22	28	40	29	120
Riverland	26	38	15	27	68

Decreases noted in the activity density of beta particle emitters collected on air filter samples at nearly all stations during this period largely resulted from the higher measurements that prevailed during the early part of the previous quarter when residual particulate contamination from outside sources prevailed in the environs. Examination of the data on a month to month basis shows that some of the concentrations measured during the latter part of the quarter were higher than those found during the first two months and also higher than those found during the last two months of the previous quarter. The increase appears to be caused by the high amount of ruthenium deposited near the 200-West area as the stations located at the Redox area show the largest increase during the month of March. Smaller increases observed at stations in the reactor areas may have been caused by the movement of the contamination by winds. In general, most of the maximum measurements tabulated in Table IV were found during the month of March.

Radiochemical analysis of filters which were removed from dual-monitors provided a number of supplementary evaluations for the activity density of beta particle emitters in the atmosphere. Table V summarizes the results obtained from these measurements.

TABLE V

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

DUAL UNIT AIR MONITORS

JANUARY, FEBRUARY, MARCH

1954

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

Location	January	February	March	Quarterly Average	Weekly Maximum
200 W. E. C. #1	180	170	54	130	330
200 W. E. C. #2	130	220	120	160	370
200 E. S. E. #1	68	81	55	69	160
200 E. S. E. #2	73	55	33	54	200
Richland #1	8	32	28	24	110
Richland #2	17	25	10	16	59

The average values shown in Table V reflected the same decrease noted when reviewing the measurements summarized in Table IV. No significant trend appears when reviewing the data on a month to month basis; some stations showed a progressive upward trend while other stations showed a decreasing trend.

The number of radioactive particles in the atmosphere was measured by radioautographing air filters through which sample rates ranging from 2.5 to 10 cfm were passed for periods ranging from daily to weekly. Monitoring stations were maintained throughout the immediate environs to measure particles emitted from HAPO sources and several stations at remote locations in Washington, Oregon, Idaho, and Montana were used for evaluating particles which may originate from sources other than Hanford. All filters were radioautographed for 168 hours using type K x-ray film. Visual counting of the darkened spots on the developed film allowed a sensitivity on the order of 5 d/m/ptle based on Ru, S^{35}, and C^{14} standards. Tables VI and VII summarizes the results obtained from these measurements for locations near the separation areas and at remote monitoring stations in the Pacific northwest, respectively.

TABLE VI

SUMMARY OF PARTICLE DEPOSITION

JANUARY, FEBRUARY, MARCH

1954

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

Location	Total Volume of air Sampled Cubic Meters	January	February	March	Present Quarter Averages	Previous Quarter Averages
200-E and Vicinity						
2704 Outside	9184	66	52	74	63	180
BY-SE	9159	84	52	47	61	160
BY-NE	8211	160	55	61	82	150
"B" Gate	9129	68	59	58	60	90
2704 Inside	9184	56	70	62	63	150
200-W and Vicinity						
2701 Outside	9261	110	109	69	97	190
2722	8912	150	73	160	120	160
"T" Gate	9184	96	98	140	110	140
222-T Outside	9180	180	87	160	140	160
231	9184	150	69	120	110	180
Redox	9002	300	200	360	280	580
W Guard Tower	8755	100	71	67	78	220
2701 Inside	8500	63	90	58	73	150
272	9014	110	56	110	89	98
222-T Hall	9184	130	54	120	100	75
222-T Lab.	8041	91	51	85	72	59
222-U Lab.	9176	100	75	170	110	69
"U" Plant Gate	8878	140	140	160	150	190
Meteorology Tower						
3'	36703	25	16	17	19	39
50'	36703	18	20	15	18	60
100'	29146	19	29	18	23	70
150'	25476	30	28	14	23	70
200'	23533	48	26	21	31	81
250'	23533	44	64	18	44	78
300'	21806	45	72	21	48	85
350'	21806	49	39	15	35	80
400'	14681	74	46	35	51	97

TABLE VII

SUMMARY OF PARTICLE DEPOSITION

JANUARY, FEBRUARY, MARCH

1954

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

Location	Total Volume of air Sampled Cubic Meters	January	February	March	Present Quarter Averages	Previous Quarter Averages
Area Locations						
100-B Area	9142	260	120	25	140	130
100-D Area	37043	39	8.0	4.0	17	140
White Bluffs	37043	19	23	14	19	160
100-F Area	37434	26	23	10	20	120
300 Area	37723	20	20	6.0	16	150
Off Area Locations						
Benton City, Wn.	37094	36	21	13	24	68
Pasco, Wn.	35887	8.0	6.0	5.0	6.6	110
Richland, Wn.	36329	21	28	10	21	140
Boise, Idaho	9240	0.3	0.3	4.5	1.6	200
Klamath Falls, Ore.	9189	6.1	0.6	3.5	3.2	160
Great Falls, Mont.	3927		<0.6	0.9	0.5	260
Walla Walla, Wn.	9146	11	5.5	1.8	6.1	250
Meacham, Ore.	7829	0.9	<0.3	0.4	0.4	110
Lewiston, Idaho	8849	3.5	0.6	0.8	1.6	280
Spokane, Wn.	37077	14	1	0.8	5	190
Kennewick, Wn.	8687	21	29	5.0	19	210
Yakima, Wn.	37519	3.0	0.4	0.7	1.2	220

Although decreases were noted at nearly all stations when comparing average measurements obtained during this quarter with those measured during the last quarter of 1953, a large number of stations show that concentrations during the individual months of January, February, and March were higher than those measured during November and December of 1953. Particulate contamination from sources other than Hanford tended to weight the averages obtained during the previous quarter on the high side while emission of significant quantities of ruthenium from the separation processes tended to influence the higher than normal measurements observed during this quarter.

Particle concentrations at remote locations throughout the Pacific Northwest were comparable in magnitude to those observed during November and December indicating the near absence of contamination from sources other than Hanford and also indicating that particles of Hanford origin were largely confined to the immediate environs. Data from remote locations indicated that values were gradually approaching those expected for normal Hanford operation.

The activity density of I^{131} was measured by analyzing caustic scrubber solutions through which air flows ranging from 2 to 2.5 cfm were passed for periods ranging from 1 to 7 days. The results obtained from the radiochemical analysis of these samples are presented in Table VIII.

TABLE VIII

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

JANUARY, FEBRUARY, MARCH

1954

Units of 10^{-12} µc/cc

Location	January	February	March	Quarterly Average	Weekly Maximum
200 Area and Vicinity					
200 East - Southeast	0.7	<0.1	0.2	0.3	0.4
200 East Tower #16	0.3	0.3	0.4	0.3	2.5
Gable Mountain	<0.1	<0.1	0.1	<0.1	0.2
200 West Gatehouse	1.0	0.7	1.0	0.9	2.7
200 West Tower #4	0.4	0.1	<0.1	0.2	0.7
200 East Semi-Works	0.1	0.1	0.1	0.1	0.2
Redox Area	0.6	0.4	1.1	0.7	2.6
Outlying Areas					
100-H Area	<0.1	<0.1	0.6	0.2	1.4
300 Area	<0.1	<0.1	0.3	0.1	0.5
North Richland	<0.1	<0.1	0.2	0.1	0.5
Richland	<0.1	<0.1	0.6	0.1	0.6
Pasco	<0.1	<0.1	<0.1	<0.1	0.1
Benton City	<0.1	<0.1	<0.1	<0.1	0.1

Increases in the average activity density of I^{131} noted when comparing these data to previous measurements were largely weighted by the results obtained from measurements taken during the month of March. The detection of significant activity of I^{131} at 10 out of the 13 monitoring stations during March was the result of increased emission of I^{131} from the separation processes during this period. A large number of the maximum values tabulated in Table VIII were obtained following emission of 11 curies of I^{131}/day over the period March 13 to 15. Positive measurements at outlying stations appear to be significant as nearly all these locations showed values less than 1×10^{-13} $\mu c/cc$ during the previous quarter and during the same three month period in 1953.

All filters which were used for determining the activity density of beta particle emitters were also used to determine the activity density of alpha particle emitters in the atmosphere. Table IX summarizes the results obtained from these analyses.

TABLE IX

CONCENTRATION OF AIRBORNE ALPHA PARTICLE EMITTERS

JANUARY, FEBRUARY, MARCH

1954

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

Location	No. Samples	Weekly Maximum	Quarterly Average
200 West Tower #4	11	44	15
200 East Semi-Works	13	14	<4
Gable Mountain	13	22	6
Pasco	12	94	18
300 Area	13	54	13
100-D Area	12	30	8
Benton City	14	4	<4
Hanford 614 Bldg.	13	5	<4
White Bluffs	12	21	7
North Richland	13	15	4
200 West Redox Area	13	23	6
100-H Area	13	21	8
Riverland	13	14	<4
PSN 320	7	13	6
Redox Experimental Unit	19	14	4
Dual Unit Monitors			
200 WEC #1	10	29	11
200 WEC #2	13	20	12
200 ESE #1	13	35	6
200 ESE #2	13	14	4
Richland #1	13	28	7
Richland #2	13	17	6

The general order of magnitude of the values summarized in Table IX was comparable to those previously observed at all locations except the 200-West area and the 100-H area. The higher concentrations which were noted at these two locations during the past 6 months decreased to values which were on the order of magnitude expected for normal Hanford operation.

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

Nearly 1,000 samples were analyzed to determine the activity density of alpha and beta particle emitters discharged in waste material from the manufacturing processes. These analyses were supplemented with portable instrument surveys to determine the deposition of contaminants discharged from waste sources. Liquid and solid samples were collected at daily to weekly frequencies from effluent basins, and ground surveys were performed weekly at the perimeter of the open waste areas on the plant. Special ground contamination surveys were performed after all unusual incidents of known contamination deposition. Summaries of the results of these measurements are presented for each of the manufacturing areas.

100 AREA WASTES

Radioactive contamination discharged to the Columbia River from the reactor areas was determined by analyzing daily samples collected from the outlet of each of the retention basins in the reactor areas. These samples were analyzed on the same day that they were collected, and in the case of beta particle emitters, the results were corrected for decay. Table I summarizes the results obtained from the analyses for beta particle emitters; Table IA shows the calculated amounts of beta particle emitters discharged to the river based on the values in Table I and the flow rate at the reactors.

TABLE I

RADIOACTIVE CONTAMINATION IN REACTOR EFFLUENT WATER DURING PERIODS OF NORMAL OPERATION JANUARY, FEBRUARY, MARCH 1954

Activity Density from Gross Beta Particle Emitters

Units of 10^{-3} μc/cc

Location	No. Samples	January Max.	January Avg.	February Max.	February Avg.	March Max.	March Avg.	Quarterly Max.	Quarterly Avg.
100-B Area	62	6.5	5.0	6.7	5.9	7.2	6.3	7.2	5.7
100-C Area	80	7.4	3.9	5.2	3.9	5.2	4.3	7.4	4.1
100-D Area	90	5.6	4.7	6.6	5.0	8.2	5.5	8.2	5.1
100-DR Area	90	7.4	5.4	7.8	6.7	72	7.7	72	6.5
100-H Area	86	3.9	3.0	4.1	3.1	6.2	4.3	6.2	3.5
100-F Area	88	7.2	4.8	8.0	5.8	7.5	5.2	8.0	5.3

TABLE IA

BETA PARTICLE EMITTERS DISCHARGED TO RIVER IN REACTOR EFFLUENT JANUARY, FEBRUARY, MARCH 1954

Units of curie/second

Location	No. Samples	January Max.	January Avg.	February Max.	February Avg.	March Max.	March Avg.	Quarterly Max.	Quarterly Avg.
100-B Area	62	0.016	0.012	0.017	0.015	0.021	0.018	0.021	0.015
100-C Area	80	0.038	0.020	0.027	0.020	0.027	0.022	0.038	0.021
100-D Area	90	0.017	0.014	0.020	0.015	0.025	0.017	0.025	0.015
100-DR Area	90	0.020	0.015	0.021	0.018	0.190	0.021	0.190	0.017
100-H Area	86	0.013	0.010	0.014	0.010	0.021	0.014	0.021	0.012
100-F Area	88	0.018	0.012	0.023	0.016	0.021	0.015	0.023	0.014

A comparison of the average activity density in reactor effluent with the results of similar measurements obtained during the last quarter of 1953 shows that concentrations increased significantly at the 100-DR and 100-F areas. Significant decreases occurred at the 100-D, 100-F, and 100-H areas while the average values at the 100-B and 100-C area showed no significant change. Increases at the 100-DR and 100-F area appeared to be related to general increases in the operating levels of the reactors at these areas. The trends noted at the 100-D and 100-H areas were largely the result of a change to the simultaneous use of two retention basins in these areas.

Maximum measurements at each individual area were on the order of magnitude expected at all reactors except 100-DR where a value of 7.2×10^{-2} μc/cc resulted from a double rupture in the reactor. As this value was approximately 10 times greater than normally expected, the measurement was deleted from the computation for the average.

The average activity density of alpha particle emitters in reactor effluent was less than 5×10^{-9} μc/cc at all areas. Individual samples showed trace alpha particle emission at times during the quarter with values generally in the range of 1×10^{-8} to 2×10^{-8} μc/cc. One sample collected from the 100-H area showed a value of 8.2×10^{-8} μc/cc.

Ten of 115 samples of reactor effluent water which were analyzed specifically for uranium showed values above 2×10^{-9} μc/cc. Nine of the positive measurements were in the range of 2×10^{-9} to 4.2×10^{-9} μc/cc and one sample collected from the 100-B area on January 18 showed a value of 7.4×10^{-9} μc/cc. At least one sample from each reactor showed detectable uranium at some time during the quarter.

Seven out of 39 samples which were analyzed for plutonium showed values above 3×10^{-9} μc/cc. The significant activity densities ranged from 3.6×10^{-9} to 5.2×10^{-9} μc/cc. Samples showing concentrations in excess

of 5 x 10^{-9} μc/cc were collected from the 107-C and 107-F basin on December 29.

Trace quantities of polonium were found in 14 out of 40 samples analyzed. Significant concentrations fould in samples from all areas ranged from 6 x 10^{-10} to 3 x 10^{-9} μc/cc. Although maximum measurements were considerably lower than those found during the previous quarter, the bulk of the values were comparable to values previously observed.

I^{131} discharged to the Columbia River from the Animal Farm in the 100-F area, decreased from an average of 60 μc/day during the last quarter to an average of 40 μc/day during the present three month period. Average discharges during January, February, and March were 40, 40, and 30 μc/day, respectively.

A ground contamination survey was performed at the 100-B area on March 26 after spot surveys indicated significant contamination of roadways near the gatehouse. The results obtained from surveying an area of 1 square meter at intervals of 250 feet inside the area showed an elongated contamination pattern approximately 1000' wide extending from the 107-C retention pond to the perimeter fence near the gatehouse. Instrument readings at ground level in this region ranged from several hundred c/m on a portable GM type meter to dosage rates approaching 50 mrads/hr. The region in which the dosage rate exceeded 10 mrads/hr was confined within the perimeter fence of the 100-B area. Figure 5 is a map of the 100-B area and shows the ground contamination pattern established after the survey was completed. Isotopic analysis of samples collected from the area of significant deposition showed that over 50 per cent of the beta particle emission was from rare earths. Approximately 5 per cent of the active material was ruthenium of which the ratio of Ru^{103} to Ru^{106} ranged from 7:1 to 4:1. Trace amounts of strontium, uranium, and plutonium were also detected.

On February 25, portable instrument surveys were performed at the 100-B area around the perimeter of an area which was covered by reactor water from a break in the 107-B effluent basin. Instrument readings ranged from several hundred c/m to 13 mrads/hr using GM or CP meters. Visual inspection indicated the water was percolating into the soil prior to reaching the shore of the river. Liquid samples collected directly from the pond showed activity densities less than 5×10^{-9} μc/cc and 4×10^{-4} μc/cc for alpha and beta particle emitters, respectively. Mud samples showed activity densities of beta particle emitters to range from 10^{-2} to 10^{-4} μc/g.

Periodic portable instrument surveys of the reactor burning grounds gave evidence of the discard of contaminated material on several occasions. Significant findings included portable GM readings of 7,000 c/m at the 100-B area, 70,000 c/m at the 100-D area, and 12,000 c/m at the 100-F area.

Liquid and solid samples were collecte d directly from the waste sources in the separation areas and analyzed for gross alpha and beta particle emitters. Selected samples were analyzed specifically for uranium and plutonium. Table II summarizes the results obtained from the alpha and beta particle measurements.

TABLE II

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS

JANUARY, FEBRUARY, MARCH

1954

Liquid Samples

Location	No. 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	29	6.1	0.6	1800	78
U-Swamp	22	35	3.8	25	8.9
Laundry Ditch	21	6,2	1.5	85	11
231 Ditch	22	77	9.6	45	9.2
200-E "B" Ditch	28	21	1.1	9.1	2.6
200-E "B" Swamp	12	3.2	1.1	6.4	2.1
234-35 Ditch	11	86	18	7.4	4.5
Redox Swamp	3	1.3	1.1	700	440
Redox Inlet	1	0.9	0.9	130	130
Redox Outlet	1	2.7	2.7	1200	1200
T-Ditch	11	1.0	<0.5	26	15

Solid Samples

		Units of 10^{-6} µc/g		Units of 10^{-5} µc/g	
T-Swamp	19	190	25	880	140
Laundry Ditch	10	70	25	280	79
200-E "B" Ditch	21	5.1	1.7	84	17
200-E "B" Swamp	11	5.6	2,1	84	27
234-35 Ditch	9	4200	910	84	25
Redox Swamp	3	140	53	380000	230000
T-Ditch Inlet	9	280	53	7500	1400

Increases and decreases which were noted when comparing the measurements summarized in Table II with similar data collected during 1953 were not significant due to the wide variation found between individual measurements at the 200 area waste sources. High results noted at the Redox swamp, T-swamp, and 234-35 ditch were a continuation of higher observations during the latter part of 1953.

Emission of over 300 curies of ruthenium from the 202-S stack during the first week in January (Section I) resulted in wide spread contamination at exceptionally high levels in the HAPO environs. Ground surveys performed immediately following the incidents showed two distinct areas in which significant deposition had occurred. Average emission of 230 curies of ruthenium on January 3 contaminated an area approximately 10 miles wide extending from the source of emission to beyond Spokane and Reardon, Washington. Figure 6 is a map of the environs which shows the estimated trajectory followed by the material based on ground survey findings. Figure 7 shows the deposition found in the immediate vicinity of the 200 West area. As indicated by the two patterns shown in Figure 7, a second emission of between 70 and 170 curies of ruthenium on January 5 caused a localized deposition in the 200 West area which tended to overlap some of the contamination caused by the January 3 emission. The combined emission caused average dosage rates ranging from 100 to 500 mrads/hr over the ground in the southeastern portion of the 200 West area. Isolated readings were as high as 1.3 rads/hr. Outside the 200 West area in the pattern caused by the first ruthenium emission, the dosage rates decreased to values ranging from 25 to 100 mrads/hr over an area several miles removed from the source of emission. VGM readings of 5,000 c/m were observed on the Wahluke Slope at the project boundary and along the road between Cunningham and Othello (Figure 6). Along U. S. Highway #10 between Ritzville and Moses Lake (64 miles from the point of emission) the counting rates were 600 c/m above background. The contamination

was detected between Spokane and Reardon where it was barely detectable above the background of the instrument; meter readings showed values ranging from 100 to 250 c/m.

This deposition caused control measures to be established which would allow a continuous study of the decay of the contamination. One-hundred control plots were established inside a radius of 6800 feet from the 202-S stack. Weekly surveys at these plots showed a progressive decrease in the extent and magnitude of the contamination; results obtained during latter part of the quarter showed that dosage rates did not exceed 10 mrads/hr at locations beyond a radius of 3 miles from the 202-S stack. A map showing the estimated deposition on March 26 may be referred to in Figure 8.

Surveys at remote locations in the contamination pattern performed during the last week of February also showed significant decreases in counting rates. Portable GM meter readings near Othello had decreased to values in the range of 2500 to 3000 c/m and on U. S. Highway #10 between Ritzville and Moses Lake had decreased to 300 c/m above background.

Portable instrument surveys at the perimeter of the open waste source in the separation areas showed average readings ranging from 400 c/m to 750 c/m at the T-ditch and swamp and ranging from 100 c/m to 500 c/m at the B-ditch and swamp. In an isolated instance on February 10, readings of 30,000 c/m were observed along the T-ditch approximately 500' from the inlet and 35,000 c/m at a location near the inlet to the swamp.

Table III summarizes the results obtained from analyzing samples from 300 area waste sources for the activity density of alpha and beta particle emitters.

TABLE III

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES

JANUARY, FEBRUARY, MARCH

1954

Liquid Samples

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	26	110	8.2	1500	610	260	11
New Pond Inlet	25	22	4.7	840	110	2.5	1.0
300 Area Waste-line	40	49	6.0	350	88	7.0	0.80

Solid Samples

		Units of 10^{-3} µc/g		Units of 10^{-3} µc/g		Units of 10^{-3} µc/g	
Old Pond Inlet	11	13	3.3	8.2	1.4	150	24
New Pont Inlet	11	9.5	3.3	9.7	1.7	200	25

Procedure changes initiated during the quarter may have accounted for increases noted in alpha particle emission in samples from 300 area waste sources. The sampling of water in the pond at the waste inlet to the pond was discontinued on February 24, and the samples were collected thereafter directly from the outfall entering the ponds. This change eliminated any necessity for sampling the 300 area waste line directly and the results indicated for this location in Table III represent samples which were collected prior to February 24.

Seventeen samples collected from the inlet to the old pond showed the average activity density from plutonium to be 5.3×10^{-9} µc/cc. The average activity density in the new pond inlet samples was 1.1×10^{-8} µc/cc. Maximum plutonium measurements were 1.5×10^{-8} µc/cc and 5.5×10^{-8} µc/cc at the old and new ponds, respectively.

A fire in the 300 burial ground on February 17 caused a small amount of contamination to spread along the fence on the east side of the burial ground. Instrument surveys using portable VGM and CP meters showed readings ranging from 2,000 c/m to 300 mrads/hr in an area within 20 feet of the east perimeter burial ground fence. Surveys between the burial ground and the river showed readings in the range of 100 to 300 c/m above background. No contamination was detected on the east side of the Columbia River although the members of the monitoring crews could detect the presence of smoke from the fire.

65

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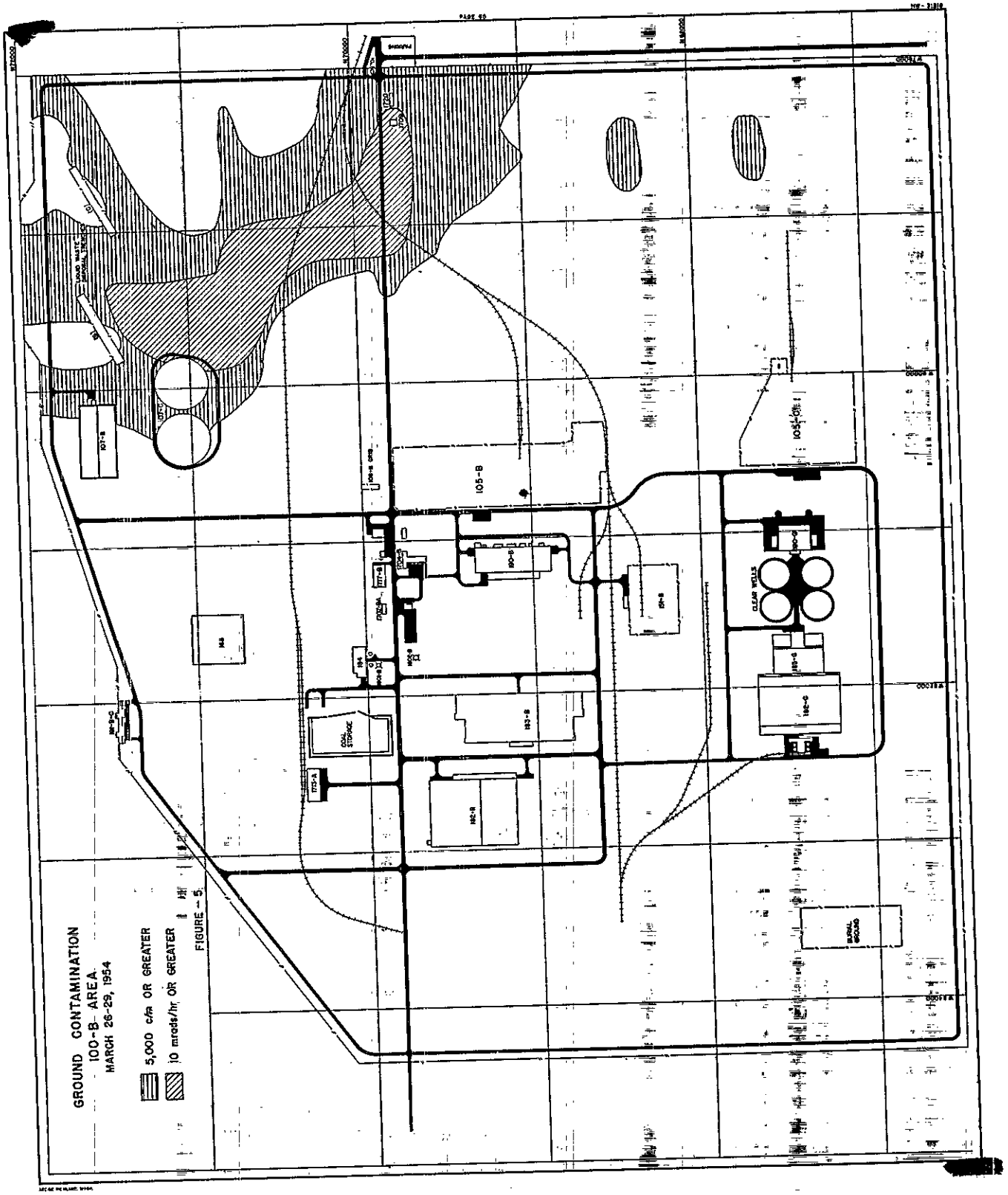

FIGURE - 5

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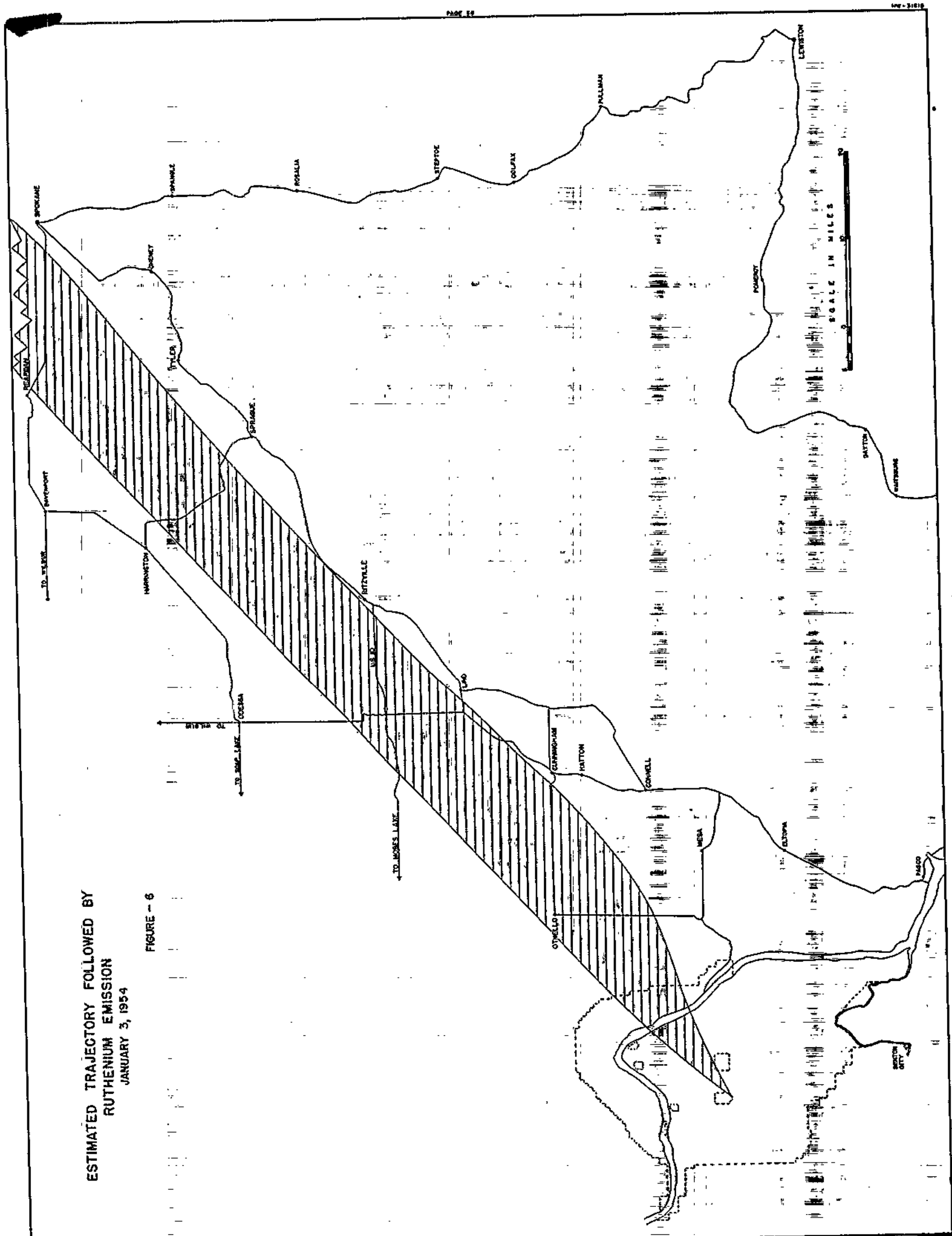

ESTIMATED TRAJECTORY FOLLOWED BY RUTHENIUM EMISSION JANUARY 3, 1954

FIGURE - 6

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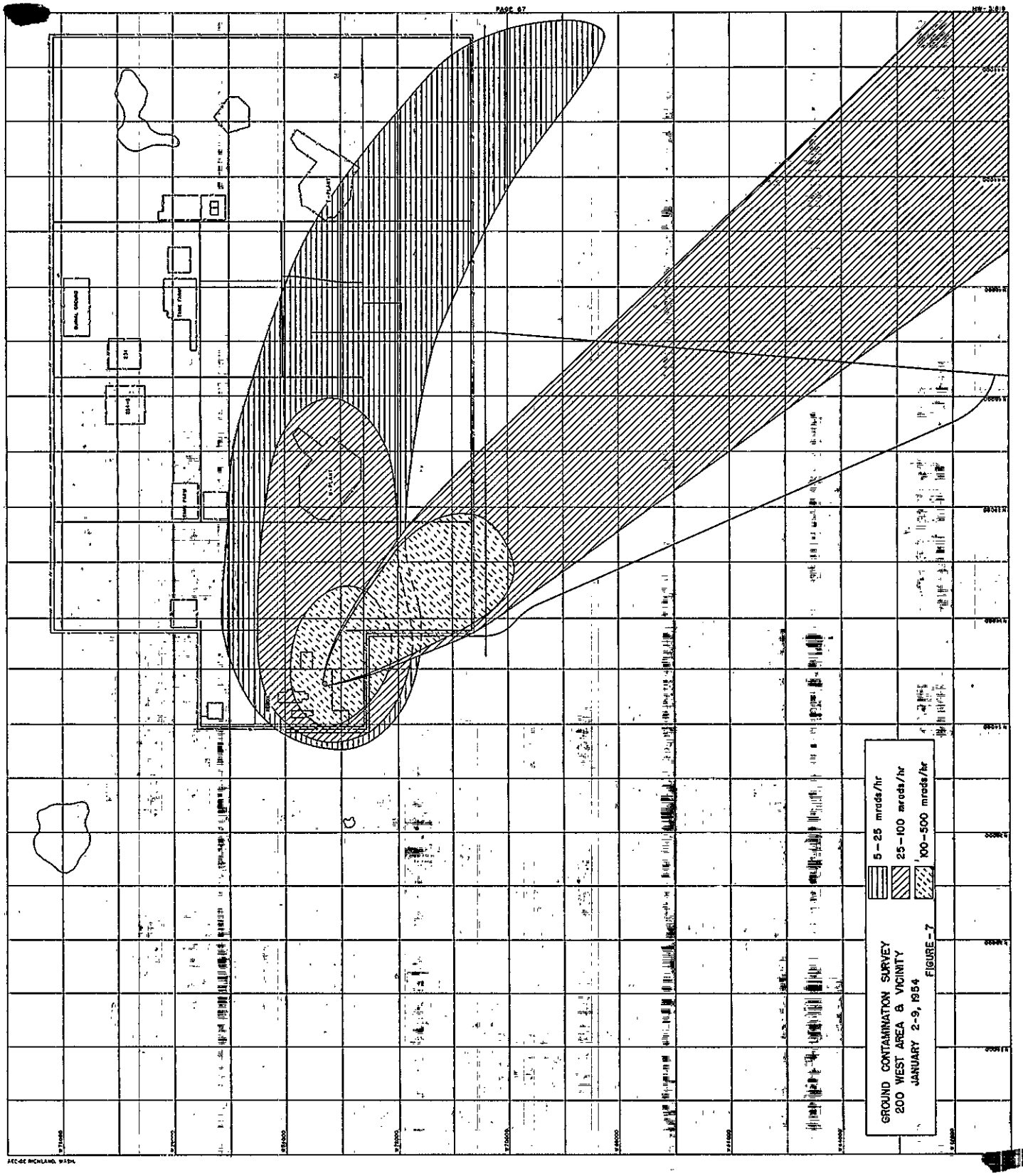

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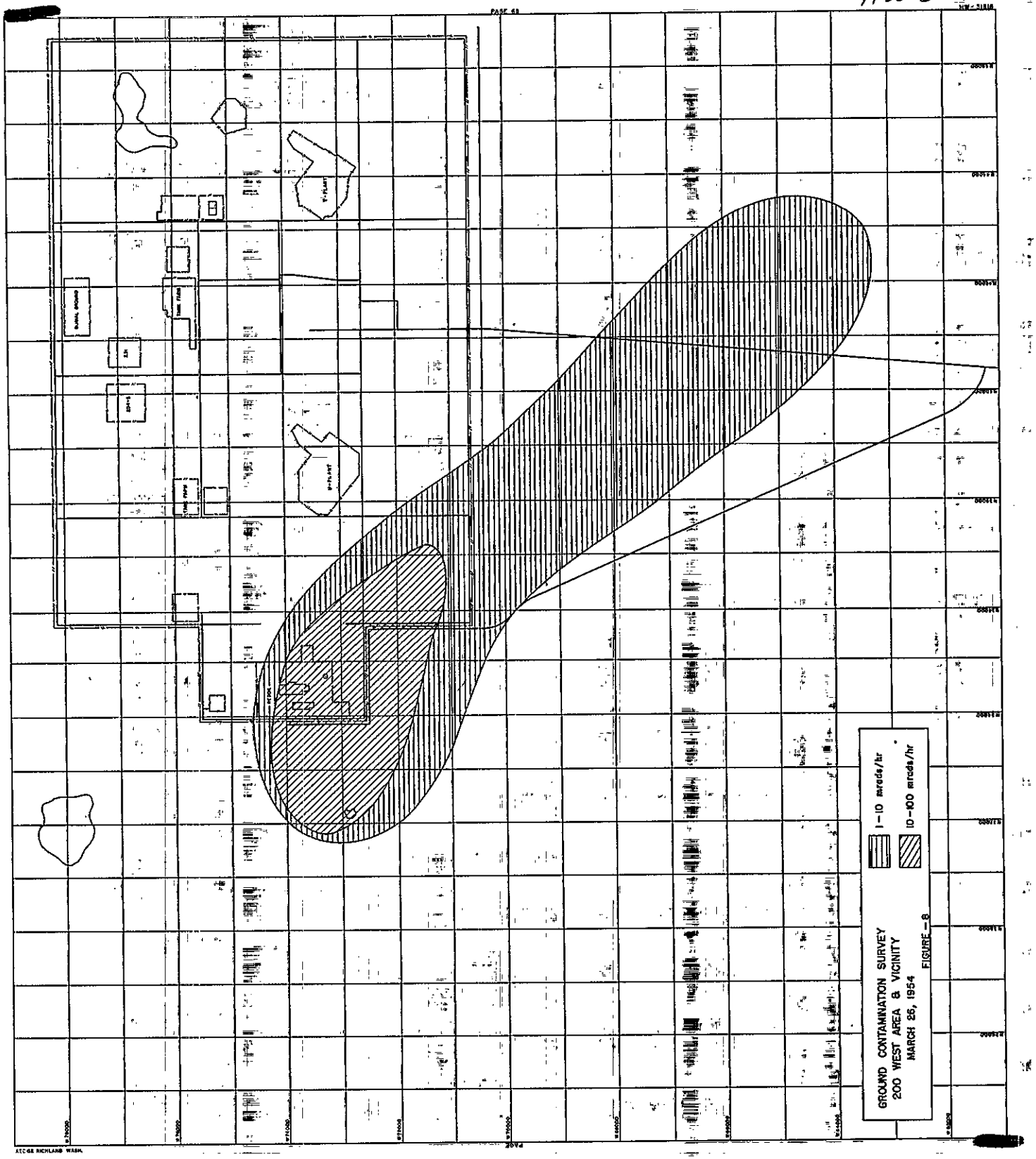


SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER AND RELATED WATERS

Radioactive contamination resulting from the discharge of reactor effluent was determined by analyzing over 800 samples of liquid and solid material collected from the Columbia River and related waters. Sampling frequencies were maintained on a weekly basis for locations in the nearby environs and on a monthly basis for remote locations. The volume of liquid samples varied from 500 ml to 1 gallon; sensitivity limits for beta particle emitter measurements in these samples were 5×10^{-8} μc/cc and 3×10^{-9} μc/cc, respectively. The larger volume samples were collected from remote locations where additional sensitivity was required. Alpha particle measurements were confined to the 500 ml samples and the sensitivity of the measurement was 5×10^{-9} μc/cc. As in the past, the results were not corrected for natural particle emitters.

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

TABLE I

AVERAGE CONTAMINATION FROM GROSS BETA PARTICLE EMITTERS IN RIVER WATER

JANUARY, FEBRUARY, MARCH

1954

Units of 10^{-8} µc/cc

Location	January Avg.	February Avg.	March Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch	<5	<5	<5	<5	6	10
181-B Area	9	6	5	7	17	15
181-C Area	5	6	9	7	38	18
Allard Station	1100	9	450	500	280	2000
181-D Area	670	700	800	730	690	1200
181-H Area	900	970	1100	1000	620	1300
Below 100-H Area	550	880	960	800	1100	1300
181-F Area	1100	1200	1300	1200	860	1700
Below 100-F Area	1300	1600	1300	1400	1300	3800
Hanford South Bank	1200	1300	1600	1400	1200	2600
Hanford Middle	960	1100	1200	1100	1200	2600
Hanford North Bank	670	700	690	440	600	2000
300 Area	420	420	540	470	530	650
Byers Landing	84	180	5	90	330	180
Richland	340	350	420	370	390	650
Kennewick Highlands Pumping Station	380	170	240	270	390	550
Pasco Bridge (Kenn. Side)	130	150	140	140	210	290
Pasco Bridge (Pasco Side)	180	200	240	210	230	510
Pasco Pumping Plant	240	200	230	230	---	320
Sacajawea Park	71	110	110	94	130	140
McNary Dam #1 and #2	19	13	34	22	26	120
McNary Pool	40	14	21	25	---	46
Patterson	16	18	21	18	19	27
Snake River at Mouth	12	23	11	14	21	40
Yakima River at Mouth	<5	<5	<5	<5	<5	8
Yakima River - Horn	8	<5	<5	<5	<5	19
Yakima River at Prosser	<5	<5	<5	<5	<5	<5
3000 Area Pond Inlet	---	---	6	6	---	7

A comparison of the average values summarized in Table I with the results of similar measurements obtained during the last quarter of 1953 shows that, except for isolated locations, the activity density remained on the same order of magnitude as previously observed. The similarity in the data was expected as the flow rate of the Columbia River during the two periods was not significantly different. The average flow rate of the river during this period was 583,000 gallons/second as compared with an average flow of 597,000 gallons/second during the previous quarter. Mean flow rates during the months of January, February, and March were 584,000; 581,000; and 585,000 gallons/second, respectively. The absence of any significant month to month trend in the contamination measurements within the quarter was clearly ascribable to the small fluctuation in flow of the Columbia River during the period. Minimum flow of 398,000 gallons/second occurred during late December and maximum flow of 675,000 gallons/second occurred on January 22. Figure 9 is a graph showing the trend of the measured flow rate during the past six months.

Studies directed toward determining the distribution of beta particle emitters across the surface of the Columbia River at the McNary Pool initiated during the previous quarter, were continued during this period. Again, the measurements indicated very little difference in the distribution of the activity with values ranging from 3.4×10^{-7} to 4.6×10^{-7} μc/cc during January, 1.1×10^{-7} to 1.7×10^{-7} μc/cc during February, and 5×10^{-8} to 3.5×10^{-7} μc/cc during March. Maximum measurements were generally confined to the middle of the river whereas the minimum measurements tend to change from the Washington to the Oregon side.

Radiochemical analysis of samples collected from 10 locations between McNary Dam and Portland, Oregon, showed detectable activity density from beta particle emitters in each sample analyzed. Values measured during January ranged from 5.9×10^{-8} to 1.3×10^{-7} μc/cc, during February from 2.6×10^{-8} to 7.7×10^{-8} μc/cc, and during March 3.3×10^{-8}

to 1.4×10^{-7} μc/cc. The maximum activity was detected at the Dalles, Oregon, in January and February and at North Bonneville, Washington, in March. The presence of the higher activity density in the Dalles-Bonneville region appears to be a departure from previous observations as the data collected during 1953 showed that the higher activity density occurred in the Arlington-Maryhill area.

A number of special samples were collected following a break in the 107-B effluent retention basin on February 25. The results of the surveys did not show the presence of any unusual amounts of active material from this incident. Ten samples collected across the surface of the river at the Hanford Ferry showed a range of values from 4.8×10^{-6} to 9.8×10^{-6} μc/cc with the lower values occurring along the north bank and the higher values at the south bank. The distribution was consistent with that previously observed at this location. River samples collected at one-hour intervals during the day at the inlet to the Pasco Filter Plant showed no significant difference in activity density over the sampling period.

The activity density of alpha particle emitters in Columbia River water averaged less than 5×10^{-9} μc/cc at all the sampling locations shown in Table I except 300 Area. Twelve samples from the latter location showed an average of 1.8×10^{-8} μc/cc including a maximum measurement of 1.6×10^{-7} μc/cc. The presence of alpha particle emission at this location confirmed an observation made during the previous quarter when this was the only location which showed detectable alpha particle emission. Eleven of these samples which were analyzed specifically for uranium showed the average activity density from this contaminant to be 1.0×10^{-8} μc/cc; the maximum measurement was 8.3×10^{-8} μc/cc. This was the only river location which showed contamination from uranium during this quarter.

The activity density of I^{131} in the Columbia River resulting from the discharge of waste materials from the Biology Farm was determined by analyzing 23 samples collected along the south bank at the Hanford Ferry. The average activity density in these samples was 3.5×10^{-7} µc/cc and the maximum measurement was 2.6×10^{-6} µc/cc. The increasing trend observed in the activity density of I^{131} in the Columbia River during the previous quarter continued during this period. Average and maximum values during the last quarter of 1953 were 2.5×10^{-7} and 2.2×10^{-6} µc/cc, respectively.

The extent and magnitude of the deposition of radioactive materials by the waters of the Columbia River was determined from the radiochemical analysis of mud samples which were collected at shore locations. Table II summarizes the results obtained from the analysis for the activity density of gross beta particle emitters.

TABLE II

RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES

JANUARY, FEBRUARY, MARCH

1954

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

Location	January Avg.	February Avg.	March Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch						
Shore	3.2	3.3	3.7	3.5	3.6	5.1
5' Out	2.2	3.9	3.1	3.1	3.1	5.8
Allar Station						
Shore	5.0	3.3	3.4	3.9	4.3	11
5' Out	3.1	6.3	4.5	4.6	3.9	11
100-H Area						
Shore	3.5	9.3	5.2	5.9	9.4	13
5' Out	3.5	6.6	4.7	4.9	11	9.3
Below 100-F						
Shore	5.4	6.0	12	8.0	12	20
5' Out	7.5	8.7	7.0	7.8	12	12

TABLE II (contd.)

Location	January Avg.	February Avg.	March Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Hanford Ferry						
Shore	12	14	7.7	11	15	13
5' Out	18	12	10	13	20	29
300 Area						
Shore	4.7	3.3	5.1	4.4	7.7	7.2
5' Out	19	12	6.1	12	7.9	43
Byers Landing Pump Plant						
Shore	3.9	3.5	6.4	4.6	17	6.4
Richland Dock						
Shore	6.6	8.5	4.8	6.5	6.4	16
5' Out	5.3	5.3	3.4	4.6	7.0	8.1
Kennewick Highlands Pump. Plant						
Shore	3.4	5.6	3.0	3.9	3.7	9.2
5' Out	3.4	3.7	2.9	3.3	4.8	5.2
P.K. Bridge (Pasco)						
Shore*					4.2	
5' Out*					4.7	
P.K. Bridge (Kennewick)						
Shore	3.2	3.4	5.4	4.2	3.4	9.4
5' Out	3.6	4.9	4.6	4.3	4.2	8.9
Sacajawea Park						
5' Out	4.1	2.6	3.6	3.6	4.6	5.8
McNary Dam						
5' Out	2.7	2.6	2.9	2.8	3.1	3.2
Patterson						
5' Out	3.4	3.0	3.6	3.4	3.7	5.9
Snake River Mouth						
5' Out	3.4	2.4	2.2	2.7	3.0	4.5
Yakima River Horn						
Shore	1.4	2.0	1.7	1.7	2.6	2.9
5' Out	3.2	2.7	2.9	2.9	3.0	5.5
Yakima River - Prosser						
5' Out	1.7	2.8	2.5	2.3	2.0	3.3
McNary Cold Spring						
5' Out	12	9.1	15	12	--	15
McNary Cold Spring Middle						
5' Out	11	30	8.1	16	--	30
McNary Cold Spring						
5' Out	15	9.8	15	13	--	15

* Discontinued

The activity density of gross beta particle emitters in mud samples was not significantly different from that observed at background locations except for those measurements which were obtained directly below the reactors. Samples collected below the 100-F Area and near the Hanford Ferry continued to show values on the order of 1×10^{-4} μc/g comparable to the measurements which were found during the previous quarter. A comparison of the results obtained from the shore samples with the results obtained from samples taken 5 feet out from the shore showed no significant difference except at the 300 Area location where the activity density 5 feet from the shore line was three times that measured at the shore.

The activity density of alpha particle emitters in mud samples collected from the locations summarized in Table II averaged less than 2×10^{-6} μc/g at all locations except at 300 Area. Ten samples which were collected from an underwater location 5 feet removed from the shore line showed an average activity density of 3.3×10^{-6} μc/g with a maximum measurement of 1.0×10^{-5} μc/g. Uranium and/or plutonium measured in selected mud samples was negligible in all cases.

Nearly 100 samples were collected from the raw water river export line at the 183 and 283 buildings in the reactor and separation areas. These samples represent river water prior to chlorination and filtration for drinking purposes in the manufacturing areas. The results obtained from the analysis of these samples for the activity density of beta particle emitters are summarized in Table III.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER

RIVER EXPORT LINE

JANUARY, FEBRUARY, MARCH

1954

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

Location	January Avg.	February Avg.	March Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
183 Bldg. - 100-B Area	65	<5	12	22	<5	130
183 Bldg. - 100-C Area	<5	<5	<5	<5	<5	9
183 Bldg. - 100-D Area	150	160	90	130	100	270
183 Bldg. - 100-F Area	190	210	170	190	140	280
183 Bldg. - 100-H Area	140	200	180	170	110	250
283 Bldg. - 200 East Area	61	59	140	82	52	290
283 Bldg. - 200 West Area	90	140	110	110	73	210
183 Bldg. - 100-DR Area	150	170	81	130	98	240

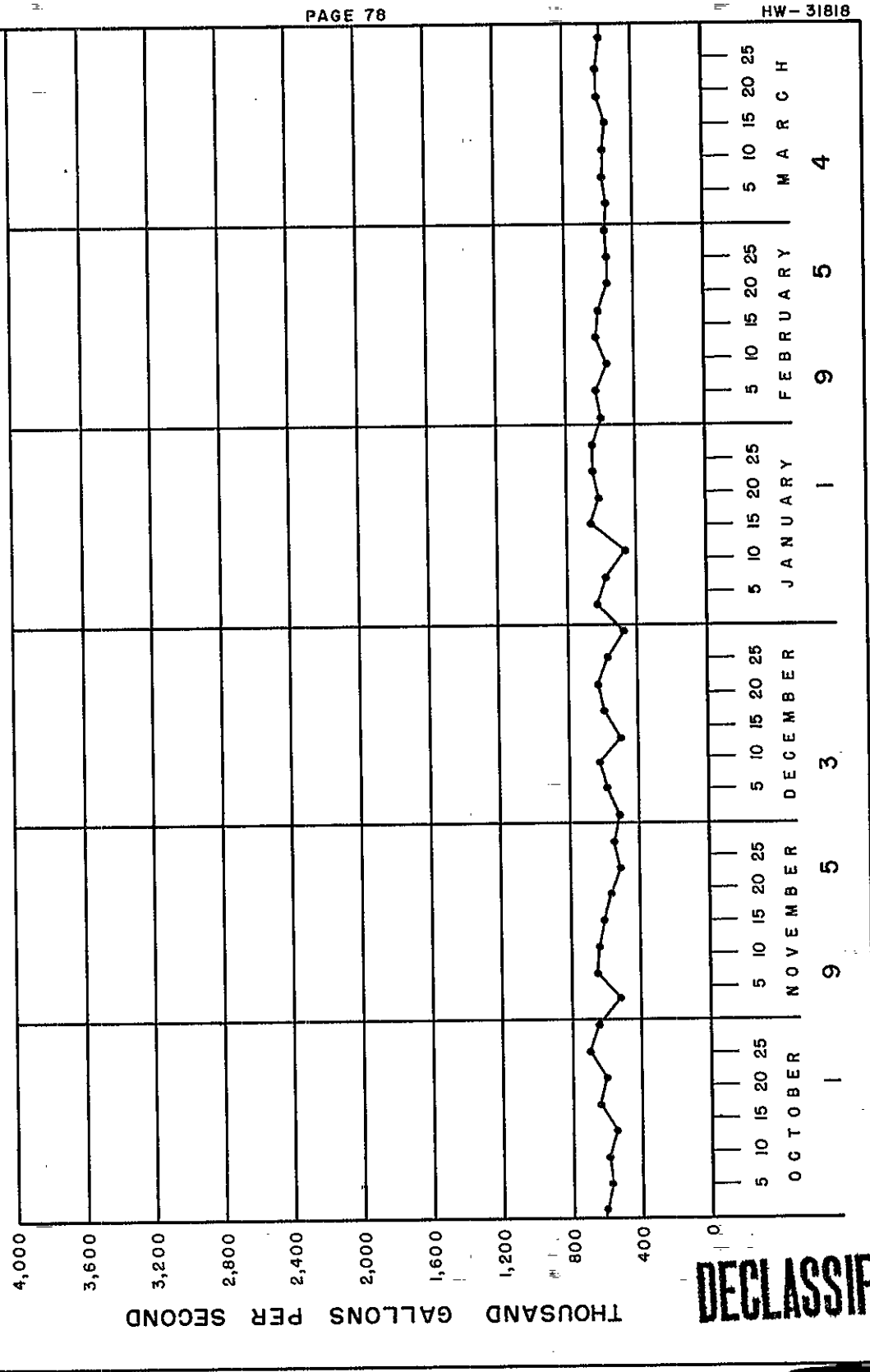
Small increases observed in the average activity density when comparing these data to measurements obtained during the previous quarter were largely weighted by several high measurements obtained during the month of February. Although some increases were noted in the activity density of beta particle emitters in reactor effluent during this period, similar increases were not noted in the direct river samples and the cause for the increase of beta particle emitters in raw water during February has not been established definitely.

The activity density of alpha particle emitters in raw water averaged less than 5×10^{-9} μc/cc at all locations indicated in Table III. Isolated samples showed trace alpha particle emission but in no case exceeded a value of 8×10^{-8} μc/cc. Samples of raw water which were analyzed for the activity density of uranium showed no detectable activity.

FIGURE — 9

COLUMBIA RIVER FLOW

JANUARY – FEBRUARY – MARCH



AEC-GE RICHLAND WASH

SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

The activity density of gross beta particle emitters in rain was determined from the results obtained from analyzing 190 samples which were collected from 26 locations in the Hanford environs. Although the total precipitation was 2.35 inches over the three month period, the majority of the samples were collected during the month of January when 1.48 inches of rainfall occurred. Total precipitation during the period was above average when compared to the 35 year average value of 1.81 inches at Hanford. Table I summarizes the precipitation measurements obtained at the Meteorology Station adjacent to the separation areas; measurements for the three previous years are included for comparison.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS

JANUARY, FEBRUARY, MARCH

1954

Units - Inches

Year	January	February	March	Quarterly Total
1951	0.84	0.51	0.46	1.81
1952	0.65	0.50	0.06	1.21
1953	2.16	0.25	0.17	2.58
1954	1.48	0.28	0.59	2.35

The results obtained from analyzing the 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

JANUARY, FEBRUARY, MARCH

1954

Location	No. Samples	Units of 10^{-6} µc/cc Maximum	Average
In 200 East Area	18	3	<1
250' E of stack	7	3	<1
2000' E of stack	5	2	<1
3500' SE of stack	6	<1	<1
In 200 West Area	36	700	34
1000' E of stack	6	16	3
7000' E of stack	8	3	<1
8000' SE of stack	7	5	2
4900' SE of stack	6	9	2
Redox Area	9	700	130
100 Area Environs	43	2	<1
100-B SE	5	<1	<1
100-D SW	6	<1	<1
100-F SW	6	<1	<1
Hanford 614	10	1	<1
White Bluffs	10	2	<1
100-H SE	6	1	<1
Perimeter Locations	36	3	<1
700A 614	6	3	<1
Pasco H and R	5	1	<1
Benton City	8	1	<1
Riverland	9	<1	<1
3000 Area North	8	2	<1
Intermediate Locations	57	23	<2
Route 4S, Mile 6	10	16	3
300 Area 614	8	<1	<1
200 North 614	8	2	<1
Gable Mountain	6	<1	<1
Batch Plant	4	3	1
622 Building	21	23	2

Except for several unusually high results which were obtained inside the 200 West area, the average activity density of beta particle emitters in rainfall was essentially below the detection limit at all environmental locations. Samples collected at locations which were inside the heavy deposition area following ruthenium emission during early January (Sections I and IV) showed significant contamination in samples collected during this period. Two samples collected from a station near the Redox area showed values of 7×10^{-4} and 2.1×10^{-4} μc/cc. These values were higher by a factor of 10 when compared to the maximum rain measurements obtained during the previous quarter and were nearly 100 times greater than any result obtained during this same three month period in 1953.

Selected samples which were analyzed for the activity density of alpha particle emitters showed no significant contamination. Several evaporated rain samples collected at perimeter locations were radioautographed to determine the presence of radioactive particles. None of the samples showed the presence of particulate contamination; the sensitivity of the radioautograph method was 5 d/m/ptle based on Ru, C^{14}, and S^{35} standards.

Seven snow samples were collected from locations inside the contaminated area in and near the 200 West area on January 22. Radiochemical analyses of these samples showed a range of activity densities from 2.5×10^{-7} μc/cc to 3.8×10^{-5} μc/cc. Values on the order of 10^{-5} μc/cc were found in the samples collected within a radius of 2000' south and east of the Redox stack. Snow samples collected at the Batch Plant and a military installation near the 200 West area showed values on the order of 10^{-7} μc/cc.

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Radioactive contamination in drinking water supplies was measured by analyzing 800 samples for the activity density of alpha and beta particle emitters. Six hundred and fifty of these samples had a volume of 500 ml and the remainder had a volume of 11.7 liters. The large volume samples were used to detect trace quantities of alpha particle emission and the smaller volume was used for repetitive alpha and beta particle measurements. These data were supplemented with similar measurements obtained by analyzing samples from test wells in the immediate environs and by more detailed studies of contamination in various stages of the filtration processes at the Pasco Filter Plant.

A summary of the results representing all locations at which the average activity density of alpha particle emitters exceeded 2.0×10^{-9} μc/cc during the quarter is presented in Table I.

TABLE I

CONTAMINATION FROM ALPHA PARTICLE EMITTERS IN DRINKING WATER JANUARY, FEBRUARY, MARCH 1954

500 ml samples

Location	Alpha Particle Emitters			Uranium		
	No. Samples	Units of 10^{-9} µc/cc Max.	Avg.	No. Samples	Units of 10^{-9} µc/cc Max.	Avg.
Richland Well #4	51	23	6	51	8	5
Richland Well #12	14	23	9	14	10	7
Richland Well #13	13	33	7	13	6	4
Richland Well #14	16	12	5	14	28	6
Richland Well #15	13	10	6	11	13	7
3000 Area Well "D"	1	8	8	1	<2	<2
Benton City Water Co. Well	13	18	14	12	20	12
Benton City Store	13	13	10	13	14	10
300 Area (Sanitary)	13	47	6	12	13	3
Sacajawea Park (Sanitary)	12	12	6	12	8	6

Alpha particle emission and the amounts of uranium found in the Richland wells and Benton City water supplies were not significantly different from those found during the past several quarters. The locations at which detectable quantities were found were in the same general areas in which positive measurements have been found in the past. Again, uranium was identified as the contaminant in nearly every sample which showed detectable alpha particle emission.

Individual samples from a number of locations other than those listed in Table I showed trace alpha particle emission at some time during the quarter. In general, most of these individual measurements were not deemed significant as resamples did not confirm the positive indications. Table II contains a tabulation of all drinking water supplies which were sampled during the quarter and shows the average and maximum values obtained at locations where trace emission was detected in random samples.

TABLE II

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN WATER SUPPLIES

JANUARY, FEBRUARY, MARCH

1954

500 ml samples

Location	No. 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	14	8	<5	10	<5
Richland Well #4	51	23	6	34	<5
Richland Well #5	14	6	<5	21	<5
Richland Well #12	14	23	9	6	<5
Richland Well #13	14	33	7	<5	<5
Richland Well #14	18	12	5	6	<5
Richland Well #15	13	10	6	43	9
Tract House J-685	12	<5	<5	25	<5
3000 Area Well "A"	11	7	<5	12	<5
3000 Area Well "B"	1	<5	<5	--	--
3000 Area Well "C"	10	<5	<5	<5	<5
3000 Area Well "D"	1	8	8	<5	<5
3000 Area Well "J"	1	<5	<5	<5	<5
3000 Area Well "K"	2	<5	<5	<5	<5
Durand Well #5	11	20	<5	<5	<5
Columbia Field Well "A"	11	<5	<5	<5	<5
Columbia Field Well "B"	12	12	<5	<5	<5
Columbia Field Well "C"	12	<5	<5	5	<5
Headgate Well	12	<5	<5	<5	<5

TABLE II (contd.)

500 ml samples

Location	No. 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.
1100 Area Well #8	15	9	<5	26	<5
Midway	12	8	<5	7	<5
Riverland	13	18	<5	6	<5
Lower Knob	12	6	<5	9	<5
Wills Ranch	9	<5	<5	9	<5
Pistol Range	15	<5	<5	35	<5
White Bluff Fire Hall	12	8	<5	170	46
White Bluff Tele. Exchange	9	<5	<5	14	7
Benton City Water Co. Well	13	18	14	6	<5
Benton City Store	13	13	10	99	<5
Kiona	13	<5	<5	20	<5
Enterprise	13	6	<5	50	5
Kennewick Standard Sta.	12	<5	<5	30	12
McGee Well	10	<5	<5	<5	<5
Ford Well	13	<5	<5	<5	<5
Meeker Well	13	<5	<5	7	<5
Hanford Well #7 (San).	3	7	<5	6	<5
100-B (Sanitary)	11	11	<5	8	<5
100-C (Sanitary)	11	<5	<5	100	11
100-D (Sanitary)	11	<5	<5	72	43
100-DR (Sanitary)	11	<5	<5	80	44
100-H (Sanitary)	11	5	<5	180	58
100-F (Sanitary)	12	<5	<5	150	63
100-K Well #1 (Sanitary)	12	<5	<5	21	<5
200-East (Sanitary)	11	<5	<5	58	25
200-West (Sanitary)	11	15	<5	68	36
300 Area (Sanitary)	13	47	6	12	<5
251 Bldg. (Sanitary)	9	<5	<5	13	6
Redox Ad. Bldg. (Sanitary)	11	16	<5	26	12
Sacajawea Park (Sanitary)	12	12	6	18	<5
McNary Dam (Sanitary)	12	6	<5	6	<5
Patterson (Sanitary)	11	8	<5	39	<5
Plymouth (Sanitary)	12	<5	<5	<5	<5
Prosser (Sanitary)	11	<5	<5	<5	<5
Byers Landing Pump. Plant	2	<5	<5	170	87
Kennewick Reservoir	11	<5	<5	300	39
Pasco Improvement Farm	3	6	<5	<5	<5
Pasco H and R Depot	13	18	<5	24	12

Values on the low order of 10^{-8} μc/cc for alpha particle emitters at locations shown in Table II were consistent with measurements obtained during the previous quarter. Larger volume samples were collected from a number of these locations in order to confirm the presence of detectable quantities of alpha particle emission at an increased sensitivity level of 2×10^{-10} μc/cc. Table III summarizes the results obtained from analyzing the 11.7 liter samples.

TABLE III

ACTIVITY DENSITY FROM ALPHA PARTICLE EMITTERS
MEASURED IN DRINKING WATER
JANUARY, FEBRUARY, MARCH
1954

11.7 liter samples

Location	Samples	Units of 10^{-10} µc/cc Maximum	Average
Richland Well #2	6	43	27
Richland Well #4	2	29	25
Richland Well #5	5	33	27
Richland Well #12	6	47	35
Richland Well #13	6	31	23
Richland Well #14	6	36	24
Richland Well #15	6	70	44
Tract House #J-685	6	19	11
Columbia Field Well "A"	5	11	9
Columbia Field Well "B"	6	32	21
Columbia Field Well "C"	6	24	17
1100 Area Well #8	4	31	24
3000 Area Well "A"	4	14	6
3000 Area Well "C"	4	12	10
3000 Area Well "D"	1	21	21
3000 Area Durand #5	5	20	16
3000 Area Well "J"	1	9	9
Benton City Store	6	95	65
Benton City Water Co. Well	7	130	72
Kiona	4	18	13
Enterprise Well	5	7	5
Headgate Well	3	10	8
Kennewick Reservoir	5	7	5
Kennewick Std. Sta.	4	8	7
Riverland	6	7	3
Midway	3	6	5
Lower Knob	5	<2	<2
Wills Ranch	4	8	6
McGee Well	5	3	<2
Ford Well	6	2	<2
Meeker Well	5	<2	<2
White Bluffs Fire Hall	7	78	19
Pistol Range	7	14	11
B-Y Well	4	27	20
251 Bldg. (Sanitary)	5	7	4
Clover Island Pump. Sta.	4	11	9
3000 Area Pond Inlet	2	5	5

Alpha particle emission measured in Richland, Benton City, and North Richland and vicinity was not significantly different from that measured during the previous quarter. Average values in excess of 2×10^{-10} μc/cc at the remaining locations listed in Table III were largely weighted by one or two positive measurements.

The activity density of beta particle emitters in drinking water increased at HAPO manufacturing areas which take their supply from the raw water-river export line. The increase in activity density was consistent with increases which were noted in the raw water which is sampled at the 183 and 283 Buildings in the operating areas (Section V). Maximum beta contamination was found at the White Bluffs Fire Hall where the three month average of 4.6×10^{-7} μc/cc represented a two-fold increase over the previous quarter's average. A sample from this well which showed 1.7×10^{-6} μc/cc represented the highest beta particle measurement noted for HAPO drinking water during the past six months.

Table IV summarizes the results obtained from analyzing samples collected at the Pasco Filter Plant for the activity density of beta particle emitters.

TABLE IV

RADIOACTIVE CONTAMINATION MEASURED AT PASCO FILTER PLANT

JANUARY, FEBRUARY, MARCH

1954

Type Sample	No. Samples	Activity Density Gross Beta Particle Emitters Maximum	Average
Water Entering Plant from River	12	3.2×10^{-6} µc/cc	2.3×10^{-6} µc/cc
Sand (Surface of sand filter)	10	4.5×10^{-4} µc/g	1.7×10^{-4} µc/g
First Backwash Material (Liquid)	11	5.3×10^{-6} µc/cc	8.8×10^{-7} µc/cc
First Backwash Material (Solid)	10	0.12 µc/g	8.7×10^{-2} µc/g
Coal (surface of coal filter)	3	1.1×10^{-4} µc/g	7.4×10^{-5} µc/g
First Backwash Material (Liquid)	3	4.5×10^{-7} µc/cc	3.3×10^{-7} µc/cc
First Backwash Material (Solid)	3	4.4×10^{-2} µc/g	3.4×10^{-2} µc/g
Water Leaving Plant	15	5.6×10^{-7} µc/cc	2.6×10^{-7} µc/cc

The activity of beta particle emitters in water leaving the filter plant and in samples of various material collected from the filtration processes was nearly identical to that observed during the previous quarter except at the coal filter where samples collected from the surface showed a decrease in average activity density from 2.7×10^{-4} µc/g to 7.4×10^{-5} µc/g. A decontamination factor of 10 in the filtration process was approximately the same as that observed during the last quarter of 1953.

The activity density of alpha particle emitters averaged below the detection limit of 5×10^{-9} µc/cc for processed water and for all liquid samples collected from the backwash process at the filter plant. Nine sample of solid material collected from backwashing the sand filter showed an average of 2.7×10^{-5} µc/g including a maximum of 6.5×10^{-5} µc/g. Alpha particle emitters in solid material from the coal filter backwash process showed an average of 2.5×10^{-6} µc/g.

The activity density of alpha and beta particle emitters was also measured in samples collected from wells which are not used for consumption purposes on the project. Table V summarizes the results obtained from these measurements for locations which showed an average activity density above the indicated detection limit.

TABLE V

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN TEST WELLS JANUARY, FEBRUARY, MARCH 1954

500 ml samples

Location	No. 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	8	120	22	<5	<5
300 Area Well #3	25	250	120	7	<5
300 Area Well #4	5	160	84	5	<5
B-Y Well	13	6	<5	31	5
1.9 - 3.4	2	6	6	<5	<5
12.3 - 2.7	2	6	5	<5	<5
17.4 - 4.5	2	25	15	<5	<5
25 - 56	1	<5	<5	18	18
32 - 77	1	5	5	28	28
34.7 - 9.2	1	8	8	<5	<5
39 - 79	1	8	8	<5	<5
43 - 88.5	1	<5	<5	89	89
45 - 69.5	1	<5	<5	54	54
46 - 42.5	1	<5	<5	14	14
60 - 60	1	<5	<5	54	54
303 - 1	6	1300	700	6	<5
303 - 2	10	760	450	14	5
303 - 3	8	2800	2100	50	21
303 - 4	11	1100	600	160	20
303 - 5	2	95	69	5	<5
303 - 6	11	710	450	980	100
303 - 7	3	360	270	8	<5
303 - 8	3	20	12	6	<5

TABLE V (contd.)

500 ml samples

Location	No. 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
303 - 9	2	39	31	42	22
303 - 10	3	410	370	<5	<5
303 - 11	3	19	11	<5	<5
303 - 12	3	170	110	<5	<5
3000 - 7	3	33	19	<5	<5

The alpha particle measurements shown in Table V were not indicative of a significant trend during this period. In general, average results were within a factor of 2 when compared to those measured during the previous quarter. Several increases were noted in the activity density of beta particle emitters in test wells, particularly at locations which did not show detectable particle emission during the previous quarter.

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