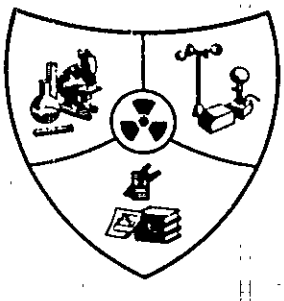
HW-36506
HEALTH & SAFETY

BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD JANUARY, FEBRUARY, AND MARCH 1955

May 15, 1955



GENERAL ELECTRIC
HANFORD ATOMIC PRODUCTS OPERATION
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HW-36506
Health and Safety
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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD JANUARY, FEBRUARY, MARCH 1955

By

Members of

Regional Radiation Measurements Unit

May 15, 1955

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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ABSTRACT

SECTION I: RADIOACTIVE CONTAMINATION IN EFFLUENT GAS

Average emission of I^{131} from separation facilities increased significantly with the daily average this quarter being 7.9 curies compared to 1.6 curies for last quarter. Unusual emissions of 92 curies and 70 curies were recorded at T-Plant on March 17 and 18 respectively. The activity of radioactive particulates emitted from the T and S Plants during the quarter averaged 4×10^{-2} and 5×10^{-2} curie per day with the particulates at T Plant being a fission product mixture and those at S Plant predominantly ruthenium. Ammonium nitrate discharged from the two facilities averaged 6.7×10^{3} and 3.6×10^{4} grams per day respectively. Average daily emissions of 3×10^{-5} curie of beta particle emitters and 6×10^{-9} curie of alpha particle emitters from the U Plant stack were similar to those of the first two quarters of the year. A combined total of 1.2 curies of tritium was emitted daily from the reactor stacks during the quarter. Combined emissions of C^{14} from the reactor stacks were below the detection limit of 2.7×10^{-2} curie per day while an average combined daily emission of less than 1.1×10^{-2} curie per day S^{35} was emitted from the same stacks. Average emissions of 7×10^{-7} curie per day of alpha particle emitters and 5.5×10^{-3} curie per day of beta particle emitters as particulates in reactor effluent gas from all areas were normal.

SECTION II: RADIOACTIVE CONTAMINATION ON VEGETATION

Average deposition of iodine in the environs showed a general increase over the previous quarter with the most extensive contamination occurring in March. The increase was attributed to the increased emission of I^{131} noted at both separation plants. The monthly average activity density of iodine on vegetation exceeded the maximum acceptable at Hanford (1×10^{-5} μc/g) over areas of approximately 20 and 250 square miles off the project during January and March, respectively. The highest concentration was noted in a sample collected nar 200-W gate on March 16.

Contamination found at most locations from non-volatile beta particle emitters remained at levels similar to the previous quarter with quarterly averages ranging from 5 to 50×10^{-5} μc/g; maximum sample concentrations of 7×10^{-3} μc/g were noted in the vicinity of Redox and on Wahluke Slope. Concentrations of alpha particle emitters on vegetation were below 1×10^{-6} μc/g except at 300 Area where a maximum of 3.4×10^{-6} μc/g was found to arise from uranium on the vegetation.

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SECTION III: RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dose rates measured by Victoreen Integrons decreased to values ranging from 2.3 to 3.5 mrad/day at 200 West Area and Redox. Values of 1.6 and 2.5 mrad/day continue to be noted at Hanford and 200 East Area, respectively. A significant increase in dosage rates at 100-B Area was measured by detachable ionization chambers; no other changes were noted at any location. Significant decreases were measured in the activity density of beta particle emitters filtered from the atmosphere; concentrations averaged between 1.5×10^{-13} µc/ml and 6.4×10^{-13} µc/ml at all sampling locations including those on-site and in residential areas. Significant decreases in radioactive particle concentrations in air were noted at locations both near the separation areas and at remote locations. The average concentrations measured on the project did not exceed 0.14 ptle/m^3; the average concentrations measured at locations off-site did not exceed 0.03 ptle/m^3. I^{131} concentrations in air increased sharply during the quarter at locations near the separations areas, with average values ranging as high as 2.6×10^{-12} µc/ml at the 200 West Area. No significant changes in concentrations were measured in the surrounding residential areas. The activity density of alpha particle emitters in the atmosphere was normal during the quarter.

SECTION IV: RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The average activity of beta particle emitters discharged to the Columbia River from reactor retention basins increased significantly in all reactor areas with the maximum increase occurring in the 100-C Area where the discharge average 28,000 µc/second for the quarter. Trace quantities of alpha particle emitters, plutonium and polonium were found in isolated samples from the effluent basins in various areas. I^{131} discharged to the river from the Animal Farm averaged 30 µc/day. Ground surveys of control plots around Redox continued. Analyses were accomplished to compute an index defining the relative frequency of particles measured in the control plots as their number varies over time. Particle frequency maps covering the plant and adjoining areas may be referred to in the text. Ground surveys in Richland showed average frequencies of particles detectable by portable instruments to be one particle per 2,000 to 2,500 square feet in February and March.

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

Uniform flow rates of the Columbia River during the past six months were reflected in the lack of significant changes in the activity density of beta and alpha particle emitters in the river water and in raw water derived from the Columbia River. Average river flow rate this quarter was 6.0×10^5 gps (the same as was noted during the last quarter). Maximum

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activity density of beta particle emitters in the river between the reactor areas and McNary Dam was 4.4×10^{-5} μc/ml just below the 100-H Area; the maximum value recorded for monthly one gallon samples collected below McNary Dam was 6.3×10^{-7} μc/ml at Troutdale, Oregon. Short-lived iodine isotopes were detected in the samples collected from the south bank of the Columbia at Hanford. Specific analyses for uranium performed on three series of samples collected upstream of the reactors and at Pasco revealed concentrations to average 5 to 8 x 10^{-10} μc/ml.

SECTION VI: RADIOACTIVE CONTAMINATION IN RAIN

The total precipitation of 0.95 inches for the period was approximately 50 per cent of the 35-year Hanford average of 1.81 inches; this was the driest first quarter during that time. The average activity density of beta particle emitters in rainfall was below the detection limits of 1×10^{-6} μc/ml for all stations except those in the vicinity of 200 W. The average concentration of all samples obtained from 200 West Area stations was greater by a factor of two than the previous quarterly average for the same locations and reflects increased emission of I^{131} during this quarter. The maximum concentration of 4.6×10^{-5} μc/ml was obtained at a station near Redox Plant.

SECTION VII: RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

Nine sources of drinking water showed significant concentrations of alpha particle emitters. Eight wells including those in Richland, Benton City, Paterson and Pasco have previously shown similar concentrations with uranium found in all of them. Concentrations ranged from <5 to 15×10^{-9} μc/ml for all such wells tested. Concentrations of beta particle emitters in all drinking water sources averaged from <5 to 80 x 10^{-8} μc/ml with the higher concentrations noted in those sources using purified Columbia River water. Activity density of beta particle emitters in Kennewick and Pasco water supplies were 2.7 and 5.1×10^{-7} μc/ml respectively. Significant increases were noted in the concentrations of alpha particle emitters in test wells 303-2, 303-4 and 303-6 where average concentrations of 8.0, 3.8 and 8.5×10^{-7} μc/ml occurred.

INTRODUCTION

This document summarizes the results obtained from monitoring the HAPO environs for radioactive contamination during the period January, February, and March 1955. Samples were collected by Regional Monitoring forces according to procedures previously outlined in documents of this series.[1, 2, 3] These samples were analyzed by the Radio-Analysis Laboratory of the Regional Radiation Measurements Unit according to procedures and techniques described in a previously published laboratory manual.[4] Counting rates obtained from these analyses were corrected for geometry, backscatter, air-window absorption, source size, self-absorption, chemical yield, and collection efficiency by Radiation Measurement Evaluation forces using factors described in previous reports.[5, 6, 7, 8] Additional corrections for decay were applied to those samples in which significant amounts of short half-life beta particle emitters were found. The findings obtained from analyzing the direct samples were supplemented with readings obtained from portable and fixed instrumentation.

The results obtained from the described efforts are presented in Sections I through VII which are written by various members of the organizations responsible for them. These sections discuss the amounts of active material discharged from plant facilities and their effect on the contamination of vegetation, air, soil, and water.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

by

C. W. Thomas

Radioactive contaminants in the effluent gases released to the Hanford environs through separation and reactor plant stacks were measured by collection of gas samples at these locations. Radiochemical and chemical analyses were performed on scrubber and filter samples collected daily in the separation area stacks and weekly at the reactor stacks. Summaries of the results from measurements in each manufacturing area are presented herein.

SEPARATION AREAS

200 EAST AREA - SEMI-WORKS

Measurements were made on the particulate material filtered from samples of effluent gas collected at the fifty foot level of the Semi-Works stack. The extended shutdown of this facility was continued through the present quarter and was responsible for the relatively low activity of gross beta particle emitters in the effluent gas stream.

TABLE I

BETA PARTICLE EMITTERS DISCHARGED AS PARTICULATES IN THE SEMI-WORKS STACK EFFLUENT GAS JANUARY, FEBRUARY, MARCH 1955

Month	Units of Curie per Day	
	Maximum	Average
January	1.2×10^{-5}	$<7.9 \times 10^{-6}$
February	7.8×10^{-6}	5.5×10^{-6}
March	1.9×10^{-5}	9.3×10^{-6}
Quarter	1.9×10^{-5}	$<7.6 \times 10^{-6}$
Last Quarter	1.5×10^{-5}	$<3.0 \times 10^{-6}$

200-WEST AREA T-PLANT

The results obtained from monitoring at the fifty-foot level of the T-Plant stack for I^{131} are summarized in Table II.

TABLE II

IODINE-131 DISCHARGED FROM THE T-PLANT STACK JANUARY, FEBRUARY, MARCH 1955

Month	Units of Curies per Day	
	Maximum	Average
January	4.6	2.1
February	8.2	1.5
March	92.	13.
Quarter	92.	5.4
Last Quarter	2.9	1.1

The I^{131} emission from T Plant stack increased markedly during the quarter with maximum emissions occurring on March 17 and 18 when 92 and 70 curies respectively were emitted; these were the highest daily emissions noted since 1951. An average of 120 curies of I^{131} per day was available in the processed metal compared to 100 curies per day during the previous quarter.

Table III is a summary of the results obtained in monitoring the T Plant stack effluent for beta and alpha particle emitters filtered from samples of the effluent gas.

TABLE III

RADIOACTIVE PARTICULATE MATERIALS IN T-PLANT STACK EFFLUENT GAS JANUARY, FEBRUARY, MARCH 1955

Month	Units of 10^{-4} Curie per Day					
	Ru	Sr	RE and Y	Nb	Zr	Pu
January	150	50	240	69	23	1.5
February	76	41	100	90	5	1.5
March	52	29	84	15	17	1.5
Quarter	93	40	141	58	15	1.5

Routine radiochemical analyses for these emitters were initiated during the quarter to follow fluctuations in emission and to determine the consistency of composition. The results show a more diverse fission product spectrum than that found at Redox. The average ratio of the activity of Ru^{103} to that of Ru^{106} was 4 indicating no appreciable hold-up in T Plant separation facilities. Due to the varying irradiation and cooling times of the processed metal the ratio varied from 8.3 to less than 1.0 during the quarter.

Routine measurements of ammonium nitrate emitted were initiated during the quarter because of its potential for concentrating radioactive materials in the stack system. Although the emissions of this material were observed to be relatively high at both plants during this quarter, the lack of radioactive material to absorb or be occluded in the ammonium nitrate prevented the emission of the numbers of highly radioactive particles previously noted. Table IV gives a summary of the ammonium nitrate discharged in the effluent gas from both separation plants during the quarter.

TABLE IV

AMMONIUM NITRATE DISCHARGED FROM THE T-PLANT AND S-PLANT STACKS JANUARY, FEBRUARY, MARCH 1955

	Units of Grams per Day	
Month	T-Plant	S-Plant
January	5.2×10^3	1.8×10^3
February	1.8×10^4	5.8×10^3
March	2.6×10^3	6.4×10^4
Quarter	6.7×10^3	3.6×10^4

200 WEST AREA - S-PLANT

A summary of the results obtained from monitoring for I^{131} at the S-Plant stack is presented in Table V.

TABLE V

IODINE-131 DISCHARGED FROM THE S-PLANT STACK

JANUARY, FEBRUARY, MARCH

1955

Month	Units of Curies per Day	
	Maximum	Average
January	4.2	0.79
February	8.1	1.2
March	17.	5.5
Quarter	17.	2.4
Last Quarter	9.5	0.46

Average daily emission of I^{131} from S-Plant constituted 30 per cent of the total emitted from separation stacks during the quarter and was five times that of the previous quarter. The maximum daily emission of 17 curies/day occurred on March 8.

Table VI summarizes the results obtained from monitoring the S-Plant effluent gases for ruthenium activity.

TABLE VI

RADIOACTIVE RUTHENIUM DISCHARGED FROM

THE S-PLANT STACK

JANUARY, FEBRUARY, MARCH

1955

Month	Units of Curie per Day	
	Maximum	Average
January	<0.1	<0.06
February	<0.1	<0.08
March	<0.2	<0.03
Quarter	<0.2	<0.05
Last Quarter	0.4	<0.02

The figures reported in Table VI are based on measurements made at a point 20 feet above the base of the stack and do not include any contributions from radioactive material sloughing off from the upper stack lines into the effluent. The ruthenium emission during the quarter was of the same magnitude as that of the previous quarter. The ratio of Ru^{103} to Ru^{106} continued to be less than 1.0 indicating hold-up of the contaminant in the plant facilities rather than emission directly from the process.

The results procured by monitoring the S-Plant stack effluent gases for fission products other than ruthenium and iodine are tabulated in Table VII.

TABLE VII

RADIOACTIVE PARTICULATE MATERIALS IN S-PLANT STACK EFFLUENT GAS JANUARY, FEBRUARY, MARCH 1955

Month	Units of 10^{-4} Curie per Day				
	Sr	RE and Y	Nb	Zr	Pu
January	-	-	-	-	0.033
February	1.4	4.1	11.	1.8	0.044
March	0.63	2.7	4.5	3.5	0.15
Quarter	1.0	3.4	7.8	2.7	0.050

Fission products in addition to ruthenium and iodine discharged from the S-Plant stack averaged approximately 1.5×10^{-3} curie/day. Table VIII is a summary of the results obtained from filtering gas samples from the U-Plant stack.

TABLE VIII

RADIOACTIVE PARTICULATE MATERIALS IN U-PLANT STACK EFFLUENT GAS JANUARY, FEBRUARY, MARCH 1955

Month	Alpha Particle Emitters Units of 10^{-8} Curie/day		Beta Particle Emitters Units of 10^{-5} Curie/day	
	Maximum	Average	Maximum	Average
January	2.1	0.71	5.5	2.3
February	1.1	0.30	4.6	2.1
March	3.6	0.82	14.	4.6
Quarter	3.6	0.61	14.	3.0
Last Quarter	6.3	0.90	7.5	0.26

The average activity density of gross beta particle emitters in stack effluent gases increased eleven fold over that of the past quarter but was comparable to that of the second and third quarter emission of 1954. Alpha emission continued within normal limits.

REACTOR AREAS

Tables IX through XIII summarize the measurements for tritium oxide, C^{14}, S^{35}, solid beta and alpha particle emitters respectively in reactor stack effluent gas. Daily maximum and average emissions of tritium oxide were comparable to the figures of the previous quarter with an average daily emission from all reactors of 1.2 curies. Only two significant emissions of C^{14} were noted including a maximum of 6×10^{-3} curie per day. A decrease to one-fourth of the previous quarter's average daily emission of S^{35} from the 105-F stack was the only significant difference in emission of S^{35}. Particulates emitted from reactor stacks were similar to those of last quarter with no abnormal values noted.

TABLE IX

TRITIUM OXIDE DISCHARGED FROM REACTOR STACKS
JANUARY, FEBRUARY, MARCH
1955

Units of Curies per Day

Stack	January		February		March		Quarterly	
	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	0.42	0.32	0.31	0.25	1.7	0.61	1.7	0.43
100-C	0.14	0.06	0.17	0.05	0.02	0.01	0.17	0.04
100-D	0.89	0.56	0.27	0.21	0.57	0.27	0.89	0.34
100-DR	0.26	0.16	0.15	0.11	0.17	0.13	0.26	0.13
100-F	0.36	0.18	0.18	0.13	1.29	0.35	1.29	0.23
100-H	0.20	0.11	0.14	0.08	0.12	0.06	0.20	0.08

TABLE X

CARBON-14 DISCHARGED FROM REACTOR STACKS
JANUARY, FEBRUARY, MARCH
1955

Units of 10^{-3} Curie per Day

Stack	January		February		March		Quarterly	
	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-C	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-D	6.4	<4.5	<4.5	<4.5	<4.5	<4.5	6.4	<4.5
100-DR	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-F	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-H	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5

TABLE XI

SULFUR-35 DISCHARGED FROM REACTOR STACKS
JANUARY, FEBRUARY, MARCH
1955

Units of 10^{-4} Curie per Day

Stack	January		February		March		Quarterly	
	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	8.7	5.4	6.5	3.5	<4.5	<4.5	8.7	<4.5
100-C	7.1	<4.5	<4.5	<4.5	9.3	<4.5	9.3	<4.5
100-D	22.0	13.0	40.0	26.0	30.	14.	40.	18.
100-DR	71.0	49.0	52.0	40.0	65.	27.	71.	38.
100-F	149.0	54.0	44.0	14.0	134.	34.	149.	34.
100-H	11.0	5.6	9.0	<4.5	20.	<4.5	20.	4.5

TABLE XII

ALPHA PARTICLE EMITTERS DISCHARGED AS PARTICULATES
FROM REACTOR STACKS
JANUARY, FEBRUARY, MARCH
1955

Units of 10^{-7} Curie per Day

Stack	January		February		March		Quarterly	
	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	0.74	0.37	4.7	2.0	0.89	0.32	4.7	0.84
100-C	1.4	0.57	7.0	2.8	1.6	0.87	7.5	1.4
100-D	2.4	0.80	4.8	0.59	1.5	0.66	4.8	0.68
100-DR	8.5	2.1	3.7	1.6	1.7	0.84	8.5	1.5
100-F	1.8	0.60	1.4	0.55	1.9	0.78	1.9	0.65
100-H	2.6	0.74	10.0	3.9	4.5	2.1	10.	2.2
100-KW	-	-	-	-	0.90	0.64	-	-

TABLE XIII

BETA PARTICLE EMITTERS DISCHARGED AS PARTICULATES FROM REACTOR STACKS JANUARY, FEBRUARY, MARCH 1955

Units of 10^{-5} Curie per Day

	January		February		March		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	160.	110.	130.	89.	660.	210.	660.	140.
100-C	87.	31.	81.	24.	5.4	3.4	87.	19.
100-D	57.	52.	470.	310.	410.	240.	470.	200.
100-DR	6.8	4.6	8.4	4.6	9.5	4.2	9.5	4.4
100-F	310.	140.	180.	110.	560.	200.	560.	160.
100-H	34.	16.	59.	40.	38.	16.	59.	23.
100-KW	-	-	-	-	2.0	0.67	-	-

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SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

by

K. C. Knoll

Determination of the radioactive contamination of vegetation in the environs was made by the radiochemical analysis of 2500 vegetation samples. More than 1800 of these were from the immediate environs and the remainder from off-area locations in eastern and southern Washington and northern Oregon. All samples were analyzed for I^{131} and 1400 of them were analyzed for non-volatile beta particle emitters. Forty seven samples from selected locations were analyzed for alpha particle emitters.

Tables I and II give comparative averages for the present and previous quarters. Tables III and IV give a breakdown of these averages by months.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION
JANUARY, FEBRUARY, MARCH
1955

Units of 10^{-6} μc/g

Location	Samples	Iodine-131 Max.	Iodine-131 Avg.	Iodine-131 Avg. Last Qtr.	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.	Non-Volatile Beta Emitters Avg. Last Qtr.
North of 200 Areas	208	42	8	<3	690	110	100
Near the 200 Areas	196	110	19	3	1700	120	110
Route 3	13	250	75	15	350	130	110
200 West Gate	57	1200	130	26	430	130	120
Batch Plant	35	870	71	7	600	130	120
Meteorology Tower	13	290	82	16	430	140	110
South of 200 Areas	330	35	6	<3	350	71	90
Richland	166	46	5	<3	150	58	67
Pasco Environs	131	10	<3	<3	150	46	56
Kennewick Environs	171	37	4	<3	190	51	56
Benton City - Kiona	39	12	4	<3	180	60	56
Richland "Y"	12	26	6	<3	-	-	-
Hanford	12	98	21	<3	-	-	-
200 East Area	48	56	16	<3	590	110	110
200 West Area Redox Area	63	750	120	6	6600	530	820
Wahluke Slope	151	38	6	3	6800	240	170
Goose Egg Hill	62	110	18	4	240	76	72
Rattlesnake Mountain	21	49	18	3	100	62	65
PSN-61-51-50	39	160	45	4	230	84	96
Redox Construction	72	520	95	9	2900	270	370
Off Area Sampling							
Pasco to Ringold	71	38	5	<3	190	65	60
Prosser to Patterson - McNary	208	18	<3	<3	160	57	52
Eastern Washington	204	13	<3	3	160	71	82
So. Washington and No. Oregon	188	11	<3	<3	280	72	77

TABLE II

RADIOACTIVE CONTAMINATION ON VEGETATION OFF-AREA LOCATIONS

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-6} μc/g

Location	Iodine-131 No. Samples	Iodine-131 Max.	Iodine-131 Avg.	Non-Volatile Beta Emitters No. Samples	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Wallula	6	5	3	3	120	78
Touchet	6	5	<3	3	74	51
Lowden	6	4	<3	3	55	43
Walla Walla	12	3	<3	6	93	54
Dixie	6	3	<3	3	120	100
Waitsburg	12	<3	<3	6	98	72
Dayton	12	7	<3	6	91	66
Pomeroy	12	3	<3	6	61	49
Lewiston	12	<3	<3	6	71	40
Uniontown	6	<3	<3	3	73	68
Pullman	12	<3	<3	6	160	95
Colfax	6	3	<3	3	68	52
Steptoe	6	<3	<3	3	110	96
Rosalia	6	4	<3	3	120	86
Spangle	6	<3	<3	3	120	67
Spokane	12	<3	<3	7	160	100
Cheney	0			0		
Reardon	6	3	<3	3	140	110
Davenport	6	<3	<3	3	57	47
Harrington	6	4	<3	3	120	110
Sprague	12	4	<3	6	110	84
Ritzville	12	13	4	6	120	77
Lind	12	5	<3	6	84	53
Connell	12	5	<3	6	110	54
Moxee	12	<3	<3	6	74	42
Union Gap	6	11	<3	4	55	46
Wapato	12	<3	<3	5	83	51
Toppenish	12	9	<3	6	85	44
Toppenish to Goldendale	15	4	<3	10	180	78
Goldendale	12	<3	<3	5	140	88
Goldendale to Wishram	7	<3	<3	4	110	53
Lyle	6	<3	<3	3	54	51
Bingen	6	4	<3	3	83	43
Camas	12	<3	<3	6	100	83
Vancouver	12	<3	<3	6	280	160
Portland	12	<3	<3	6	270	140
Troutdale	6	<3	<3	3	230	130
Bonneville	6	<3	<3	3	160	92

TABLE II (contd.)

Location	Iodine-131 No. Samples	Iodine-131 Max.	Iodine-131 Avg.	Non-Volatile Beta Emitters No. Samples	Non-Volatile Beta Emitters Max.	Non-Volatile Beta Emitters Avg.
Hood River	6	<3	<3	3	100	62
Dalles	12	<3	<3	6	68	41
Moody	4	<3	<3	2	69	69
Rufus	6	4	<3	3	65	43
Blalock	6	<3	<3	3	70	55
Arlington	6	4	<3	3	68	50
Heppner Junction	6	<3	<3	3	68	46
Boardman	6	4	<3	3	52	40

TABLE III

ACTIVITY DENSITY OF I-131 ON VEGETATION

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-6} µc/g

Location	January Max.	January Avg.	February Max.	February Avg.	March Max.	March Avg.
North of 200 Areas	27	7	39	8	42	10
Near the 200 Areas	49	12	80	15	110	29
Route 3	260	110	42	26	140	85
200 West Gate	240	120	240	86	1200	190
Batch Plant	53	29	82	29	870	140
Meteorology Tower	120	51	26	21	290	180
South of 200 Areas	30	6	12	5	35	7
Richland	19	6	17	4	46	4
Pasco Environs	10	3	8	<3	9	<3
Kennewick Environs	37	7	14	4	10	<3
Benton City - Kiona	12	5	11	4	6	3
Richland "Y"	26	11	12	4	8	4
Hanford	6	5	10	5	98	52
200 East Area	36	14	22	9	56	26
200 West Area Redox Area	290	74	380	120	750	160
Wahluke Slope	12	5	11	3	38	6
Goose Egg Hill	83	20	41	10	110	25
Rattlesnake Mountain	49	20	28	12	42	21
PSN-50-51-61	160	39	160	58	120	39
Redox Construction	210	60	200	55	520	150
Off-Area Sampling						
Pasco to Ringold	8	4	7	<3	38	8
Prosser to Patterson - McNary	11	4	18	<3	6	<3
Eastern Washington	5	<3	5	<3	13	<3
So. Washington and No. Oregon	4	<3	11	<3	<3	<3

TABLE IV

CONCENTRATIONS OF NON-VOLATILE BETA PARTICLE EMITTERS ON VEGETATION

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-6} µc/g

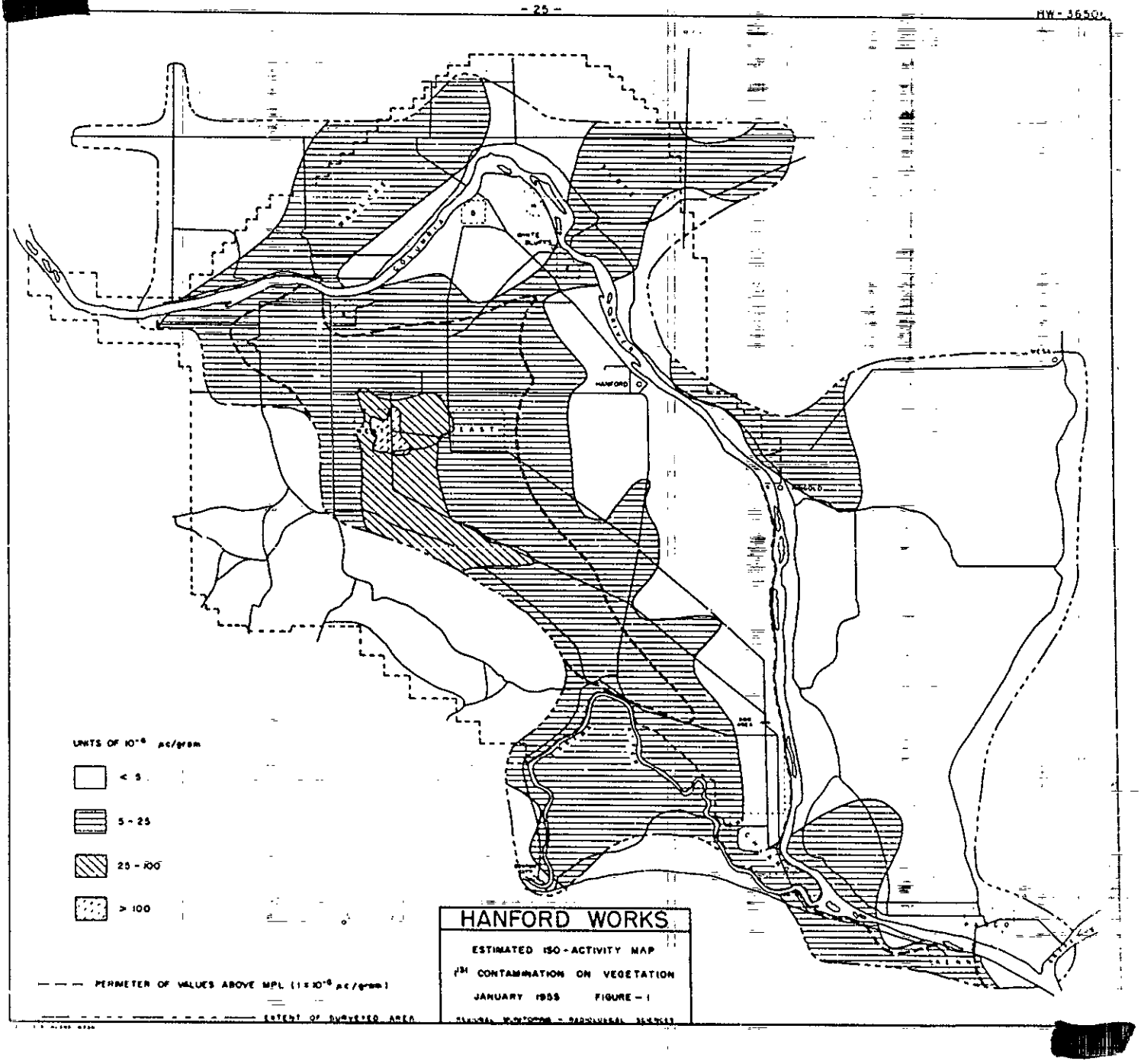
Location	January		February		March	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
North of 200 Areas	690	160	240	110	140	74
Near the 200 Areas	1600	170	330	96	1700	146
Route 3	140	96	200	130	350	170
200 West Gate	430	170	240	140	220	97
Batch Plant	330	150	610	160	230	96
Meteorology Tower	240	130	430	150	230	140
South of 200 Areas	350	79	250	71	190	61
Richland	150	64	120	54	100	48
Pasco Environs	99	43	120	51	150	45
Kennewick Environs	140	56	190	53	120	46
Benton City - Kiona	140	66	180	68	82	43
Richland "Y"	-	-	-	-	-	-
Hanford	-	-	-	-	-	-
200 East Area	370	110	130	87	590	170
200 West Area Redox Area	6600	650	2800	540	4400	380
Wahluke Slope	6800	570	130	64	190	75
Goose Egg Hill	170	90	190	89	240	63
Rattlesnake Mountain	85	57	100	81	90	57
PSN-50-51-61	210	97	230	95	100	53
Redox Construction	1100	220	2900	350	1100	200
Off-Area Sampling						
Pasco to Ringold	110	62	85	48	190	77
Prosser to Patterson - McNary	160	67	150	55	120	51
Eastern Washington	140	70	160	71	140	72
So. Washington and No. Oregon	280	80	180	64	240	71

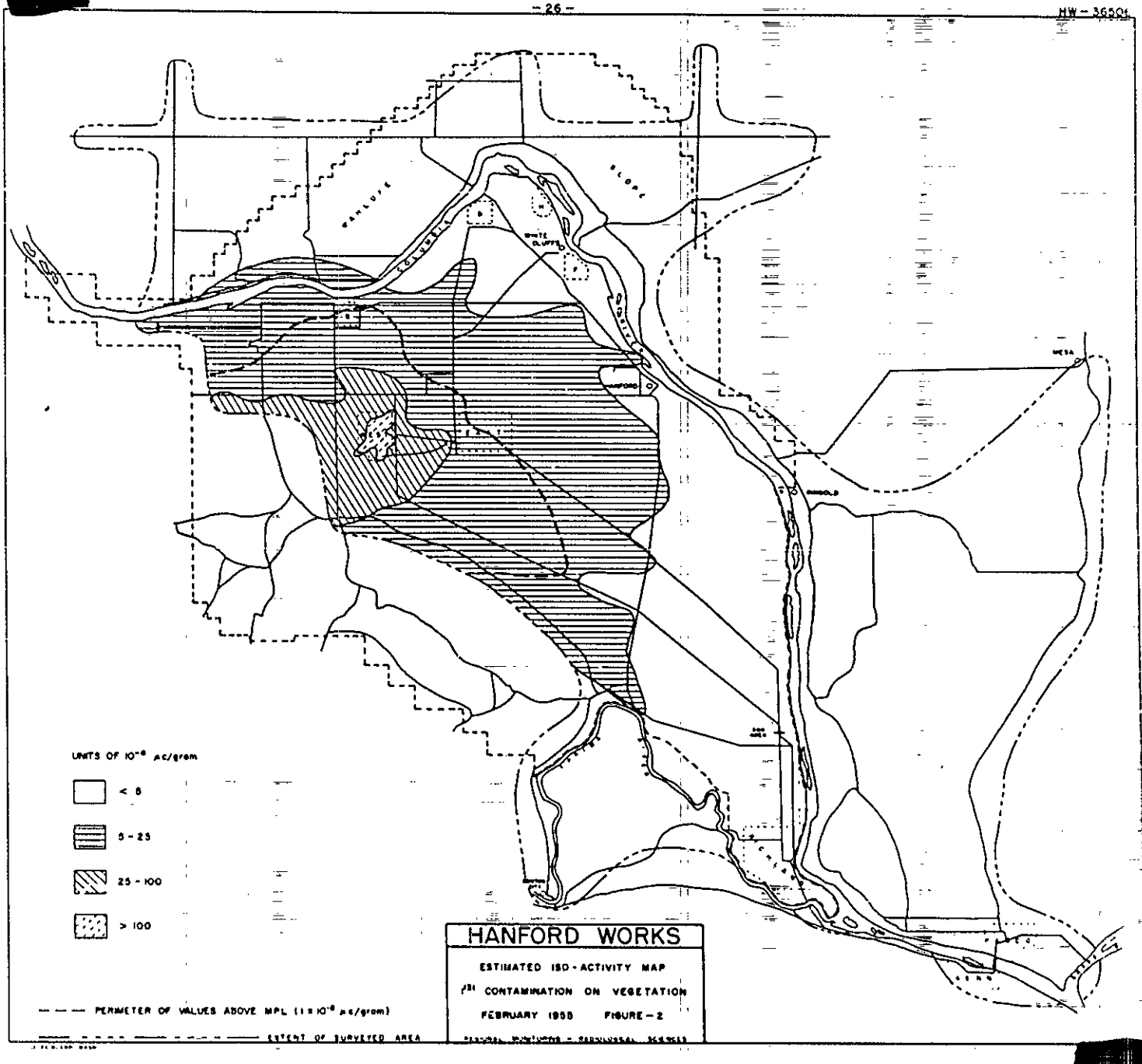
[redacted]

Average concentrations of I^{131} on vegetation increased at nearly all locations during the quarter with the most extensive contamination noted in March. These increases reflect the increased emission of I^{131} from the separation plants during the quarter (Section I). The average activity density of iodine on vegetation exceeded 1×10^{-5} μc/g, the maximum concentration acceptable at Hanford,[9] over an area of approximately 250 square miles outside of the reservation in March. Similar concentrations were measured over an area of 20 square miles off the project in January compared to less than one square mile during any month of the last quarter. Figures 1, 2, and 3 illustrate the pattern of contamination for January, February, and March respectively.

Average concentrations of non-volatile beta particle emitters were not significantly different from the previous quarter.

Table V summarizes the results of analysis of vegetation samples for alpha particle emitters.





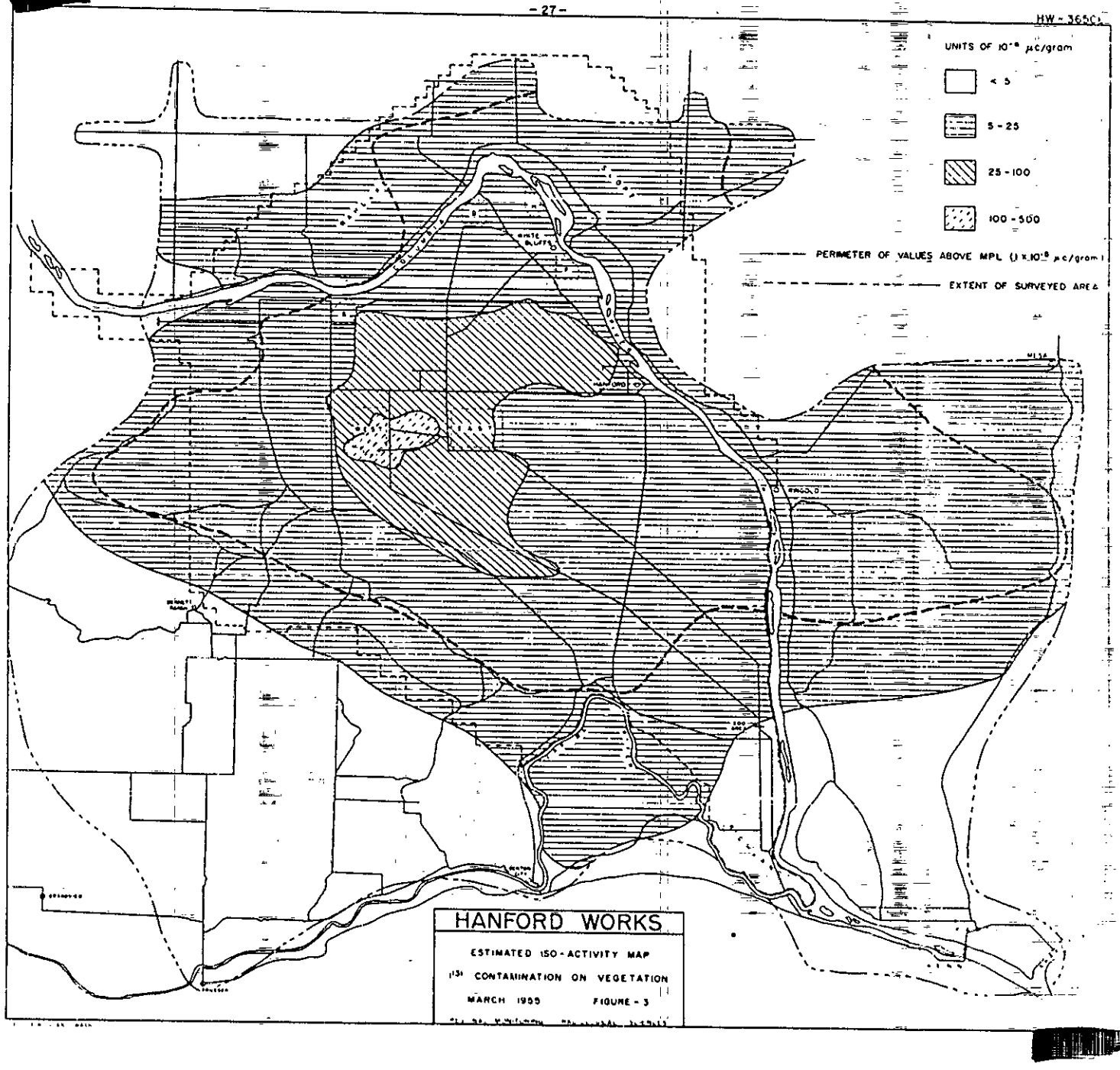


TABLE V

CONCENTRATION OF ALPHA PARTICLE EMITTERS ON VEGETATION

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-8} μc/g

Location	January	February	March	Quarterly Maximum	Quarterly Average
Near 200 Areas					
200 West Gatehouse	87	58	19	87	56
Batch Plant	19	33	22	43	27
Rt 4S - Mi. 4	24	14	12	24	17
Meteorology	48	50	<10	64	38
Rt. 4S - Mi. 6	17	17	<10	20	12
300 Area	340	21	11	340	120
Outlying					
Richland	<10	12	<10	12	<10
Pasco	23	<10	<10	36	11
Benton City	11	<10	<10	15	<10

Concentrations of alpha particle emitters on vegetation showed no increase for the reporting quarter over previous results except for the 300 Area. The increase here occurred during January and is the result of samples from one location immediately outside of the southern perimeter of the area. Fluorophotometric analysis determined the source of this contamination to be uranium.

[redacted]

SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

by

G. E. Pilcher

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

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

TABLE I

AVERAGE DOSE RATES MEASURED BY VICTOREEN INTEGRONS

JANUARY, FEBRUARY, MARCH

1955

Units of mrad per 24 hours

Location	No. of Units	January	February	March	Quarterly Average
100-B Area	3	132.*	0.4	0.1	44.2*
100-D Area	3	0.6	0.3	0.4	0.4
100-F Area	3	0.6	0.4	1.4	0.8
100-H Area	3	0.8	0.6	0.4	0.6
200 West Area	2	3.5	<0.1	3.5	<2.4
200 East Area	3	5.8	0.6	1.0	2.5
Riverland	1	0.1	<0.1	<0.1	<0.1
300 Area	1	<0.1	<0.1	0.1	<0.1
700 Area	1	<0.1	0.1	<0.1	<0.1
Pasco	1	<0.1	<0.1	<0.1	<0.1
Benton City	1	<0.1	0.7	0.5	0.4
North Richland		<0.1	**		
Hanford	1	3.3	1.1	0.5	1.6
Kennewick	1	<0.1	<0.1	<0.1	<0.1
Redox	1	1.2	1.4	7.9	3.5
200 East Semi-Works	1	0.4	0.4	1.0	0.6

*Suspected presence of particle, January 17-21. Omitting these values, monthly and quarterly averages are 0.2 mrad/24 hrs.

**Discontinued.

Significant decreases in average dose rates compared to those reported during the previous quarter were measured at nearly all locations. This trend represents a return to values normally found in the environs following the increases noted in the previous reporting periods. However, values measured at 200 East Area and Hanford showed this trend only in the last two months of the period.

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

TABLE II

AVERAGE DOSE RATES MEASURED WITH
"C" TYPE DETACHABLE IONIZATION CHAMBERS
JANUARY, FEBRUARY, MARCH
1955
Units of mrad per 24 hours

Location	January	February	March	Quarterly Average
100-B Area	3.1	2.7	2.1	2.6
100-D Area	0.8	0.8	0.8	0.8
100-H Area	0.6	0.6	0.5	0.6
100-F Area	0.5	0.4	0.4	0.4
200 West Area	0.6	0.5	0.5	0.5
200 East Area	0.5	0.6	0.6	0.6
200 East, Semi-Works	0.5	0.8	0.6	0.6

[redacted]

A comparison of the above data with previous results showed that there were no significant changes in the values for the current period from similar measurements made during the past year at any location except at 100-B. Values measured in this area were higher by a factor of 2 to 3 from previously reported results for unexplained reasons.

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

TABLE III

AVERAGE DOSAGE RATES MEASURED
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
JANUARY, FEBRUARY, MARCH
1955

Units of mrad/24 hours

Location	January	February	March	Quarterly Average	Group Average
100 Areas and Environs					
Route 1, Mile 8	0.75	0.65	0.61	0.67	
Route 2N, Mile 10	0.90	0.45	0.47	0.61	
Route 2N, Mile 5	0.75	0.79	0.56	0.70	
White Bluffs	0.59	0.69	0.69	0.66	
Route 11-A, Mile 1	0.51	2.32	0.82	1.22	
Hanford 614 Bldg.	0.40	0.46	0.43	0.43	0.64
Intersection Rt. 1 and Rt. 4N	0.56	0.53	0.48	0.52	
Military Camp, PSN 3		***	0.33	0.33	
Military Camp, PSN 21		***	0.60	0.60	

TABLE III (contd.)

Units of mrad/24 hours

Location	January	February	March	Quarterly Average	Group Average
Within 5 miles of 200 East Area					
Route 4S, Mile 6	3.01	0.55	0.80	1.45	
Batch Plant	2.06	1.84	1.26	1.72	
Route 11-A, Mile 6	0.87	1.12	1.11	1.03	
Route 3, Mile 1	0.61	0.81	1.18	0.87	
Route 4S, Mile 2.5	0.66	1.76	1.51	1.31	
Redox Area	1.27	1.18	1.17	1.21	1.34
Route 4S, Mile 4.5	1.34	2.08	1.22	1.55	
Military Camp PSN 61	0.96	5.22	0.88	2.35	
Military Camp PSN 51	2.13	1.49	1.16	1.59	
Military Camp PSN 50	1.68	1.21	1.16	1.35	
Military Camp PSN 40*	1.49	1.56	0.81	1.29	
Military Camp PSN 42		***	0.33	0.33	
Within 10 miles of 200 East					
Route 4S, Mile 10	>5.24	1.75	1.59	2.86	
Route 10, Mile 1	0.74	1.59	0.70	1.01	
Military Camp PSN 60		***	1.19	1.19	1.34
Route 10, Mile 3	1.03	1.41	0.47		
Military Camp PSN 70		***	0.13	0.13	
Route 2S, Mile 4	2.40	0.96	1.24	1.53	
300 Area and Environs					
Route 4S, Mile 16	0.99	1.66	0.86	1.17	
Route 4S, Mile 22	2.30	2.44	0.97	1.90	
North Richland North	0.58	**		0.58	1.01
1100 Area	***	0.96	0.49	0.72	
300 Area	0.53	0.80	0.75	0.69	
Outlying					
Richland	0.89	1.27	0.78	0.98	
Benton City	0.41	0.60	0.87	0.63	
Pasco	0.62	0.41	0.36	0.46	0.68
Kennewick	0.83	0.50	0.69	0.67	

*Discontinued because of proximity of chamber at Rt. 4S, Mile 4.5
**Replaced by unit in 1100 Area
***New Unit

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

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

TABLE IV

CONCENTRATIONS OF FILTERABLE BETA PARTICLE EMITTERS IN AIR

SINGLE UNIT MONITORS

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-14} µc/ml

Location	January	February	March	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-D Area	34	32	33	33	50
100-H Area	54	38	57	50	110
Hanford 614 Building	14	20	38	24	68
White Bluffs	47	40	49	46	78
200 Areas and Vicinity					
200 East, Semi-Works	44	39	40	41	57
200 West - West Center	55	67	46	56	160
200 West - Redox Area	62	48	83	64	170
Gable Mountain	30	24	56	36	140
PSN 50	81	52	27	56	180
200 West - East Center	55	45	83	60	130
300 Area - 614 Building	14	14	18	15	29
Outlying Areas					
Pasco	36	9	21	23	59
Benton City	14	14	20	16	27
Riverland	35	31	30	32	54
1100 Area - 614 Bldg*	17	18	25	20	46

*Unit located at North Richland during January.

Significant decreases were noted in the activity density of beta particle emitters collected on air filter samples at all stations during this period. This condition represents a return to values normally measured in the environs following the increases noted in the previous reporting period.

The pending closure of the North Richland Area to civilians prompted the moving of two air sampling stations from that vicinity. One station was relocated in the 1100 Area transportation center and the other was relocated at the plant barricade near 300 Area.

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

TABLE V

CONCENTRATIONS OF FILTERABLE BETA PARTICLE EMITTERS IN AIR

DUAL UNIT MONITORS

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-14} µc/ml

Location	January	February	March	Quarterly Average	Weekly Maximum
200 ESE #1	29	14	26	24	40
200 ESE #2	6	28	30	20	52
Richland #1	19	16	23	19	57
Richland #2	24	17	17	19	37

[redacted]

The quarterly averages shown in Table V also reflect significant decreases from the previous period. Again in these cases, the concentrations measured in the current period were essentially normal following the higher activity densities reported during the previous quarter.

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

TABLE VI

SUMMARY OF PARTICLE CONCENTRATIONS NEAR THE SEPARATION AREAS

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-3} particle/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	9278	18	6	2	9	110
BY - SE	8462	33	10	25	23	150
"B" Gate	9274	26	8	13	16	130
2704 Inside	9274	25	6	8	14	130
2-EWC-614 Bldg.	9278	20	6	6	11	110
200-W and Vicinity						
2701 Outside	9435	92	24	24	50	210
2722	9278	27	8	14	17	120
"T" Gate	8874	41	12	31	29	97
222-T Outside	9274	79	75	290	140	190
231	9278	29	20	42	30	130
Redox	9172	130	27	30	71	250
2701 Inside	9126	27	16	22	22	170
272	9278	18	11	18	16	140
2-WWC-614 Bldg.	9282	17	6	8	11	130
U-Gate	8453	18	10	14	14	110
222-U Lab. Inside	9282	24	26	8	19	93
Meteorology Tower						
3'	36703	14	5	5	8	43
50'	37111	15	6	3	8	39
100'	29471	13	5	3	7	47
150'	25760	9	10	3	7	64
200'	23795	11	8	3	8	68
250'	23795	11	10	4	8	70
300'	22049	12	8	6	9	78
350'	22049	13	13	7	11	62
400'	14845	16	11	7	12	94

TABLE VII

SUMMARY OF PARTICLE CONCENTRATIONS OUTSIDE THE SEPARATION AREAS

JANUARY, FEBRUARY, MARCH

1955

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

Location	Total Volume of Air Sampled Cubic Meter	January	February	March	Present Quarter Averages	Previous Quarter Averages
Area Locations						
100-B Area	7119	18	1	7	9	50
100-D Area	26388	19	2	4	11	110
White Bluffs	14985	16	2	3	11	110
100-F Area	29240	22	1	10	14	110
300 Area	17846	23	2	1	16	130
Off Area Locations						
Benton City, Wn.	19979	14	5	2	11	73
Pasco, Wn.	17200	6	2	2	5	65
Richland, Wn.	16957	31	6	5	23	150
Boise, Idaho	8751	50	6	36	31	320
Klamath Falls, Ore.	9257	61	2	6	26	240
Great Falls, Mont.	9198	70	4	3	29	91
Walla Walla, Wn.	9274	39	6	5	19	320
Meacham, Ore.	9282	43	4	3	19	120
Lewiston, Idaho	9176	51	6	6	23	280
Spokane, Wn.	9181	49	6	6	23	100
Kennewick, Wn.	8283	24	4	3	12	200
Yakima, Wn.	23719	23	1	3	16	96
Seattle, Wn.	2873	47	2	1	20	66

The concentrations of particles measured both near the plant separation areas and at remote locations decreased significantly during the quarter to reach the lowest values reported in the past two years. The specific concentrations measured showed the virtual absence of additional contamination from sources other than Hanford and also showed that particles of Hanford origin were largely confined to the immediate environs.

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

TABLE VIII

CONCENTRATIONS OF I-131 DETECTED BY AIR SCRUBBERS

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-12} µc/ml

Location	January	February	March	Quarterly Average	Weekly Maximum
200 Areas and Vicinity					
200-ESE	<0.1	0.1	7.4	2.3	27
Gable Mountain	0.1	0.1	0.5	0.2	1.0
200 West Gatehouse	0.7	0.4	7.1	2.6	17
200 West, West Center	0.2	0.7	0.7	0.5	1.9
200 East Semi-Works	<0.1	0.1	5.2	1.7	18
Redox Area	0.3	0.4	2.4	1.0	4.9
Outlying Areas					
100-H Area	<0.1	<0.1	0.3	0.1	0.5
300 Area	<0.1	<0.1	0.9	0.3	2.7
Richland	<0.1	<0.1	0.2	0.1	0.5
Pasco	<0.1	<0.1	<0.1	<0.1	0.2
Benton City	<0.1	<0.1	<0.1	<0.1	0.2
1100 Area, 614 Bldg.*	<0.1	<0.1	0.7	0.4	2.7

*This unit was located at North Richland during January.

Significant increases in I^{131} activity densities in air were measured during the quarter at all stations in the vicinity of the separations areas and at 100-H and 300 Areas. No significant changes in concentrations were measured in the surrounding residential areas. The increases noted occurred principally during the month of March and coincide with the abnormal I^{131} emissions from the separation plant stacks during this period.

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

[redacted]

TABLE IX

CONCENTRATIONS OF FILTERABLE ALPHA PARTICLE EMITTERS IN AIR

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-15} µc/ml

Locations	No. Samples	Weekly Maximum	Quarterly Average
200 West - West Center	13	12	<4
200 East Semi-Works	12	5	<4
Gable Mountain	12	8	<4
Pasco	12	12	<4
300 Area	13	6	<4
100-D Area	13	9	<4
Benton City	12	4	<4
Hanford - 614 Building	13	<4	<4
White Bluffs	13	6	<4
1100 Area - 614 Building*	12	4	<4
200 West - Redox Area	12	14	<4
100-H Area	13	24	6
Riverland	13	13	<4
PSN #50	12	15	<4
200 West-East Center	13	6	<4
Dual Unit Monitors			
200 ESE #1	13	4	<4
200 ESE #2	13	7	<4
Richland #1	13	17	5
Richland #2	13	9	<4

*This unit was located at North Richland during January.

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

[redacted]

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

by

B. V. Andersen

The activity densities of alpha and beta particle emitters in Hanford wastes were determined from results of the radiochemical analysis of liquid and solid samples collected directly from the open waste sources. Over 1,800 samples were collected from the various waste sources at frequencies ranging from daily to weekly during the three month period. Specific isotopic analyses were performed when measurements indicated unusual contamination and were carried out repetitiously on samples from locations which have a high probability of containing unusual quantities of certain contaminants. Special ground contamination surveys were performed after all incidents of known contamination deposition. The results of these measurements are summarized for each of the manufacturing areas.

100 Area Waste

The results obtained from analysis of 500 ml samples of effluent water which were collected at the outlet weir of the reactor retention basins are summarized in Table I. The samples were analyzed within twelve hours after collection and the measured counting rates of beta particle emitters were corrected for decay and expressed as activity of materials discharged to the Columbia River per unit of time.

TABLE I

BETA PARTICLE EMITTERS DISCHARGED TO RIVER
IN REACTOR EFFLUENT WATER
JANUARY, FEBRUARY, MARCH
1955

Units of 10^3 μc/second

Location	No. Samples	January		February		March		Quarterly	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B Area	72	20	17	20	17	21	17	21	17
100-C Area	64	41	24	31	27	37	26	41	26
100-D Area	84	20	16	23	17	21	18	23	17
100-DR Area	96	16	14	17	14	16	14	17	14
100-H Area	84	20	16	20	18	23	15	23	16
100-F Area	74	20	18	20	18	26	19	26	18
100-KW Area	8	--	--	--	--	3.6	3.2	--	--

A comparison of the average activity of beta particle emitters discharged to the river with the results of similar measurements obtained during the last quarter of 1954 shows that amounts discharged increased significantly in all of the reactor areas. The greatest increase occurred in the 100-C Area where the discharge averaged 26,000 μc/sec during the quarter compared with 19,000 μc/sec to the river during the last quarter of 1954. The significant increase in operating levels at all areas was probably the main cause for the increase. The average activity of alpha particle emitters in reactor effluent water entering the river was less than 1×10^{-2} μc/sec at all areas. Individual samples showed trace alpha particle emitter discharge at various times during the quarter with values indicating contaminants in the range of 1×10^{-2} to 5×10^{-2} μc/sec.

No positive uranium measurements were found in 112 samples analyzed specifically for uranium during this quarter compared with at least one sample from each area that showed detectable uranium during the first quarter of 1954.

Six out of 34 reactor effluent water samples which were analyzed for plutonium showed values above 3×10^{-9} μc/ml. The significant activities discharged ranged from 0.01 to 0.11 μc/sec with the maximum discharged to the river from 107-C Basin on March 1.

Trace quantities of polonium were found in 13 out of 34 samples of effluent water from all of the reactors. The indicated activity of polonium varied from 2×10^{-3} to 8×10^{-3} μc/sec with maximums of 0.1 μc/sec for samples from 100-B and 100-F respectively.

Eighty-eight composite samples collected from the sump at the Biology Farm were analyzed for the activity density of I^{131} discharged to the Columbia River. The average activity density was 7.5×10^{-7} μc/ml with a maximum value of 1.6×10^{-5} μc/ml found on December 29, 1954. The average was 30 μc/day compared with 39 μc/day during the fourth quarter of 1954.

200 Area Waste

The activity density of gross alpha and beta particle emitters in 200 Area wastes was determined by radiochemical analysis of liquid and solid samples collected directly from the open waste areas. Specific analyses for the activity density of uranium and plutonium were performed on a number of samples at suspected locations and on all samples which showed high alpha particle emission. A summary of the results is given in Table II.

TABLE II

RADIOACTIVE CONTAMINATION IN 200 AREA WASTE SYSTEMS

JANUARY, FEBRUARY, MARCH

1955

LIQUID SAMPLES

Location	No. Samples	Uranium and Plutonium Units of 10^{-8} µc/ml Maximum	Uranium and Plutonium Units of 10^{-8} µc/ml Average	Beta Particle Emitters Units of 10^{-7} µc/ml Maximum	Beta Particle Emitters Units of 10^{-7} µc/ml Average
T-Ditch	12	0.5	<0.5	540.	150.
T-Swamp	32	1.8	<0.5	1200.	120.
U-Swamp	26	79.	4.5	1400.	150.
Laundry Ditch	21	160.	14.	62.	12.
231 Ditch	25	160.	12.	29.	8.2
200-E "B" Ditch	3	4.1	1.8	6.6	4.4
200-E "B" Swamp	2	<0.5	<0.5	4.5	3.4
234-35 Ditch	12	13.	2.0	12.	5.2
U-Ditch Inlet	12	0.5	1.3	400.	78.

SOLID SAMPLES

		Units of 10^{-6} µc/g		Units of 10^{-5} µc/g	
T-Ditch	8	15.	4.2	*11,000.	1500.
T-Swamp	17	16.	2.9	900.	230.
Laundry Ditch	11	290.	92.	28.	18.
200-E "B" Ditch	1	5.5	5.5	20.	20.
200-E "B" Swamp	2	1.5	1.1	59.	46.
234-35 Ditch	9	9000.	2100.	22.	7.5

*If this maximum is omitted the maximum becomes 830 and the average becomes 42.

The wide fluctuations noted in the activity density measurements at many of the locations summarized in Table II were partially caused by the variation of concentrations in the system. In general, the increases noted in activity density were weighted by one or two high results and concentrations compared favorably with previous values when these high results were deleted.

Values obtained from specific analyses for uranium in liquid and solid waste agreed with results from previous quarters. The activity density of uranium in liquid waste varied from 2.2×10^{-9} to 22.0×10^{-9} μc/ml while the values obtained from mud samples varied from 2.3 to 30×10^{-6} μc/g.

Portable instrument surveys using GM type meters were performed at the perimeter of all open waste zones in the separations areas. Counting rates obtained over mud showed values ranging from 400 to 80,000 c/m at 200-West Area locations while all 200-East locations showed counting rates of less than 1,000 c/m above background. Readings obtained over the waters at the edge of the swamps and ditches ranged from 400 to 25,000 c/m at 200 West Area with background reading obtained in 200-East.

300 Area

Radioactive contamination in waste in the 300 Area was measured in samples collected directly from the north pond inlet by means of a proportional sampler. Table III summarizes the results obtained from the radiochemical analyses for alpha particle emitters, beta particle emitters, uranium, and plutonium.

TABLE III

RADIOACTIVE CONTAMINATION IN 300 AREA POND INLET

JANUARY, FEBRUARY, MARCH

1955

Liquid Samples	No. Samples	Activity Density Units of 10^{-8} µc/ml Maximum	Average
Beta Particle Emitters	59	710.	75.
Alpha Particle Emitters	59	2800.	200.
Uranium	60	3000.	160.
Plutonium	60	17.	9.7

Solid Samples	No. Samples	Activity Density Units of 10^{-3} µc/g Maximum	Average
Beta Particle Emitters	12	6.8	3.4
Alpha Particle Emitters	12	4.9	2.4
Uranium	12	7.2	5.1

Individual samples from the 300 Area pond inlet varied widely in activity density as was expected in this waste stream. The values are in the same range as those obtained in earlier quarters.

Environs - Ground Contamination

Ground surveys of control plots around Redox were continued intensively throughout the quarter. Several particles were found in the surface of the snow in January indicating that the emission of particulate material was continuing. Analyses were accomplished to compute an index defining the relative frequency of particles measured in the control plots as their number varies over time. The number of particles in each plot during each of the several surveys was expressed as a ratio to the median number of particles found in that particular plot during the first four weeks of November 1954, which was a period of rather stable concentration. The median values of this index for all control plots are shown in Figure 4. While this index does not represent the same plots for different survey periods, it does represent all sectors from the stack and is not considered seriously biased by this difference.

The very low values illustrated in Figure 4 for the period January 10, 1955 to January 14, 1955 were caused by the snow cover on the control plots.

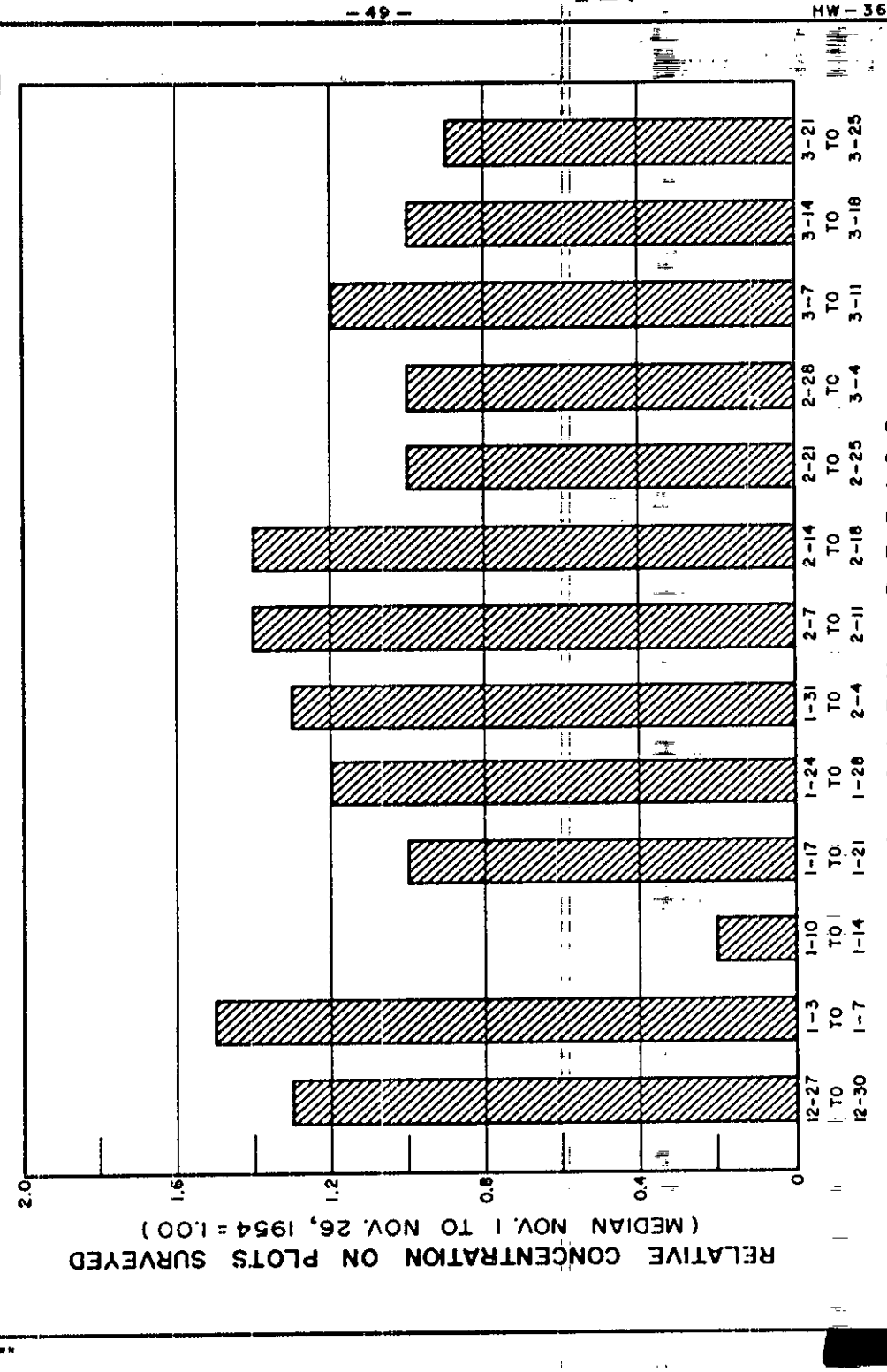
A comparison of Figure 4 with similar indices for the last quarter indicates that the particle frequency was higher during December, January and part of February with a tendency at the end of the quarter for a lower particle frequency very comparable to the base established in November 1954.

Ground surveys were completed each month along the side of main roads on and adjacent to the project with 2,000 square feet surveyed at one-mile intervals. The patterns of particle frequencies found during these surveys in February and March are shown as Figures 5 and 6. No map was prepared for January since measurements through the snow cover during the month were not comparable with those when the cover was not present.

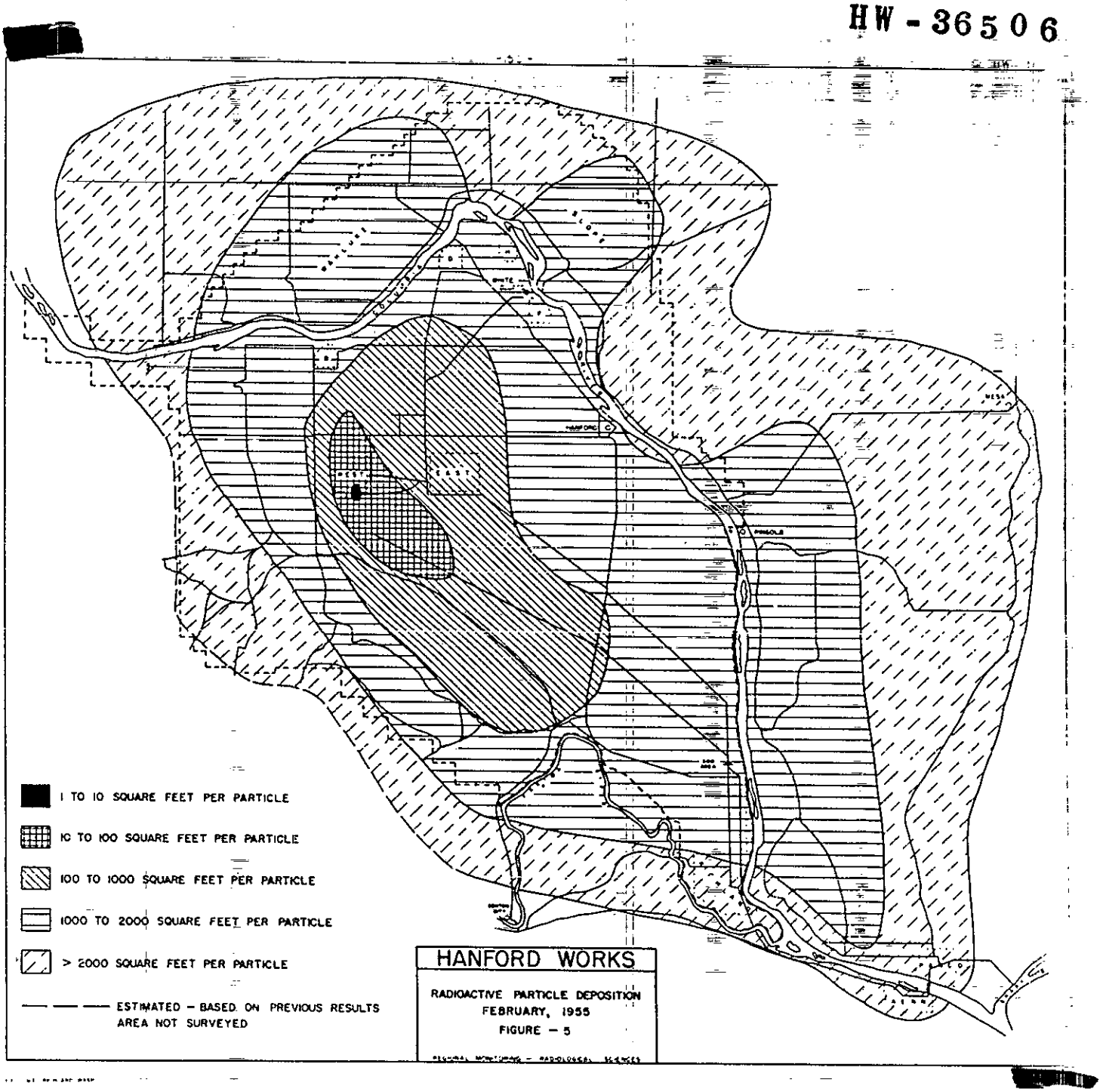
[redacted]

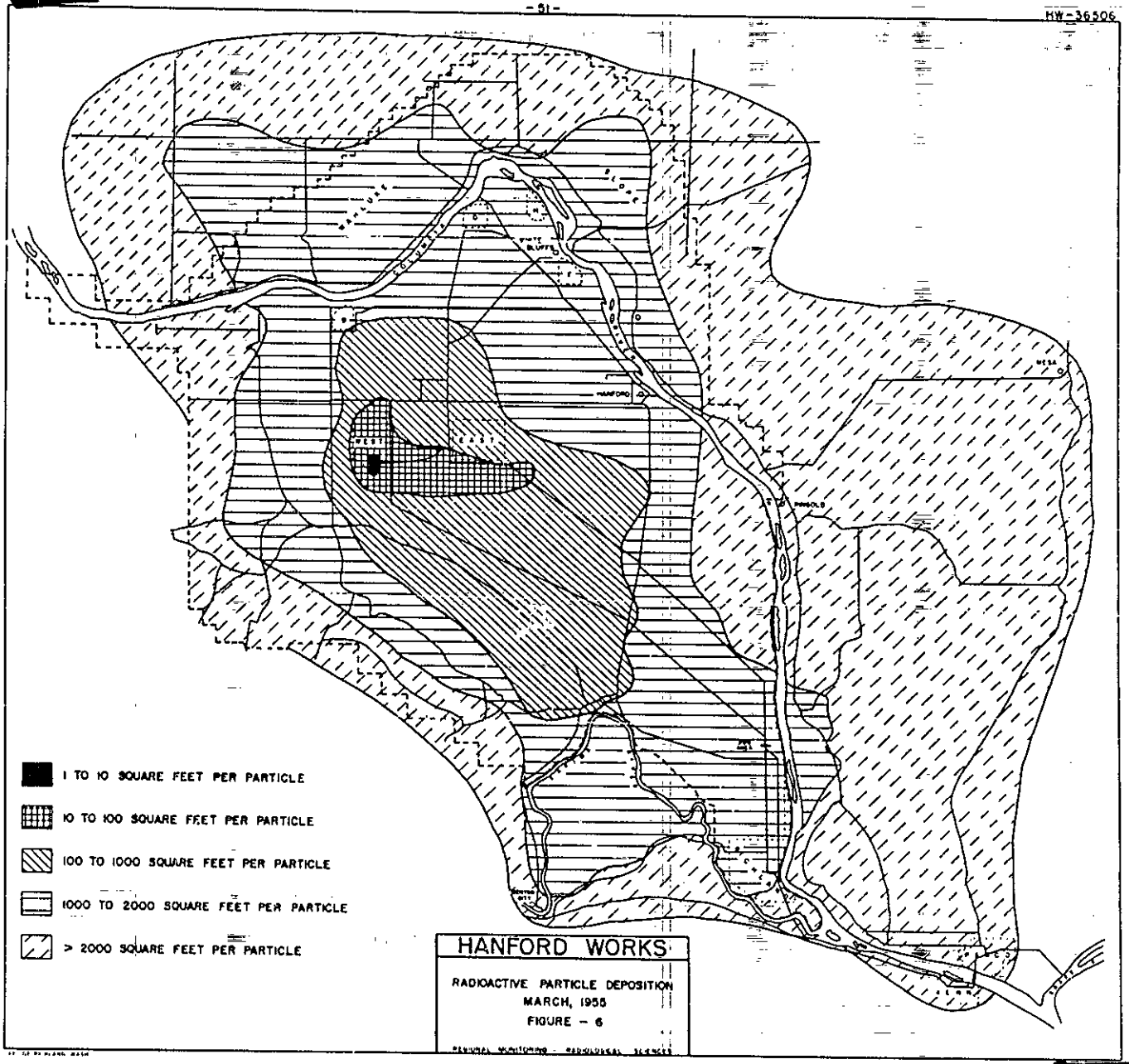
FIGURE – 4

CONCENTRATIONS OF PARTICLES ON 200-W CONTROL PLOTS



AEC-GE RICHLAND WN





Ground surveys of selected locations in Richland showed average frequencies of particles detectable by portable instruments of one particle per 4,000 square feet in January, and one particle per 2,000 to 2,500 square feet in February and March. The frequency measured during January was possibly low because of snow covering some of the particles.

Measurement of the frequencies of those particles not detectable by portable instruments also continued by exposure of film in light-proof envelopes to ground surfaces at critical areas for one-week periods. Concentrations of these particles varied from 160 particles per square foot near Redox to less than 3 particles per square foot in the vicinity of Richland, Pasco, and Kennewick. Concentrations in the vicinity of T Plant were on the order of 5-10 particles per square foot.

Work continued to define the most satisfactory techniques for measuring particle fallout. Glass wool pads backed by cardboard was the best retention medium found. It was found that the cardboard backing increased the retention of particles by glass wool by factors from 5 to 100. Comparison of the numbers of particles retained by glass wool pads on the ground and those mounted on frames two feet above the ground showed a greater number on the pads on the ground indicating movement of particles at near ground level. However, gummed paper mounted vertically on telephone poles showed particles in the air as high as 9 feet above the ground.

On December 30, 1954, a tank truck containing uranium solution overturned and spilled on the 200-E hill at Route 4-S, Mile 5 1/2. Air, soil, and vegetation samples were taken around this location several times during the quarter. After removal of most of the contamination by excavation of the soil, filling in the top with new soil, and resurfacing the road, the potential contamination hazard to the environs was eliminated.

[redacted]

Vegetation samples, ground survey results, and air samples have all indicated the source of ruthenium found in air samples collected near the BY Tank Farm to be within the tank farm itself. Average activity density of radioactive particles in weekly air samples collected approximately 700 yards southeast of the BY Tank Farm stack were as high as 1.3×10^{-10} μc/ml for the 7-day period ending February 17. Radiochemical analysis of material from the tank farm stack received during March indicated that the stack effluent was not the source of contamination although glass wool deposition pads indicated again that the source was inside the tank farm.

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER AND RELATED WATERS

by

J. K. Soldat

Nearly 1200 samples of water and mud from the Columbia River and related waters were collected this quarter to determine the contamination of the Columbia River resulting from the discharge of Hanford wastes. These samples were analyzed for the activity density of gross beta and gross alpha particle emitters, and in some instances for uranium. Sample volumes and frequencies of collection ranged from 500 ml samples collected on a daily to weekly basis in the immediate HAPO environs to one gallon samples collected on a monthly basis downstream of McNary Dam.

Table I is a summary of the results obtained from the analysis of the 500 ml samples for gross beta particle emitters during this quarter.

TABLE I

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RIVER WATER

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-8} μc/ml

Location	Jan. Avg.	Feb. Avg.	Mar. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch	<5	<5	<5	<5	<5	12
181-B Area	<5	<5	<5	<5	9	8
181-C Area	<5	<5	10	6	7	30
Allard Station	23	<5	6	10	8	70
181-D Area	600	650	500	580	710	1000
181-H Area	950	680	670	780	820	1500
Below 100-H Area	2300	1300	1300	1600	1300	4400
181-F Area	1200	1800	1300	1400	1400	2000
Below 100-F Area	2500	1100	1300	1600	1400	3500
Hanford South Bank	2400	1800	1900	2000	2000	3500
Hanford Middle	1600	1600	1200	1500	1200	3000
Hanford North Bank	1000	970	570	860	720	3000
300 Area	970	620	600	730	670	1500
Byers Landing	-	170	-	170	260	170
Richland	710	440	450	520	510	1100
Kennewick Highlands Pumping Station	500	270	360	380	290	720
Pasco Bridge (Kenn. Side)	320	260	240	270	290	540
Pasco Bridge (Pasco Side)	350	300	390	350	260	1100
Pasco Pumping Plant	600	380	440	420	300	810
Sacajawea Park	230	180	200	210	160	290
McNary Pool	72	74	-	73	55	100
McNary Dam	52	48	37	42	54	80
Paterson	57	50	47	50	36	75
Snake River at Mouth	49	<5	<5	24	18	130
Yakima River at Mouth	5	<5	<5	<5	6	8
Yakima River - Horn	<5	<5	<5	<5	<5	<5
Yakima River at Prosser	<5	<5	<5	<5	<5	6
3000 Area Pond Inlet	<5	<5	<5	<5	<5	<5

No significant changes in the activity density of beta particle emitters were noted when comparing the average values of this quarter with those of the previous period. This uniformity was expected since the flow rates of the Columbia River were fairly constant throughout the period October 1953 to March 1954, as shown in Figure 7, and the effect of increases on the activity of reactor effluent entering the river was within the variation of measurements of river water activity. Average flow rate this quarter was 6.0×10^5 gps with a maximum of 6.9×10^5 gps on March 12, 1955. Average and maximum figures for the previous quarter were 6.0×10^5 and 7.5×10^5 gps, respectively.

Special river studies, mentioned in the previous report of this series, (10) continued on a reduced scale. Because of inclement weather, only 200 surface water samples were collected this quarter for the study. No samples were collected from McNary Pool during March.

Trace activities of beta particle emitters were detected in all samples collected downstream of McNary Dam this quarter; results ranged from 7×10^{-8} to 6×10^{-7} μc/ml. The maximums of 2.0×10^{-7} μc/ml during January and February occurred in the Maryhill-Arlington region; during March, the maximum of 6.3×10^{-7} μc/ml occurred at Troutdale, Oregon, with the second highest activity density of 5.0×10^{-7} μc/ml occurring at Maryhill.

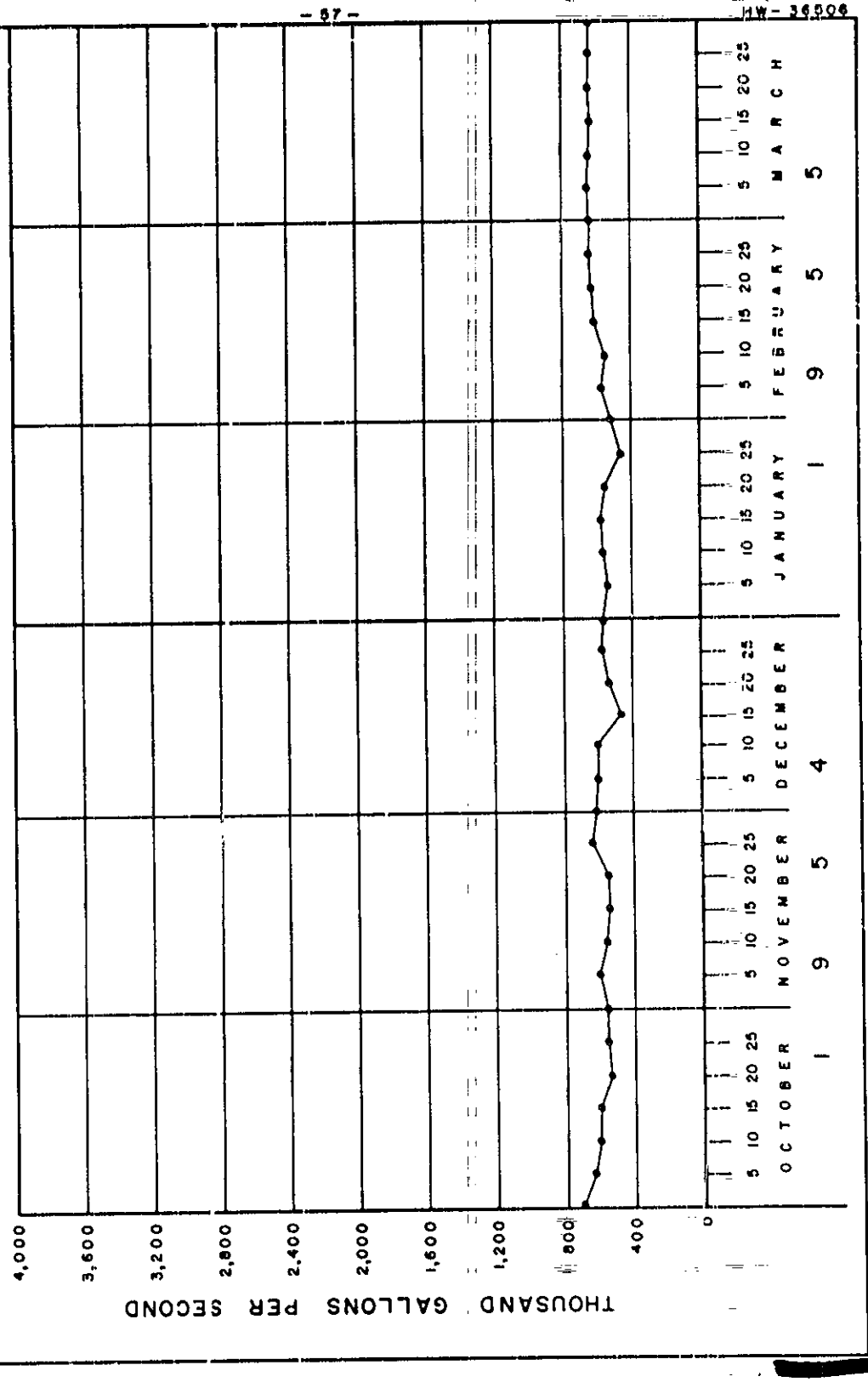
Measurements of alpha particle emitter activity density averaged below the laboratory detection limit for 500 ml samples of 5×10^{-9} μc/ml this quarter for all locations shown in Table I except for the Highlands Pumping Station and the 300 Area locations. Average and maximum values for the Highlands Pumping Station were 6.0×10^{-9} μc/ml and 5.4×10^{-8} μc/ml, respectively. The activity density of alpha particle emitters found in river water near 300 Area continued on the order of magnitude found in the past; the average value this quarter was 2.2×10^{-8} μc/ml, including a maximum of 1.8×10^{-7} μc/ml.

[redacted]

FIGURE — 7

COLUMBIA RIVER FLOW

JANUARY – FEBRUARY – MARCH



Samples of Columbia River water collected from the south bank at Hanford for I^{131} analysis were found to contain other short-lived iodine isotopes during the quarter. This finding indicated that the activity density of I^{131} reported in previous quarterly reports of this series was biased on the high side by inclusion of activity from these other iodine isotopes. This finding necessitates evaluation of I^{131} in such samples in the future by observation of the decay characteristics of the total iodine. Measurements obtained during the present quarter were still calculated, assuming that all the iodine activity present in the freshly collected samples was due to I^{131}. These results averaged 1.2×10^{-7} μc of iodine per ml of river water, with a maximum of 3.8×10^{-7} μc/ml.

One gallon samples of water were collected from three locations in the Columbia River during March for measurements of the concentration of uranium in the river above and below the reactor areas. Samples collected at one-half mile above Will's Ranch, opposite Will's Ranch, and near the old Pasco - Kennewick Bridge showed average concentrations at these locations to be on the order of 5 to 8×10^{-10} μc/ml.

The extent and magnitude of the deposition of radioactive materials from the Columbia River were determined by the radiochemical analysis of mud samples collected from the Columbia, Yakima, and Snake Rivers. The results from the analysis of these samples for beta particle emitters are summarized in Table II.

TABLE II

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RIVER MUD SAMPLES JANUARY, FEBRUARY, MARCH 1955

Units of 10^{-5} μc/g

Location	Jan. Avg.	Feb. Avg.	Mar. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Wills Ranch						
Shore	2.4	2.6	2.7	2.6	3.3	3.2
5' Out	4.7	2.7	1.6	2.9	2.7	9.4
Allard Station						
Shore	2.9	2.5	2.9	2.8	2.4	3.6
5' Out	2.6	2.1	2.9	2.6	2.7	6.2
100-H Area						
Shore	13.	7.8	6.5	9.0	9.5	34.
5' Out	6.8	7.4	4.6	6.2	11.0	16.
Below 100-F Area						
Shore	5.4	11.	5.7	7.3	13.	19.
5' Out	10.	11.	6.0	8.7	13.	20.
Hanford Ferry						
Shore	9.9	9.4	4.7	7.9	7.5	20.
5' Out	9.3	12.	4.1	8.1	9.7	21.
300 Area						
Shore	4.6	7.3	6.8	6.4	9.5	13.
5' Out	5.4	9.3	5.3	6.7	13.	9.8
Byers Landing Pump Plant						
Shore	7.9	4.4	-	6.2	8.2	7.9
Richland Dock						
Shore	5.4	4.6	5.1	5.0	7.2	7.8
5' Out	7.6	9.5	6.5	7.8	19.	14.
Kennewick Highlands Pumping Plant						
Shore	3.8	2.5	4.2	3.4	3.4	7.4
5' Out	3.2	4.3	3.0	3.6	4.8	7.7
Pasco-Kennewick Bridge (Kenn. Side)						
Shore	4.0	5.0	2.9	4.0	4.4	6.2
5' Out	3.0	4.6	2.6	3.4	5.2	5.6
Sacajawea Park						
5' Out	5.0	3.8	3.8	4.2	4.5	6.0
McNary Cold Spg. So.						
Shore	11	-	-	11	7.3	11.
McNary Cold Spg. Middle	17	-	-	17	11.	17.
McNary Cold Spg. No.						
Shore	5.5	8.3	-	6.9	8.2	8.3
McNary Dam						
5' Out	3.6	2.8	2.5	2.9	3.5	6.3
Paterson						
Shore	2.9	3.8	3.0	3.2	3.5	5.0

TABLE II (contd.)

Units of 10^{-5} μc/g

Location	Jan. Avg.	Feb. Avg.	Mar. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
Snake River Mouth						
5' Out	1.8	2.7	2.7	2.4	2.9	4.5
Yakima River Horn						
Shore	2.8	1.8	1.6	2.0	1.9	4.0
5' Out	2.4	1.6	2.0	2.0	2.6	3.0
Yakima River - Prosser						
5' Out	1.9	2.3	1.6	2.0	1.9	3.9

Small decreases in the average activity density of beta particle emitters in river mud were noted in the region between 100-H and Richland this quarter. The most notable decrease was observed in the Richland Dock samples from 5 feet off-shore, where the previous quarterly average had been weighted by an unusually high measurement during November. The other decreases noted in Table II for this section of the river were similar to those noted during the first quarter of 1954. As usual, there were no significant changes in the concentration of naturally occurring emitters in river mud above the reactor areas or in the Yakima or Snake Rivers.

Almost all of the solid samples collected this quarter for beta particle emitter analysis were also analyzed for the activity density of alpha particle emitters. The samples collected from 300 Area location were the only ones which had an average activity density of alpha particle emitters equal to or above the detection limit of 3×10^{-6} μc/g. Average and maximum values from the shore samples at this location were 5×10^{-6} and 1.2×10^{-4} μc/g, respectively; similar values for the samples collected five feet out from shore were 3×10^{-6} and 1.6×10^{-5} μc/g, respectively. Detectable alpha particle emitter activity density has been found at this location consistently and maximum values on the order of 2×10^{-5} μc/g are not unusual.

Samples of raw water prior to purification for drinking purposes were collected from the 183 and 283 buildings in the reactor and separation areas.

Table III summarizes the results obtained from the analysis of 140 of these samples for the activity density of beta particle emitters.

TABLE III

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RAW WATER

RIVER EXPORT LINE

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-8} µc/ml

Location	Jan. Avg.	Feb. Avg.	Mar. Avg.	Qtr. Avg.	Last Qtr. Avg.	Max. This Qtr.
183 Bldg., 100-B Area	7	<5	<5	<5	<5	18
183 Bldg., 100-C Area	<5	<5	<5	<5	10	6
183 Bldg., 100-D Area	230	120	100	150	130	370
183 Bldg., 100-DR Area	220	120	110	150	140	420
183 Bldg., 100-F Area	130	230	260	210	180	380
183 Bldg., 100-H Area	320	150	180	210	180	500
183 Bldg., 100-KW Area	110	62	53	71	*	150
283 Bldg., 200 East Area	63	55	77	64	86	94
283 Bldg., 200 West Area	120	94	150	120	120	210

*Not sampled during previous quarter.

No significant changes were noted when the values in Table III were compared with those obtained during the previous quarter. This was expected since no significant changes were noted in the river water activity density this quarter. The raw water originates from the Columbia River and the activity density of the river and raw waters are directly related.

Analysis of samples from locations listed in Table III for the activity density of alpha particle emitters revealed only three significant measurements. One measurement from each of the 183-DR, 183-H, and 283-E locations showed concentrations of 7×10^{-9} μc/ml. The monthly and quarterly averages for all the locations in Table III were below the detection limit of 5×10^{-9} μc/ml, and the results discussed above are not unusually different from measurements obtained during previous quarters.

SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

by

D. L. Reid

A total of 154 rain samples were collected from 25 locations in the Hanford environs and analyzed for the gross beta particle emitter activity density. The total precipitation of 0.95 inches for the period was approximately 50 per cent of the 35-year average of 1.81 inches at Hanford and was the driest first quarter in the history of the area. Table I summarizes the precipitation measurement obtained at the Meteorology Tower adjacent to the separation areas; measurements for the three previous years are included for comparison.

TABLE I

MEASURED PRECIPITATION AT HANFORD WORKS

JANUARY, FEBRUARY, MARCH

1955

Units of Inches

Year	January	February	March	Quarterly Total
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
1955	0.56	0.22	0.17	0.95

The values obtained for the activity density of gross beta particle emitters in the rain samples are presented in Table II.

TABLE II

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RAIN

JANUARY, FEBRUARY, MARCH

1955

Units of 10^{-6} μc/ml

Location	Number Samples	Maximum	Average
In 200 East Area	15	3	<1
250' E of B-Plant stack	6	3	<1
2000' E of B-Plant stack	4	<1	<1
3500' SE of B-Plant stack	5	1	<1
In 200 West Area	32	46	10
1000' E of T-Plant stack	7	14	6
7000' E of T-Plant stack	6	14	7
8000' SE of T-Plant stack	6	20	11
4900' SE of T-Plant stack	7	12	5
Redox Area	6	46	23
100 Area Environs	35	4	<1
100-B SE	5	1	<1
100-D SW	5	<1	<1
100-F SW	6	<1	<1
Hanford 614	7	<1	<1
White Bluffs	6	1	<1
100-H Area SE	6	4	1
Perimeter Locations	27	2	<1
700 Area 614	5	<1	<1
Pasco H and R	6	<1	<1
Benton City	6	<1	<1
Riverland	7	<1	<1
300 Area North	3	2	<1
Intermediate Locations	45	10	<1
Route 4S, Mile 6	8	<1	<1
300 Area 614	6	<1	<1
200 North Area 614	6	2	<1
Gable Mountain	6	5	<1
Batch Plant	1	1	1
622 Building	18	10	1

The average activity density of beta particle emitters in rainfall was below the detection limit of 1×10^{-6} μc/ml for all stations except those in close proximity to the active separations stacks and those favorably positioned in the principal down-wind directions from the stacks. The maximum concentration of 4.6×10^{-5} μc/ml was obtained from a station located in the Redox Separation Area and was higher by a factor of 1.4 than the maximum value obtained during the previous quarter. The average concentration of all samples obtained from the 200 West Area stations was greater by a factor of two than the previous three-month average for the same locations, and reflects the increased stack emission for the first quarter of 1955 as compared with the last quarter of 1954.

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SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

by

Z. E. Carey

Approximately 750 samples of water were analyzed to determine possible contamination of drinking water sources in the Hanford environs and an additional 180 samples from test wells were analyzed to determine any contamination in the water table underlying the project. Volumes collected were 500 ml except for 165 samples where 11.7 liters were collected to give increased sensitivity in the detection of alpha particle emitters. Additional samples of filter and backwash material were collected at the Pasco Filter Plant to allow evaluation of the efficiency of this plant in removing contaminants from Columbia River water. Table I summarizes the results of measurements made on 500 ml samples at those locations where the activity density of alpha particle emitters in drinking water averaged greater than the detection limits of 5×10^{-9} μc/ml during the quarter.

TABLE I

CONCENTRATIONS OF ALPHA PARTICLE EMITTERS IN DRINKING WATER JANUARY, FEBRUARY, MARCH 1955

Location	500 ml Samples: Uranium and Plutonium, Units of 10^{-9} µc/ml			Uranium, Units of 10^{-9} µc/ml		
	No. Samples	Max.	Avg.	No. Samples	Max.	Avg.
Midway	9	37	6	-	-	-
Richland Well #4	10	14	7	10	7	6
Richland Well #12	2	15	14	3	11	8
Richland Well #13	2	6	5	2	4	4
Benton City Store	13	24	15	13	14	8
Benton City Water Company	11	17	14	11	18	10
Sacajawea	12	14	7	12	8	6
Pasco Improvement Farm	1	8	8	-	-	-
Paterson Store	13	7	5	13	8	6

Similar concentrations were reported at all locations except Midway at some time during the previous year. With the exception of the maximum concentration observed in a sample collected at Midway on February 28, values at this location were on the order of those previously reported. All concentrations were considerably below the maximum permissible concentrations of the isotopes involved.(11)

The results of the radiochemical analysis of 500 ml samples of drinking water at all locations where samples were collected are given in Table II. While individual samples at many of the locations did show significant concentrations of alpha particle emitters, none was abnormally high except for the value at Midway mentioned previously.

TABLE II

CONCENTRATION OF ALPHA AND BETA PARTICLE EMITTERS IN WATER SUPPLIES JANUARY, FEBRUARY, MARCH 1955

500 ml Samples

Location	No. Samples	Uranium and Plutonium Units of 10^{-9} µc/ml Maximum	Uranium and Plutonium Units of 10^{-9} µc/ml Average	Beta Particle Emitters Units of 10^{-8} µc/ml Maximum	Beta Particle Emitters Units of 10^{-8} µc/ml Average
Richland Well #2	2	<5	<5	<5	<5
Richland Well #4	10	14	7	<5	<5
Richland Well #5	2	<5	<5	<5	<5
Richland Well #12	2	<5	<5	<5	<5
Richland Well #13	2	6	5	10	8
Richland Well #14	2	6	<5	7	<5
Tract House - J-685	10	<5	<5	39	7
3000 Area Well "A"	8	<5	<5	<5	<5
3000 Area Well "B"	1	<5	<5	5	5
3000 Area Well "C"	13	<5	<5	43	9
3000 Area Well "E"	7	<5	<5	<5	<5
3000 Area Well "F"	7	<5	<5	60	10
3000 Area Well "H"	10	9	<5	6	<5
3000 Area Well "J"	8	<5	<5	<5	<5
3000 Area Well "K"	11	<5	<5	6	<5

TABLE II (contd.)

500 ml Samples

Location	No. Samples	Uranium and Plutonium Units of 10^{-9} µc/ml Maximum	Uranium and Plutonium Units of 10^{-9} µc/ml Average	Beta Particle Emitters Units of 10^{-8} µc/ml Maximum	Beta Particle Emitters Units of 10^{-8} µc/ml Average
Durand Well #5	13	7	<5	<5	<5
Columbia Field Well "A"	13	9	<5	7	<5
Columbia Field Well "B"	13	5	<5	<5	<5
Columbia Field Well "C"	13	8	<5	160	14
Headgate Well	10	23	<5	9	<5
1100 Area Well #8	51	21	<5	41	<5
Midway	9	37	6	11	<5
Riverland	3	<5	<5	<5	<5
Lower Knob	12	5	<5	32	6
Will's Ranch	13	10	<5	99	10
Pistol Range	12	5	<5	7	<5
White Bluff Fire Hall	13	6	<5	96	48
Benton City Store	13	24	15	14	<5
Benton City Water Co. Well	11	17	14	9	<5
Kiona	13	10	<5	8	<5
Enterprise	13	<5	<5	23	<5
Kennewick Std. Station	13	<5	<5	63	27
100-B (San)	13	<5	<5	60	8
100-C (San)	13	<5	<5	36	7
100-D (San)	13	6	<5	170	55
100-DR (San)	13	8	<5	130	58
100-H (San)	13	<5	<5	120	64
100-F (San)	13	<5	<5	200	80
100-K Well #1 (San)	12	6	<5	93	45
200-East (San)	13	<5	<5	45	31
200-West (San)	13	6	<5	110	64
300 Area (San)	13	6	<5	6	<5
251-Building (San)	13	<5	<5	22	13
Redox Ad. Building (San)	12	<5	<5	66	48
Sacajawea Park (San)	12	14	7	32	<5
McNary Dam (San)	13	<5	<5	8	<5
Paterson (San)	13	7	5	<5	<5
Plymouth (San)	13	<5	<5	38	<5
Prosser (San)	13	<5	<5	<5	<5
Byers Landing Pump Plant	2	<5	<5	<5	<5
Kennewick Reservoir	10	<5	<5	66	26
Pasco Improvement Farm	1	8	8	<5	<5
Pasco H and R Depot	13	<5	<5	41	18
Clover Island Pumping Station	9	<5	<5	90	26

Concentrations of beta particle emitters at the various locations were comparable to those noted for the same period in 1954. A few maximum values reported for sources using well water were not confirmed by resampling and the average concentrations measured otherwise were normal. Average concentrations of beta particle emitters at those locations where the drinking water originated from the Columbia River were comparable to those of the last quarter of 1954. The lower flow of the Columbia River during this period of the year results in higher concentrations of these emitters through decreased dilution of upstream reactor effluent water.

Approximately one hundred seventy 11.7 liter samples of water were analyzed for alpha particle emitters to obtain the greater sensitivity of measurement afforded by the larger sample. Results of these analyses are given in Table III. No unusual concentrations were observed during the quarter.

TABLE III

CONCENTRATION OF ALPHA PARTICLE EMITTERS IN DRINKING WATER

JANUARY, FEBRUARY, MARCH

1955

11.7 Liter Samples

Location	No. Samples	Units of 10^{-10} µc/ml Maximum	Average
Richland Well #2	1	18	18
Richland Well #5	1	27	27
Richland Well #12	1	41	41
Richland Well #13	1	34	34
Richland Well #14	1	30	30
Tract House J-685	4	17	14
Columbia Field Well "A"	6	16	13
Columbia Field Well "B"	6	76	23
Columbia Field Well "C"	6	28	19
1100 Area Well #8	7	28	23
3000 Area Well "A"	5	17	13
3000 Area Well "B"	1	17	17
3000 Area Well "C"	7	80	23
3000 Area Well "E"	4	18	14
3000 Area Well "F"	2	5	3
3000 Area Well "H"	4	13	11
3000 Area Well "K"	6	15	11
3000 Area Well "J"	3	18	14
3000 Area Durand #5	6	21	16
Benton City Store	4	97	74
Benton City Water Co. Well	5	100	90
Kiona	4	10	8
Enterprise Well	4	9	7
Headgate Well	3	15	9
Kennewick Reservoir	4	9	7
Kennewick, Std. Station	6	9	7
Riverland	1	6	6
Midway	4	6	5
Lower Knob	7	<2	<2
Will's Ranch	5	5	4
McGee Well	6	14	3
Ford Well	6	2	<2
Meeker Well	5	<2	<2
White Bluff Fire Hall	6	8	5
Pistol Range	6	22	18
B. Y. Well	6	28	21
251 Building (San)	7	7	4
Clover Island Pump Station	3	9	7
3000 Area Pond Inlet	1	12	12

The results from analysis of water and solid samples collected at various stages of processing in the Pasco Filter Plant are given in Table IV.

TABLE IV

CONCENTRATIONS OF BETA PARTICLE EMITTERS AT THE PASCO FILTER PLANT JANUARY, FEBRUARY, MARCH 1955

Type Sample	No. Samples	Maximum	Average
Water Entering Plant from River	34	8.1×10^{-6} µc/ml	4.3×10^{-6} µc/ml
Sand (surface of sand filter)	12	2.6×10^{-4} µc/g	1.7×10^{-4} µc/g
First Backwash Material (liquid)	12	1.0×10^{-6} µc/ml	4.9×10^{-7} µc/ml
First Backwash Material (solid)	12	4.1×10^{-2} µc/g	2.2×10^{-2} µc/g
Coal (surface of coal filter)	12	2.7×10^{-4} µc/g	1.8×10^{-4} µc/g
First Backwash Material (liquid)	12	1.4×10^{-6} µc/ml	5.1×10^{-7} µc/ml
First Backwash Material (solid)	12	1.1 µc/g	0.1 µc/g
Water Leaving Plant	12	2.2×10^{-6} µc/ml	5.1×10^{-7} µc/ml

The activity density of beta particle emitters in water leaving the plant was approximately equal to that of the previous quarter and the average decontamination factor of 8 was similar to those noted in earlier quarters. While the concentration in the water leaving the plant was about twice that noted for the same period in 1954, it was still less than one per cent of the maximum permissible concentration based on a composition calculated by using the composition of reactor effluent water and allowing for its decay. Permissible limits used for comparison were those given in Handbook 52.(11)

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

TABLE V

CONCENTRATIONS OF ALPHA AND BETA PARTICLE EMITTERS IN TEST WELLS JANUARY, FEBRUARY, MARCH 1955

500 ml Samples

Location	No. Samples	Uranium and Plutonium Units of 10^{-9} µc/ml Maximum	Uranium and Plutonium Units of 10^{-9} µc/ml Average	Beta Particle Emitters Units of 10^{-8} µc/ml Maximum	Beta Particle Emitters Units of 10^{-8} µc/ml Average
300 Area Well #1	5	26	12	<5	<5
300 Area Well #3	4	76	63	5	<5
300 Area Well #4	3	110	64	<5	<5
B-Y Well	13	14	5	35	6
303-1	12	1100	670	22	8
303-2	12	950	800	16	6
303-4	12	750	380	7	<5
303-6	12	1400	850	99	12
303-7	3	140	110	<5	<5
303-9	3	56	32	<5	<5
303-10	2	370	290	6	<5
303-11	3	20	15	<5	<5
303-12	3	250	170	<5	<5
3000-7	3	13	10	<5	<5
25-56	1	38	38	<5	<5
25-35	2	28	16	<5	<5
17.4-4.5	2	37	24	12	8
S-12.3-2.7	2	19	18	<5	<5
S-30.7-.7	1	6	6	<5	<5
10.2-53.5	1	<5	<5	6	6
54-42.5	1	10	10	<5	<5
55-50	1	9	9	<5	<5
60-60	1	12	12	<5	<5
62.5-90	1	23	23	<5	<5
60-80	1	15	15	<5	<5
49-79	1	170	170	<5	<5
71-52	1	<5	<5	5	5
361-B-6	1	11	11	5	5
361-B-7	1	<5	<5	14	14
361-B-11	1	<5	<5	7	7
McGee Ranch Well	13	<5	<5	110	17
Meeker Ranch Well	13	<5	<5	91	11

Significant increases were noted in the concentration of alpha particle emitters in test wells 303-2, 303-4, and 303-6 with that in well 303-2 averaging twice as high as any quarterly average during the year. High concentrations of alpha particle emitters were also found in test wells 62.5-90 and 49-79 but these results are based on single samples and were not confirmed by more recent results. High average concentrations of beta particle emitters in McGee Ranch and Meeker Ranch wells were weighted by one high sample collected at each location.

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