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BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD
JULY, AUGUST, SEPTEMBER 1952

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HANFORD TECHNICAL RECORD

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1952

by

H. J. Paas

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April 15, 1953

HANFORD WORKS
RICHLAND, WASHINGTON

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

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INTRODUCTION

This report summarizes the results obtained from a three month study of monitoring for radioactive contamination in the environs of the Hanford Works. Radioactive contamination originating as a result of the operation of the Hanford Works and from naturally occurring isotopes was monitored in the liquid, gaseous, and solid states. Data obtained from the radiochemical analysis of samples of various materials were supplemented with portable instrument surveys. Detailed explanation of the monitoring methods employed during this quarter may be referred to in previous documents of this series (HW-23133, HW-24203, and HW-25866). Laboratory procedures used by the control laboratory of the Biophysics Section are outlined in HW-20136. The correction factors applied to the counting rates obtained from the radiochemical analysis of direct samples are summarized in documents HW-22682 and HW-23769. In addition to the corrections outlined in the latter publications, many of the samples were also corrected for the decay of specific isotopes when the total activity density from gross beta particle emitters included a predominance of short half-life emitter.

Maps which show the location of monitoring stations and sampling locations referred to in the discussion have been published in documents HW-25866 and HW-21214. Project boundaries indicated on these location maps are those defined by the United States Atomic Energy Commission in drawing SK-7-414.

ABSTRACT

SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES:

Daily emission of I^{131} from separation facilities averaged 3 curies per day. Maximum I^{131} emission of 16.4 curies per day occurred at the 202-S facility during a period of faulty silver reactor operation. Approximately 80 per cent of the total I^{131} discharged to the atmosphere was emitted from the 202-S facility. Ruthenium emission at the Redox plant averaged 0.2 curie per day including a maximum emission of 4.1 curies per day. Stack emission measurements initiated at the U-plant showed average daily emission of 1.2×10^{-7} curie per day and 8.2×10^{-7} curie per day for gross alpha and gross beta particle emitters, respectively. Monitoring at the reactor stacks for C^{14}, S^{35}, tritium oxide and radioactive particles showed results comparable to those observed during the previous quarter. Initial gross activity determinations for alpha and beta particle emitters by direct counting methods at each reactor area indicate average daily emission on the order of 10^{-7} curie per day from alpha particle emitters and 10^{-5} curie per day from beta particle emitters, at each reactor.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

The decrease in the amount of I^{131} deposited on vegetation observed during the previous quarter continued during this period. Maximum deposition measured directly east and south of the 200 West area did not exceed 4×10^{-5} μc/g during any part of the three month period. Values in the range of 5×10^{-6} to 2.5×10^{-5} μc I^{131}/g predominated in the area of highest contamination. I^{131} deposition was below the detection limit of 3×10^{-6} μc/g at all other locations except for several small isolated areas in the immediate environs. The activity density from non-volatile beta particle emitters was on the order of 3×10^{-5} μc/g in the immediate environs and

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in the range of 1 to 2 x 10^{-5} μc/g for off-site locations. Except for several samples which showed values on the order of 1 x 10^{-6} μc/g near the separation areas, the activity density from alpha particle emitters on vegetation was less than 5 x 10^{-8} μc/g.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Detachable ionization chamber readings showed that the average dosage rate decreased from 1.2 mrep/day to 0.97 mrep/day at locations within a radius of 5 miles of the separation area. Dosage rates in communities around the project perimeter ranged from 0.3 to 0.9 mrep/day. General decreases in the average activity density from air-borne beta particle emitters were observed throughout the environs; average values in the range of 1 to 5 x 10^{-13} μc/cc predominated on the site. The average activity density from filterable beta particle emitters did not exceed 2.6 x 10^{-13} μc/cc in the nearby residential areas. General decreases in the number of radioactive particles in the atmosphere were noted throughout the region. Particle concentrations averaged between 0.01 and 0.1 particle/m^3 at all project locations except those near the 202-S facility where several values in the range of 0.1 to 0.8 particle/m^3 were obtained. Decreases in particle contamination were also reflected at off-site locations where average values in the range of 0.004 to 0.08 particle/m^3 predominated. The average number of radioactive particles measured during the quarter were weighted by higher measurements obtained during the month of July which were believed to be associated with residual contamination from the nuclear explosion tests. The activity density from I^{131} in the atmosphere averaged in the range of 1 x 10^{-13} to 4.8 x 10^{-12} μc/cc on the project. In outlying locations, trace amounts of iodine were detected at only 2 of 7 fixed locations. Air filters analyzed for the activity density from alpha particle emitters showed average values varying from less than 4 x 10^{-15} μc/cc to 3.5 x 10^{-14} μc/cc; the bulk of these measurements were below the detection limit of 4 x 10^{-15} μc/cc.

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SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

Averages obtained from samples collected at the outlet side of the reactor retention basins showed the activity density from gross beta particle emitters to range from 2.5 to 3.9 x 10^{-3} $\mu c/cc$ at the five reactor areas. The application of revised correction factors to the counting rates of these samples caused these values to be somewhat higher than those previously measured; statistical analysis of the data indicated no significant change in the activity levels in this water during this period. A complete tabulation of recomputed values for the activity density from gross beta emitters in effluent water obtained by applying the revised correction factors to past data is included in the text. Studies to determine the effective hold-up time of the effluent in the retention basin showed values ranging from 1.5 to 3 hours at the various reactor areas; values on the order of 2 hours predominated in these data. I^{131} discharged to the Columbia River in the Biology Farm waste averaged 0.20 mc/day. With the exception of one mud sample collected at the edge of the B-swamp in which the activity density from gross beta emitters was 0.7 $\mu c/g$, the amounts of radioactive contamination in separation area wastes were comparable with previous results.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER:

The decrease in the activity density from beta particle emitters in Columbia River water which were observed during the previous quarter continued during July when high flow rates on the order of 1,500,000 gallons per second prevailed in the river. Significant decreases in flow to 837,000 and 481,000 gallons per second during August and September caused increases in the activity density by factors varying from 2 to 5. Maximum measurements were obtained below the 100-F area and at the Hanford ferry where the average activity was 4.5 x 10^{-6} $\mu c/cc$ including a maximum measurement of 1.1 x 10^{-5} $\mu c/cc$. Analysis of river samples for the activity density

 [redacted]

from alpha particle emitters showed values below the detection limit of 5×10^{-9} μc/cc. I^{131} in the Columbia River at the Hanford ferry averaged 7×10^{-8} μc/cc. The average activity density from beta particle emitters in mud samples collected along the shore of the river varied from 4×10^{-5} μc/g to 1.4×10^{-4} μc/g with the higher values occurring immediately below the most downstream reactor. Observed increases in the activity density of beta particle emitters in raw water correlated favorably with river flow changes; maximum measurements obtained at the 100-F area showed an average of 3.9×10^{-7} μc/cc with a maximum of 7.6×10^{-7} μc/cc.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN:

All rain samples analyzed were collected during the month of September. Trace indications of beta particle emitters were found in rain collected inside the separation areas up to distances 8,000 ft. from the effluent stacks; samples collected beyond this point showed no detectable activity.

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

Drinking water samples obtained from four Richland Wells and two Benton City wells showed trace alpha emission which was identified as uranium. Mean values were on the order of 5×10^{-3} μg U/cc in Richland and 1.0×10^{-2} μg U/cc at Benton City. Drinking supplies using the Columbia River as a source of water and showing positive beta particle emission included Pasco, Kennewick, and the Hanford operating areas. Maximum measurements were obtained at Pasco where the average was 4.4×10^{-7} μc/cc including a maximum of 1.0×10^{-6} μc/cc. Samples of filtering media obtained from the Pasco Filter Plant showed the activity density from beta particle emitters to average 7×10^{-5} μc/g and 1.3×10^{-4} μc/g on the surface of the sand and coal filters, respectively. Backwash material showed values on the order of 10^{-7} μc/cc in the liquid portion and average values ranging from 7.8×10^{-3} μc/g to 1.1×10^{-2} μc/g in the solid portion. Drinking water samples obtained from remote locations in Washington and Oregon showed no detectable activity from natural emitters.

[redacted]

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

200 AREAS

Samples of the effluent gases from the separations areas stacks and sand filters were collected and analyzed for I^{131}, and Ru^{103} and Ru^{106}. Total I^{131} emission decreased from 4 curies per day during the previous quarter to an average of 3 curies per day during the current period. Approximately 80 per cent of the total I^{131} discharged was emitted from the 202-S facility. Ruthenium discharged from the Redox Stack averaged 0.2 curie per day with the maximum emission of 4.1 curies per day occurring during July.

The results obtained from the monitoring of each separation facility are discussed below.

200 EAST AREA

The B-Plant facility was not operated during this quarter. Installation of off-gas monitoring equipment at the new Hot Semiworks facility was nearly completed in September. Monitors for making evaluations of the total I^{131} and ruthenium emission along with independent monitors in the dissolver and sand filter lines will be available coincident with startup of this plant.

200 WEST AREA - T-PLANT

Table I summarizes the results obtained from I^{131} monitoring at the T-Plant facility during the quarter.

 [redacted]

TABLE I

SUMMARY OF RESULTS FROM I^{131} MONITORING

T-PLANT

JULY, AUGUST, SEPTEMBER

1952

	Curies of I^{131} Dissolved per 24 Hrs.		Curies I^{131} Emitted Daily		Curies Emitted Through Sand Filter Daily	
Month	Maximum	Average	Maximum	Average	Maximum	Average
July	505	70	3.2	0.3	0.2	0.1
August	1220	385	2.2	1.0	0.3	0.2
September	505	85	2.3	0.7	-	-
Quarter	1220	180	3.2	0.7	0.3	0.1
Last Quarter	3040	580	9.2	1.7	9.4	1.3

Decreases in the amount of I^{131} released in the dissolvers, and emitted to the atmosphere at T-Plant this quarter, are a result of the increased cooling periods of the irradiated metal dissolved. The average cooling period this quarter was 62 days as compared to 49 days during the previous quarter. Monitoring of the gas stream after the sand filter was stopped during early August because the low amount of I^{131} emitted from the stack did not warrant operation of this additional equipment.

200 WEST AREA - S-PLANT

Results obtained from I^{131} monitoring at the Redox stack and sand filter are presented in Table II; Table III summarizes the results of the ruthenium measurements determined from analyzing filter and scrubber samples.

 [redacted]

TABLE II

SUMMARY OF RESULTS FROM I^{131} MONITORING

S-PLANT

JULY, AUGUST, SEPTEMBER

1952

Month	Curies of I^{131} Dissolved per 24 Hrs.		Curies I^{131} Emitted per 24 Hrs.		Curies Emitted Through Sand Filter Daily	
	Maximum	Average	Maximum	Average	Maximum	Average
July	610	130	1.3	0.5	1.2×10^{-3}	5.8×10^{-4}
August	685	170	10.4	2.1	5.6×10^{-4}	1.6×10^{-4}
September	810	260	16.4	3.5	2.2×10^{-3}	6.2×10^{-4}
Quarter	810	195	16.4	2.4	2.2×10^{-3}	5.8×10^{-4}
Last Quarter	1610	520	21	2.5	*	*

* This equipment was operated during only one month of the previous quarter.

TABLE III

SUMMARY OF RESULTS FROM RUTHENIUM MONITORING

S-PLANT STACK

JULY, AUGUST, SEPTEMBER

1952

Month	Curies of Ruthenium Emitted Per Day	
	Maximum	Average
July	4.1	0.6
August	0.3	0.06
September	0.6	0.07
Quarter	4.1	0.2
Last Quarter	1.7	0.09

[redacted]

Unusually high I^{131} daily emission from the Redox stack was noted during the week ending August 23, 1952. Correlation of the constant stack monitor recorder charts with operating conditions revealed that, as far back as August 1, the peaks on the charts occurred at or near the times when the metal solution in the B-2 dissolver reached the boiling point. This evidence indicated that the B-3 silver reactor following this dissolver had been losing its efficiency since August 1 and had experienced a sharp drop in efficiency during the week ending August 23, 1952. Separations Section personnel replaced the faulty B-3 silver reactor with the C-3 spare reactor on August 24, 1952. The I^{131} emission rate remained high until the C-3 reactor was adjusted for efficient operation. During the first week of September, I^{131} emission decreased to a maximum of 3.0 curies per day and remained on this order of magnitude throughout the balance of the month.

Further correlation of the constant monitor charts with operating conditions during September revealed that sporadic I^{131} emission on the order of 2 to 3 curies per day occurred when either or both dissolvers were in operation and that low emission rates, less than 1.0 curie per day, could occur with both dissolvers in operation. There was no apparent correlation between the cooling times of the metal dissolved and the periods of higher I^{131} evolution. Discussions with Separations Section personnel revealed that occasional failure of the pre-heater systems of both A-3 and B-3 silver reactors was occurring. During these failures, the gases were not heated to the proper temperature and the efficiency of the silver reactors was materially reduced.

200 WEST AREA - U-PLANT

The sampling facilities at the 10 foot level of the 291-U stack were placed in operation during July.

Table IV summarizes the results of the filter samples collected from this stack during the quarter. Due to the presence of natural radioactivity from radon and thoron decay products, these filters are held for 48 hours before being counted. One uranium analysis performed on a filter removed during August indicated that the uranium emission rate from this stack was on the order of 10^{-8} curie per day.

TABLE IV

SUMMARY OF MEASUREMENTS FILTERABLE EMITTERS

U-PLANT STACK

JULY, AUGUST, SEPTEMBER

1952

Alpha and Beta Particle Emitters - Units of Curie Per Day

	Total Alpha		Total Beta	
Month	Maximum	Average	Maximum	Average
July	$<1.0 \times 10^{-7}$	$<1.0 \times 10^{-7}$	$<1.0 \times 10^{-6}$	$<1.0 \times 10^{-6}$
August*	4.8×10^{-7}	7.2×10^{-8}	7.7×10^{-6}	1.2×10^{-7}
September	4.1×10^{-7}	1.7×10^{-7}	2.4×10^{-6}	1.2×10^{-6}
Quarter	4.8×10^{-7}	1.2×10^{-7}	7.7×10^{-6}	8.2×10^{-7}

* The detection limits were lowered in August by increasing the volume of gas filtered.

REACTOR AREAS

The results obtained from measurements for C^{14}, S^{35}, tritium oxide, and radioactive particles at the reactor area stacks are presented in Table V.

The results obtained from measurements initiated during August to determine the activity density of filterable gross beta and gross alpha particle emitters at reactor stacks are also included.

TABLE V
SUMMARY OF REACTOR AREA STACK MEASUREMENTS
JULY, AUGUST, SEPTEMBER
1952

Activity Type	Units of	105-F Max.	105-F Avg.	105-D Max.	105-D Avg.	105-DR Max.	105-DR Avg.	105-H Max.	105-H Avg.
C^{14}	10^{-3} c/day	7.3	<6	<6	<6	14.3	<6	<6	<6
S^{35}	10^{-4} c/day	<3	<3	4.2	<3	3.8	<3	<3	<3
Tritium Oxide	c/day	0.6	0.1	0.3	0.1	0.4	0.07	0.3	0.06
Radioactive Particles	10^5 P/day	22.8	8.0	8.1	1.4	0.8	0.3	30.4	4.0
Filterable Total Alpha	10^{-7} c/day	3.5	1.5	1.7	0.3	0.3	<0.01	9.6	2.5
Filterable Total Beta	10^{-5} c/day	18	15	47	17	0.14	0.08	6.4	4.1

Excluding those measurements initiated during this quarter, the results summarized above compared favorably with similar measurements obtained during the previous quarter. Gross activity determinations for alpha and beta particle emitters by direct counting methods will be continued on a weekly basis in the future. General increases in the sensitivity of several of the reactor effluent gas measurements were accomplished by increasing the volume of gas sampled and by decreasing the decay interval between sample collection and counting.

 [redacted]

SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Over twenty-two hundred samples of vegetation were collected from the environs to determine the magnitude and extent of the deposition of radioactive contaminants from Hanford effluent gases. Approximately seventeen-hundred samples were obtained from locations within a forty mile radius of the reactor and separation stacks; the remaining samples were collected in populated areas in southern and eastern Washington, and in northern Oregon. All samples were analyzed for I^{131} and nearly one-half of the total samples were also analyzed for the activity from non-volatile beta particle emitters. The latter measurement included the activity from naturally occurring isotopes such as potassium (K^{40}) and uranium.

Table I summarizes the maximum and average results obtained from the analyzed vegetation samples which were collected in the immediate environs; average values obtained during the previous quarter (HW-26493) are included for comparison.

The amount of I^{131} deposited on vegetation decreased at nearly all locations during this quarter. This decrease was largely a result of a decrease in the amount of I^{131} (Section I) that was discharged from the separation area stacks. The trend was a continuation of the lower deposition noted during May and June of 1952.

[redacted]

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

JULY, AUGUST, SEPTEMBER

1952

Location	No. Samples	I^{131} Units of 10^{-6} μc/gram Maximum	I^{131} Average	I^{131} Last Qtr. Average	Non-Volatile Emitters Units of 10^{-6} μc/gram Maximum	Non-Volatile Average	Non-Volatile Last Qtr. Average
North of 200 Areas	191	7	< 3	4	76	27	70
Near the 200 Areas	166	18	< 3	10	130	35	97
Route 3	9	9	4	31	---	--	100
200 West Gate	124	24	8	48	120	32	100
200 East Tower	123	15	3	12	70	32	70
Batch Plant	52	48	5	26	150	37	70
Meteorology Tower	13	7	4	4	---	--	80
South of 200 Areas	314	45	< 3	5	110	29	100
Richland	120	7	< 3	< 3	140	31	70
Pasco Environs	75	7	< 3	< 3	110	35	90
Kennewick Environs	105	13	< 3	4	80	27	65
Benton City - Kiona	39	7	< 3	< 3	77	20	50
Richland "Y"	13	42	4	12	---	--	50
Hanford	23	10	< 3	6	31	30	100
200 East Area	48	40	3	11	94	28	70
200 West Area	65	37	6	41	73	29	50
Redox Const. Area	90	72	8	31	---	--	110
Wahluke Slope	4	< 3	< 3	5	48	36	120
Goose Egg Hill	38	8	< 3	14	76	38	230
Rattlesnake Mountain	50	6	< 3	5	81	24	50
PSN-300-310-330	39	17	3	15	---	--	53
Off-Area Sampling							
Pasco to Ringold	24	9	< 3	6	65	29	200
Prosser to Patterson McNary	128	9	< 3	< 3	147	27	55
Eastern Washington	140	14	< 3	< 3	58	21	41
So. Washington and No. Oregon	137	13	< 3	< 3	52	19	38

[redacted]

Table II summarizes the results obtained from the vegetation monitoring program on a month to month basis.

TABLE II

ACTIVITY DENSITY FROM I^{131} ON VEGETATION

JULY, AUGUST, SEPTEMBER

1952

Units of 10^{-6} μc/gram

Location	July Max.	July Avg.	August Max.	August Avg.	September Max.	September Avg.
North of 200 Areas	4	< 3	8	< 3	6	< 3
Near the 200 Areas	14	< 3	17	< 3	18	< 3
Route 3	7	4	7	< 3	9	9
200 West Gate	17	7	22	6	24	9
200 East Tower #16	15	3	11	< 3	10	4
Batch Plant	13	5	6	≤ 3	48	6
Meteorology Tower	7	4	6	4	7	5
South of 200 Areas	13	< 3	45	≤ 3	11	< 3
Richland	4	< 3	6	< 3	5	< 3
Pasco Environs	< 3	< 3	5	< 3	7	< 3
Kennewick Environs	5	< 3	13	< 3	7	< 3
Benton City-Kiona	4	< 3	5	≤ 3	7	< 3
Richland "Y"	42	12	3	< 3	< 3	< 3
Hanford	< 3	< 3	3	< 3	< 3	< 3
200 East Area	40	5	3	3	15	< 3
200 West Area	37	8	30	5	32	4
Redox Const. Area	20	8	14	4	72	13
Wahluke Slope	--	--	3	< 3	--	--
Goose Egg Hill	8	< 3	8	< 3	--	--
Rattlesnake Mtn.	4	< 3	6	< 3	--	--
P-S-N-300-310-320	9	< 3	17	< 3	12	4
Off Area Sampling						
Pasco to Ringold	--	--	9	< 3	--	--
Prosser to Patterson-McNary	5	< 3	6	4	5	3
Eastern Washington	--	--	14	< 3	7	< 3
So. Washington and No. Oregon	--	--	13	< 3	7	< 3

 [redacted]

A review of the data presented in Table II along with a comparison of the estimated iso-activity maps which show the deposition of I^{131} in the Hanford environs for the months of July, August, and September (Figures 1, 2, and 3) show that there was very little change in the amount of I^{131} deposition on vegetation during any period within the present quarter. Trace quantities of I^{131} were detected in a small area directly east and south of the 200 West area throughout the quarter. The activity density did not exceed 4×10^{-5} μc/g at this location during any part of the three month period. In general, values in the range of 5×10^{-6} to 2.5×10^{-5} μc/g predominated in the area at which contamination was detected. Except for several small isolated areas on the order of one square mile each, the amount of I^{131} deposited on the remaining environs was below the detection limit of 3×10^{-6} μc/g throughout the quarter.

Figure 4 shows the estimated I^{131} deposition as determined from the results of all samples analyzed during this period. As indicated by these results, the deposition of I^{131} during this period was about the lowest observed since the start up of the Hanford operation. The latter statement bears significance as the amount of available I^{131} in the combined dissolving operations at the separations areas was comparable to that which was available during other three month periods when the average deposition of the entire environs was on the order of 10^{-4} or 10^{-5} μc/g.

The results obtained from analyzing vegetation samples which were collected at off-site locations are presented in Table III.

As indicated in the data presented in Table III, the average activity density from I^{131} was $< 3 \times 10^{-6}$ μc/g at all locations monitored; this quarter represents the first three month period in which the average amount of I^{131} deposited at off-site locations was below the detection limit at all stations.

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TABLE III

RADIOACTIVE CONTAMINATION ON VEGETATION
OFF AREA LOCATIONS
JULY, AUGUST, SEPTEMBER
1952

Units of 10^{-6} μc/g

Location	No. Samples	I^{131} Maximum	I^{131} Average	Non-Volatile Emitters Maximum	Non-Volatile Emitters Average
Moxee	8	4	< 3	30	18
Union Gap	4	5	< 3	35	28
Wapato	8	13	< 3	35	14
Toppenish	8	< 3	< 3	38	26
Toppenish to Goldendale	18	13	< 3	32	18
Goldendale	8	3	< 3	38	23
Goldendale to Wishram	6	6	< 3	21	12
Lyle	4	4	< 3	47	25
Bingen	4	< 3	< 3	47	19
Camas	7	3	< 3	52	26
Vancouver	8	< 3	< 3	44	16
Portland	8	< 3	< 3	42	24
Troutdale	4	< 3	< 3	20	13
Bonneville	4	< 3	< 3	28	13
The Dalles	8	5	< 3	52	26
Moody	2	< 3	< 3	16	14
Rufus	4	3	< 3	20	14
Blalock	4	5	< 3	28	21
Arlington	4	7	< 3	34	20
Heppner Junction	4	< 3	< 3	25	15
Boardman	4	< 3	< 3	29	19
Umatilla	4	< 3	< 3	14	11
Hood River	4	< 3	< 3	18	16
Wallula	8	< 3	< 3	50	30
Touchet	4	< 3	< 3	31	21
Louden	4	< 3	< 3	21	14
Walla Walla	8	3	< 3	43	20
Dixie	4	3	< 3	34	24
Waitsburg	8	6	< 3	43	25
Dayton	8	< 3	< 3	39	16
Pomeroy	8	< 3	< 3	45	20
Dodge	2	< 3	< 3	18	18
Lewiston	8	< 3	< 3	37	18

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TABLE III (contd.)

Units of 10^{-6} μc/g

Location	No. Samples	I^{131} Maximum	I^{131} Average	Non-Volatile Emitters Maximum	Non-Volatile Emitters Average
Uniontown	4	< 3	< 3	34	25
Pullman	8	13	< 3	28	17
Colfax	8	< 3	< 3	56	30
Steptoe	4	4	< 3	19	11
Rosalia	4	5	< 3	40	22
Spangle	2	< 3	< 3	48	41
Spokane	8	< 3	< 3	38	16
Cheney	8	< 3	< 3	44	19
Sprague	8	< 3	< 3	32	19
Ritzville	8	3	< 3	58	24
Lind	8	5	< 3	28	19
Connell	8	14	< 3	51	24

The average activity density from non-volatile beta particle emitters decreased at all locations during this quarter. A comparison of present values (Table I and Table III) with those previously observed show the current values to be about one-half of those measured during the previous quarter. This trend approached significance but was not associated with any change in Hanford emission. The higher results observed during the previous quarter were apparently associated with the influx of particulate contamination from the nuclear explosion tests performed by the Atomic Energy Commission.

In addition to measuring the amount of contamination deposited on predominant vegetation, several samples of fruit were obtained from orchards around the project perimeter. The activity density from I^{131} on these fruit samples was less than 3×10^{-6} μc/g on all samples analyzed; non-volatile beta particle emitters on these samples ranged from 1 to 4×10^{-5} μc/g. The outer skin was removed from several peach and apricot samples and analyzed separately from the pulp and stones. The results from these analyses were not significantly different from those discussed in previous reports of this series.

Table IV summarizes the results obtained from the analysis of vegetation samples for the activity from gross alpha particle emitters.

TABLE IV

ACTIVITY DENSITY FROM GROSS ALPHA PARTICLE EMITTERS ON VEGETATION

JULY, AUGUST, SEPTEMBER

1952

Location	July	August	September	Quarterly Average	Maximum Result
	Units of 10^{-8} μc/gram				
Near 200 Areas					
200 West Gatehouse	< 5	< 5	< 5	< 5	< 5
Batch Plant	57	< 5	18	26	110
Route 4S, Mile 4	16	46	< 5	21	90
Meteorology Tower	34	< 5	< 5	22	150
Route 4S, Mile 6	< 5	< 5	< 5	< 5	< 5
300 Area	16	11	7	11	16
Outlying					
Richland	< 5	< 5	--	< 5	< 5
Pasco	< 5	< 5	< 5	< 5	5
Benton City	< 5	< 5	< 5	< 5	< 5

Although the majority of samples analyzed for alpha particle emitters showed this activity to be less than 5×10^{-8} μc/g, several of the samples which were collected in the vicinity of the separation areas showed results higher than those previously observed. Values on the order of 1×10^{-6} μc/g found at the Batch Plant and the Meteorology Station were 2 to 3 times higher than those found during the previous quarter. A comparison of these data on a month to month basis showed that nearly all the higher values were obtained during the month of July and that the deposition from alpha particle emitters barely exceeded the detection limit of the measurement during August and September.

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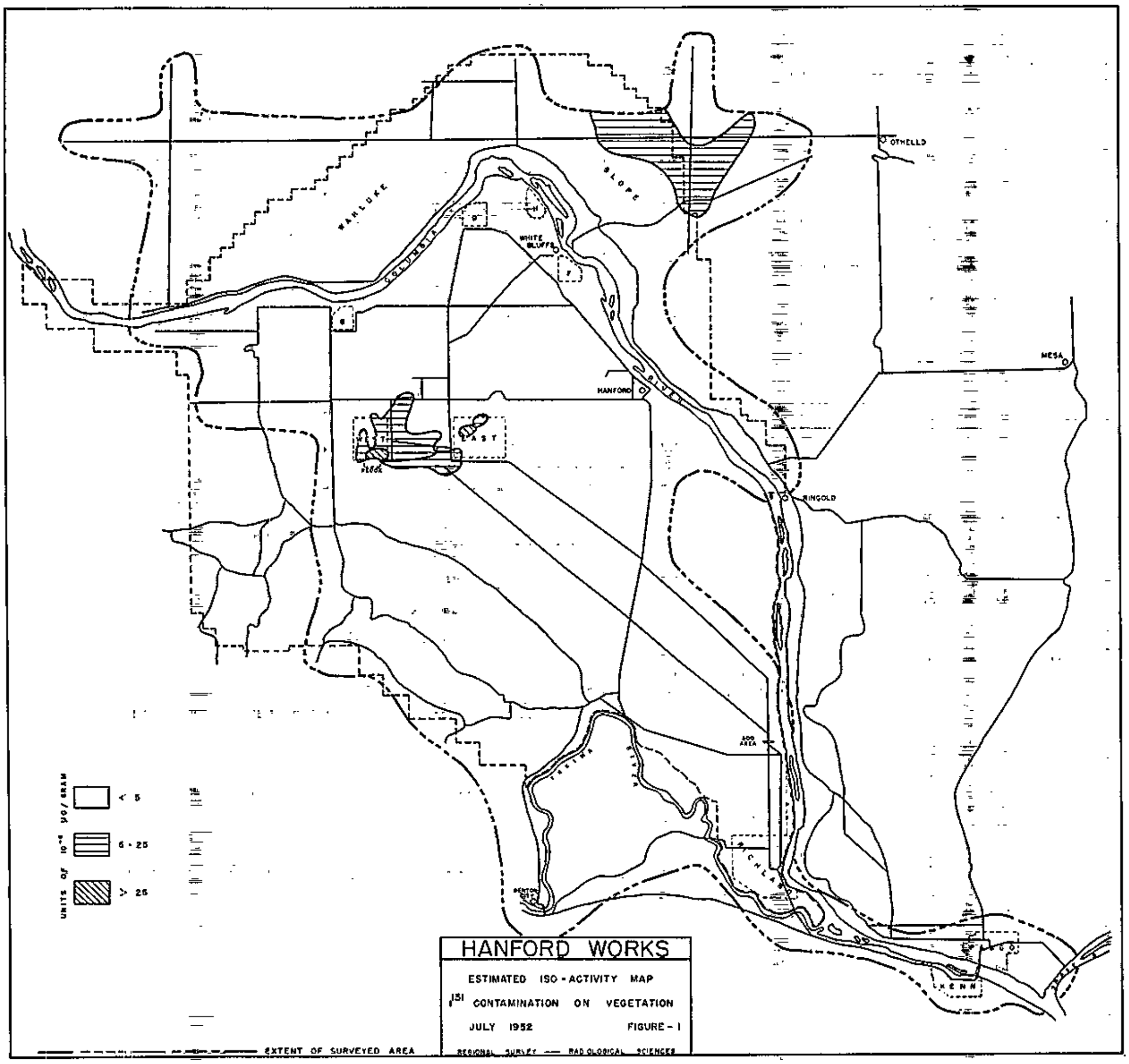

OTHELLO
WAHLUKE
SLOPE
COLUMBIA
WHITE BLUFFS
HANFORD
RIVER
RINGOLD
MESA
YAKIMA
RIVER
BENTON CITY
300 AREA
RICHLAND
KENN
UNITS OF 10⁻⁴ μC/GRAM
< 5
5 - 25
> 25
EXTENT OF SURVEYED AREA
HANFORD WORKS
ESTIMATED ISO-ACTIVITY MAP
I131 CONTAMINATION ON VEGETATION
JULY 1952
FIGURE - I

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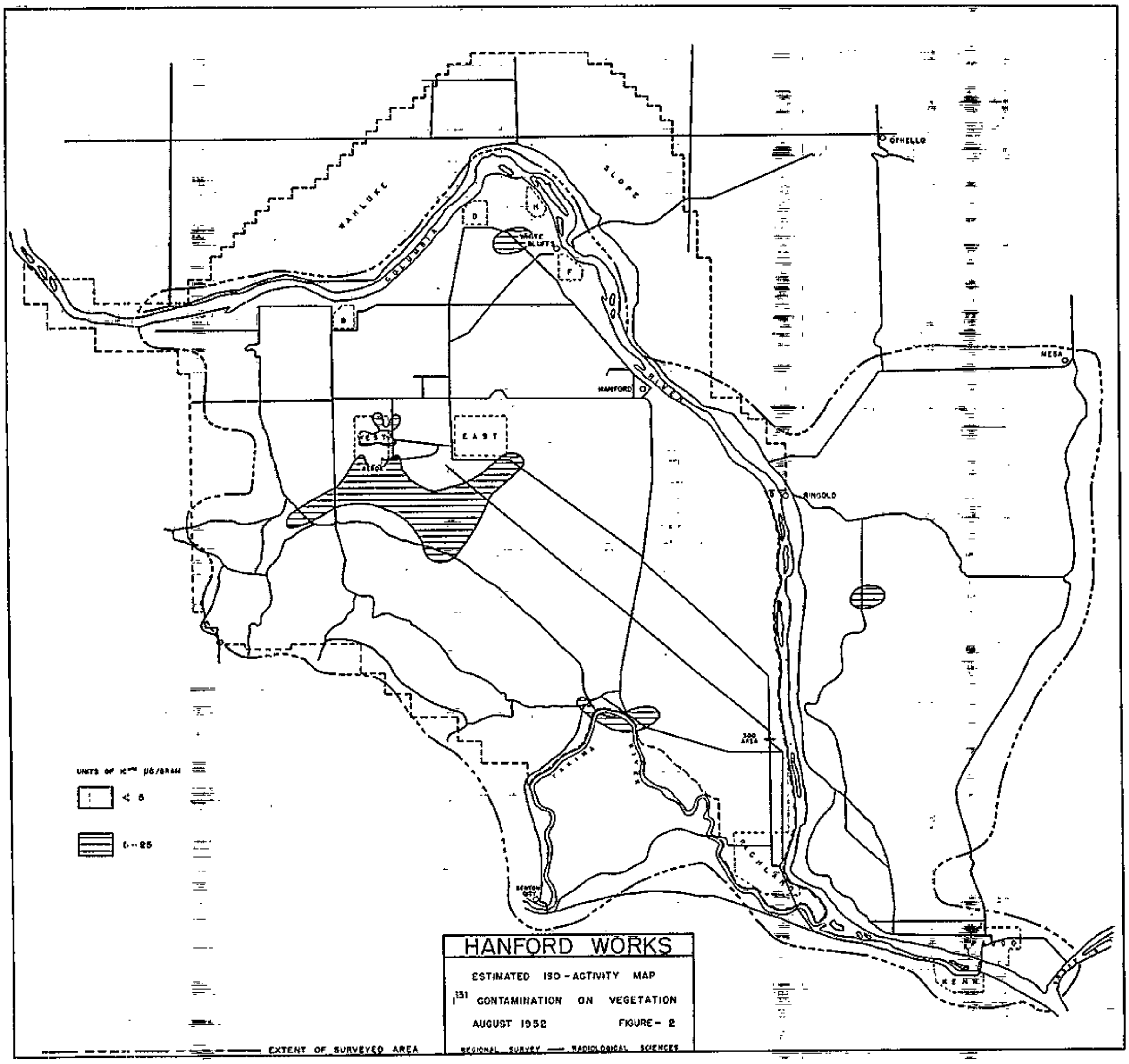
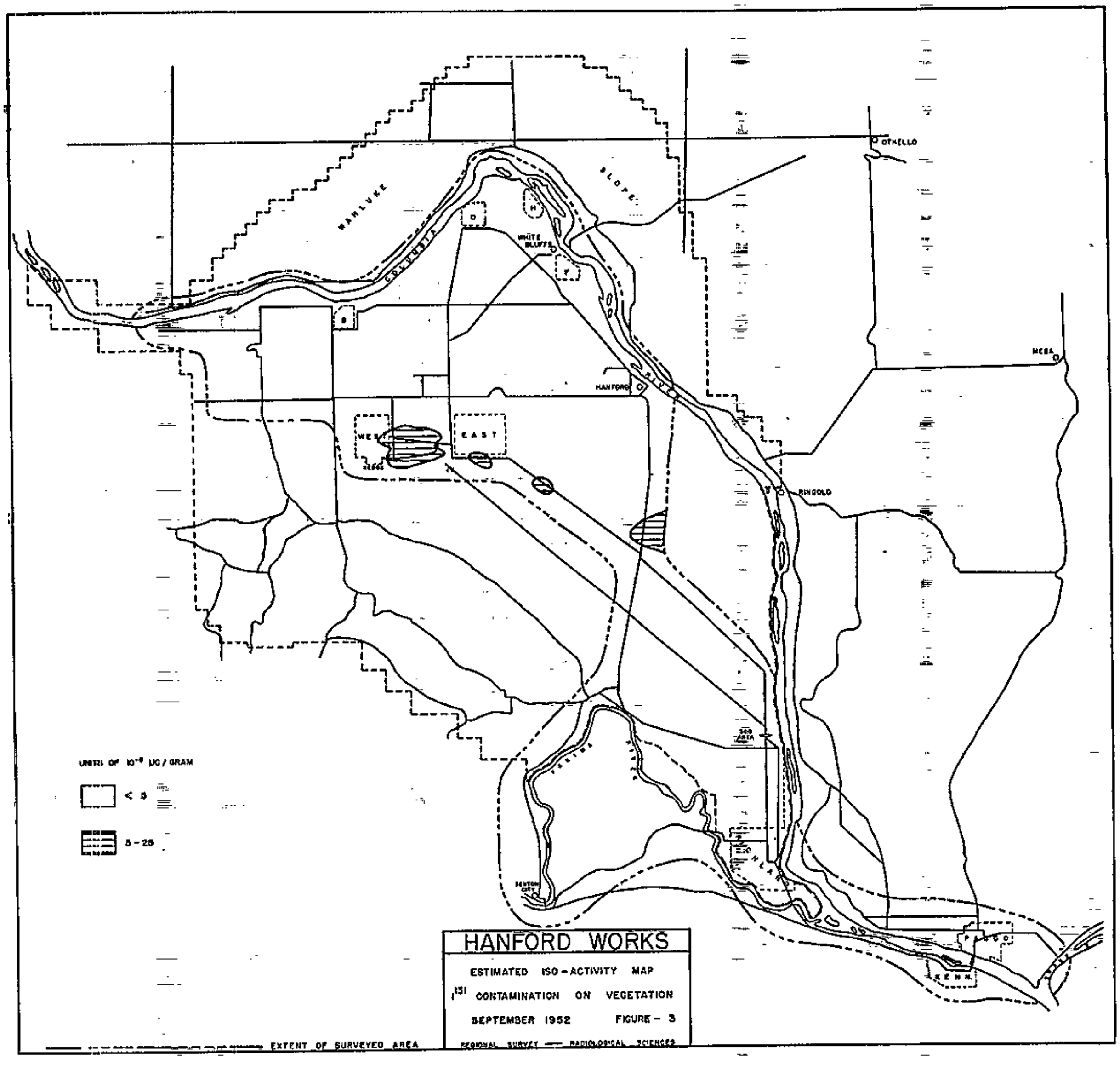
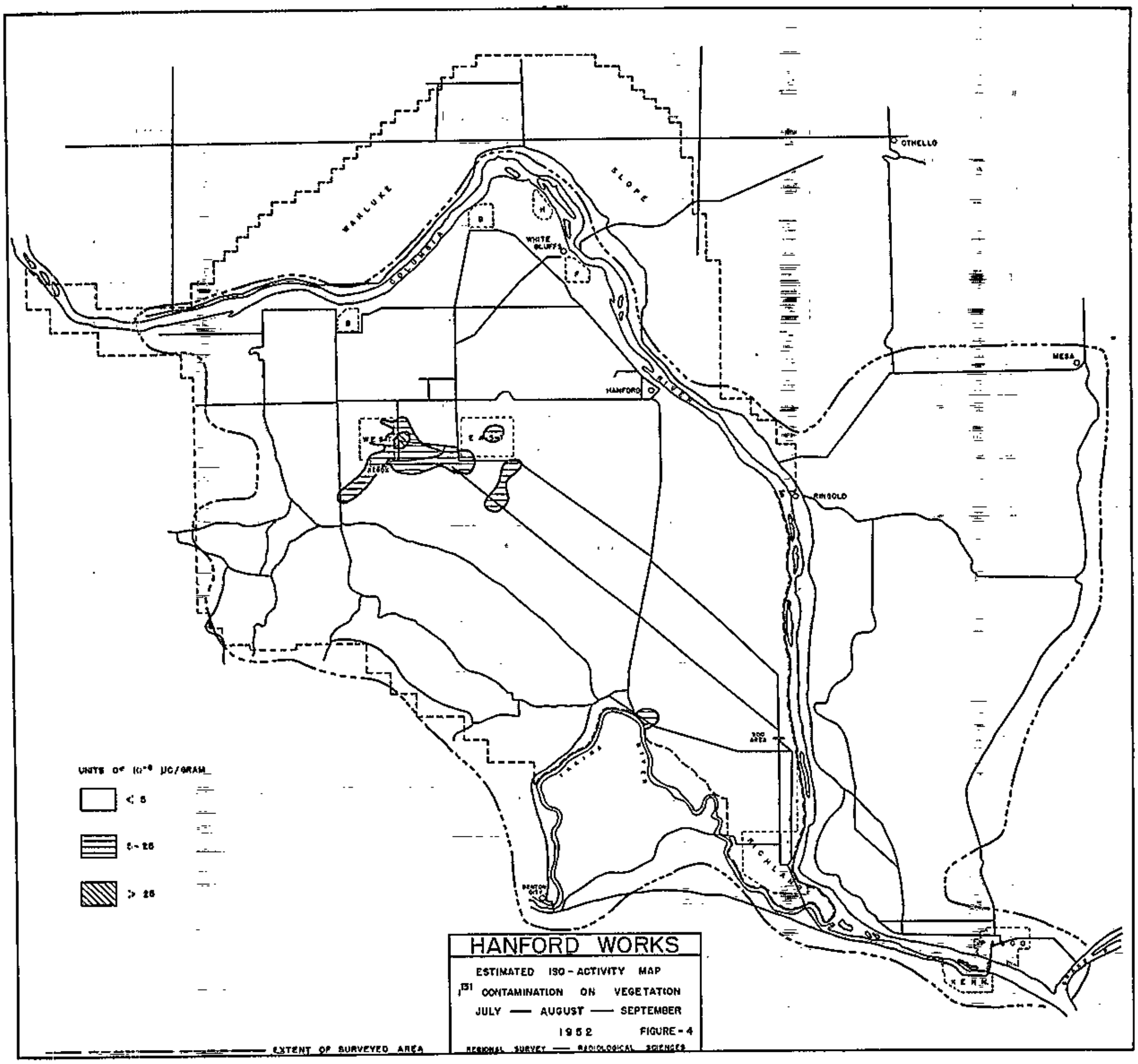




HANFORD WORKS
ESTIMATED ISO-ACTIVITY MAP
I^{131} CONTAMINATION ON VEGETATION
SEPTEMBER 1952 FIGURE - 3

[redacted]



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SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dosage rates from air-borne contaminants and air radiation levels were determined from readings obtained from Victoreen integrons and detachable ionization chambers. Integron units were maintained at fixed locations on and adjacent to the project and the detachable ionization chambers were operated at intermediate field locations.

Table I summarizes the results obtained from evaluating integron readings for each 8 hour period throughout the quarter; the average dosage rate represents the minimum value of these accumulated 8 hour readings.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JULY, AUGUST, SEPTEMBER

1952

Location	No. of Integrons	Units of mrep per 24 hours			Quarterly Average
		July	August	September	
100-B Area	3	0.6	0.6	0.9	0.7
100-D Area	3	0.6	0.8	0.6	0.7
100-F Area	3	0.6	0.6	1.6	0.9
100-H Area	3	0.6	0.5	0.6	0.6
200 West Area	2	3.8	0.6	0.7	1.7
200 East Area	4	0.3	0.9	1.4	0.9
Riverland	1	1.0	0.6	0.4	0.7
300 Area	1	2.6	1.8	1.3	1.9
Richland	1	1.7	1.7	0.7	1.4
Pasco	1	1.6	1.5	0.7	1.3
Benton City	1	1.6	2.9	1.0	1.8
North Richland North	1	0.8	0.9	<0.1	0.6
North Richland South	1	0.9	0.7	<0.1	0.5
Hanford	1	0.5	2.0	0.9	1.1
Redox	1	0.4	0.1	1.0	0.5

Average dosage rates at the various stations indicated in Table I were within the expected range of fluctuation, based on a comparison to measurements obtained during the first half of 1952. A comparison of average readings for individual stations to similar data obtained during the previous quarter shows that at the fifteen stations, the readings at one station remained the same, those at seven increased and those at seven decreased. A comparison of these same data on a month to month basis was not indicative of any change or trend within the period.

Supplementary data were obtained by exposing two "C" type ionization chambers inside the 614 Buildings at which integrons were operated. Radiation levels determined by evaluating minimum readings obtained from the two chambers are presented in Table II.

TABLE II
RADIATION LEVEL OBSERVED WITH "C" TYPE
DETACHABLE IONIZATION CHAMBERS
JULY, AUGUST, SEPTEMBER
1952

Location	Units of mrep per 24 hours			Quarterly Average
	July	August	September	
Within 100-B Area	0.3	0.4	0.4	0.4
Within 100-D Area	0.5	0.5	0.6	0.5
Within 100-F Area	0.4	0.3	0.4	0.4
Within 200 West Area	0.4	0.4	0.4	0.4
Within 200 East Area	0.5	0.5	0.6	0.5

The range of readings obtained from the "C" type ionization chambers at the various operating areas (0.4 to 0.5 mrep per 24 hours) was nearly identical to values measured during April, May, and June when the dosage at these same stations ranged from 0.3 to 0.5 mrep per 24 hours. Dosage rates as measured by these instruments were extremely consistent over the thirteen week period as the maximum week to week deviation was only 0.2 mrep.

Table III summarizes the results obtained from the operation of "M" and "S" type detachable ionization chambers at intermediate locations on the environs. Again, two chambers were exposed at each location and the average dosage rates were computed by using the data from the sample which showed the minimum discharge.

TABLE III

RADIATION LEVEL OBSERVED WITH "M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS JULY, AUGUST, SEPTEMBER 1952

Location	Units of mrep per 24 hours			Quarterly	Group
	July	August	September	Average	Average
100 Areas and Environs					
Route 1, Mile 8	0.59	0.41	0.27	0.42	
Route 2N, Mile 10	0.40	0.40	0.44	0.41	
Route 2N, Mile 5	0.41	0.38	0.43	0.41	
At White Bluffs	0.45	0.40	0.46	0.44	
Route 11-A, Mile 1	1.07	1.31	0.81	1.06	
Hanford 614 Bldg.	0.40	0.35	0.34	0.36	0.50
Intersection Rt. 1 and Rt. 4N	0.50	0.45	0.30	0.42	
At Hanford 101 Bldg.	0.39	0.37	0.46	0.41	
100-H Area	0.49	0.54	0.53	0.52	
P-11 Area	0.41	0.41	0.52	0.45	
100-B NE Construction	0.62	0.60	0.66	0.63	
100-B SE Construction	0.53	0.42	0.30	0.42	
Within 5 Miles of 200 East Area					
Route 4S, Mile 6	0.55	1.20	0.83	0.86	
Batch Plant	0.45	0.43	0.44	0.44	
Route 11-A, Mile 6	0.57	0.62	1.61	0.94	
Route 3, Mile 1	0.78	0.89	1.15	0.94	
Meteorology 200'	0.45	0.52	0.37	0.45	
Route 4S, Mile 2.5	1.27	0.74	0.44	0.82	
Redox Area	0.71	0.91	0.96	0.86	0.97

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TABLE III (contd.)

Location	Units of mrep per 24 hours			Quarterly Average	Group Average
	July	August	September		
Within 5 Miles of 200 East Area (contd.)					
Route 4S, Mile 4.5	*	2.77	1.44	2.10	
Semiworks # 1	2.64	1.03	0.86	1.51	
Semiworks # 2	0.78	0.77	0.94	0.83	
Military Camp PSN 300	1.82	1.47	1.54	1.61	
PSN 310	0.84	0.54	0.78	0.72	
PSN 320	0.34	1.44	0.78	0.85	
PSN 330	0.92	0.79	0.72	0.81	
Redox Outside	0.86	0.71	0.86	0.81	
Within 10 Miles of 200 East Area					
Route 4S, Mile 10	1.41	0.96	0.46	0.94	
Route 10, Mile 1	1.50	0.69	1.43	1.21	
Route 10, Mile 3	2.74	2.71	0.91	2.12	1.16
Route 2S, Mile 4	*	0.18	0.52	0.35	
Near 300 Area					
Route 4S, Mile 16	0.77	1.18	0.64	0.86	
Route 4S, Mile 22	0.71	0.67	*	0.69	
North Richland North	0.65	0.52	0.72	0.63	0.67
North Richland South	0.70	0.56	0.57	0.61	
300 Area	0.41	0.73	0.58	0.57	
Outlying					
Richland	0.84	0.60	1.15	0.86	
Benton City	0.57	0.63	0.71	0.64	
Pasco	0.30	0.30	0.38	0.33	0.56
Kennewick	0.47	0.51	0.21	0.40	

* Readings voided due to faulty chambers

No significant change was observed in the air radiation levels near the reactor areas, near the 300 Area, or at the outlying communities around the project perimeter. Average dosage rates within a radius of 5 miles from the separation areas decreased from 1.2 mrep per 24 hours to 0.97 mrep per 24 hours. This decrease was largely a result of reduced

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radiation levels at locations near the 200 West Area; several locations adjacent to the 200 East Area showed increased radiation levels. A significant increase was observed at the Route 4-S, Mile 4.5 which is located between military camp PSN 300 and the 200 East Area. The average dosage rate at this location was 2.1 mrep per 24 hours as compared to a mean dosage of 0.82 mrep per 24 hours during the previous quarter. The highest measurements observed during this period were measured at this location.

The activity density from filterable beta particle emitters in the atmosphere was determined by analyzing small air filters through which an air flow of 2.0 to 2.5 cfm was passed for a period of 7 days. An interval of from two or three days was allowed between the time of sample removal and the time of analysis to allow for the decay of the daughter products of radon and thoron. The results obtained from this type of measurement for the period July, August, and September are summarized in Table IV.

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TABLE IV

AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR

JULY, AUGUST, SEPTEMBER

1952

Location	July	August	September	Quarterly Average	Maximum Weekly
	Activity Density - Units of 10^{-14} μc/cc				
200 Area and Vicinity					
200 East Semiworks	19	33	-	22	37
200 West Tower #4	100	35	38	53	140
200 West Redox Area	440	270	490	390	1400
Gable Mountain	31	12	13	18	45
200 East Tower #15	12	16	31	20	73
100 Area and Vicinity					
100-D	46	20	37	34	61
100-H	46	36	45	41	55
Hanford 101 Bldg.	22	7	5	11	28
Hanford 614 Bldg.	45	9	19	26	72
White Bluffs	26	15	< 4	14	60
300 Area, 614 Bldg.	29	11	5	15	50
Outlying					
North Richland	13	7	5	8	18
Pasco	33	15	33	26	50
Kennewick	23	43	8	25	140
Benton City	23	6	4	11	29
Riverland	28	9	9	15	30

General decreases in the average activity density from airborne beta particle emitters were observed at all monitoring stations except at 200 West Redox Area. A small change from a previous average of 3.2×10^{-12} μc/cc to 3.9×10^{-12} μc/cc at the latter location was not significant when compared to data collected at this station since the start-up of the operation of the 202-S facility. The general decrease noted at the remaining stations throughout the environs largely resulted from the higher measurements which were observed during the latter part of the

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previous quarter when particulate contamination from the Nevada nuclear explosion tests apparently covered this region. Except for slightly higher values measured during the month of July which were attributed to residual particle contamination from the bomb tests, the order of magnitude of current measurements is in agreement with expected levels attributed to Hanford operations.

Supplementary data for evaluating the activity density from filterable beta particle emitters in the atmosphere was obtained by analyzing the air filters which were removed from dual air monitoring units at several locations in the environs. These samples were collected in the same manner as that indicated for the measurements presented in the preceding table. Table V summarizes the results obtained from the dual monitors.

TABLE V
AVERAGE FILTERABLE BETA PARTICLE EMITTERS IN AIR
DUAL UNIT MONITORS
JULY, AUGUST, SEPTEMBER
1952

	Activity Density - Units of 10^{-14} $\mu c/cc$				
Location	July	August	September	Quarterly Average	Maximum Weekly
200 West East Center #1	90	29	7	49	170
200 West East Center #2	57	100	12	63	200
200 East Southeast #1	110	31	64	66	200
200 East Southeast #2	31	26	24	27	120
Richland #1	27	12	13	17	40
Richland #2	17	15	15	16	37
Meteorology Tower					
Ground Level	77	56	180	100	600
200' Level	26	27	22	25	49
400' Level	86	15	21	38	160

Analyses of the results summarized in Table V reflected the same decreasing trends observed in the data collected from operating the single unit monitor stations. With the exception of the results observed at ground level at the Meteorology Tower, the values observed during the month of September were representative of normal Hanford operation. The average activity density of 1.8×10^{-12} µc/cc at the former location was approximately 2 times greater than that normally expected; this value was weighted by high results obtained during one week when the average activity density from filterable beta particle emitters was 6×10^{-12} µc/cc.

The number of radioactive particles in the atmosphere was measured by radioautographing air filters which had been exposed at various locations for periods of 1 to 7 days. Air flows through the CWS number 6 type filters were either 2.5 or 10.0 cfm. Exposure periods to the film were 168 hours and the number of particles was determined by visually counting the number of darkened spots on the developed film. The sensitivity of the measurement using Type K X-ray film was 3 d/m based on Sr^{90} and C^{14} standards. Tables VI and VII summarize the results obtained from these measurements at on-area and off-area locations, respectively.

As indicated in Table VI, the number of radioactive particles decreased by about two at locations in the immediate environs except those in the immediate vicinity of the 202-S facility. No significant change in the number of particles was observed at the latter locations. The general decrease resulted from the higher measurements observed during the previous quarter when significant deposition of particulate contamination occurred after nuclear explosions at Nevada. This latter fact appeared to influence local measurements during the month of July; the higher values observed during July were apparently due to residual contamination from the earlier explosions.

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TABLE VI
SUMMARY OF PARTICLE DEPOSITION
JULY, AUGUST, SEPTEMBER
1952

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

Location	Total Volume of air sampled m^3	July	August	September	Present Quarter Averages 1952	Previous Quarter Averages 1952
200 East and Vicinity						
2704 Outside	7060	64	34	46	50	110
H. I. Garden (1)	2873	65	120		78	98
BY - SE	8891	240	87	58	120	63
BY - NE	9248	360	30	48	140	70
"B" Gate	9224	67	37	33	45	95
222-B Outside (2)	5423	64	33		49	100
2701 Outside	9088	150	28	21	63	130
2704 Inside	9266	71	25	35	42	76
221-B	9278	100	19	23	45	28
222-B Hall (2)	5423	40	18		30	80
222-B Lab. (2)	5419	38	5.9		23	250
2701 Inside	9274	59	30	28	39	85
200 West and Vicinity						
2701 Outside	6369	220	90	7.4	130	210
2722	8870	43	54	310	130	120
"T" Gate	8933	68	38	92	64	120
222-T Outside	8968	47	72	280	130	160
231	9283	73	75	180	110	130
Redox	5811	1140	400	450	750	340
W Guard Tower	8900	37	76	8.1	44	110
2701 Inside	9134	100	45	250	130	120
272	9269	48	53	300	130	88
222-T Hall	9283	83	110	320	98	130
222-T Lab.	9282	540	280	340	380	870
222-U Lab.	6803	78	70	260	140	57
291-S Inside	9605	>510	>440	280	>410	610

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TABLE VI (contd.)

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

Location	Total Volume of air sampled m^3	July	August	September	Present Quarter Averages 1952	Previous Quarter Averages 1952
Meteorology Tower						
3'	34323	15	14	68	32	30
50'	34272	21	8.2	26	17	25
100'	18131	20	11	3.7	18	26
150'	23752	19	14	4.4	13	30
200'	20906	24	13	2.7	14	26
250'	21941	33	7.5	5.3	16	25
300'	20333	42	11	4.5	20	33
350'	20333	61	9.5	5.9	26	28
400'	13687	56	33	2.9	33	36

(1) Monitoring discontinued 7-18-52.
(2) Monitoring discontinued 8-5-52.

TABLE VII

SUMMARY OF PARTICLE DEPOSITION

JULY, AUGUST, SEPTEMBER

1952

Location	Total Volume of air sampled m^3	July	August	September	Present Quarter Averages 1952	Previous Quarter Averages 1952
Area Locations						
100-B Area	37111	15	6.3	1.7	7.6	37
100-D Area	37060	10	7.2	3.1	6.9	26
White Bluffs	23477	17	6.7	1.3	8.9	42
100-F Area	33235	43	11	3.4	17	63
300 Area	37077	18	39	32	30	61
Hanford 101	37111	18	9.1	0.7	9.4	42
Off Area Locations						
Benton City, Wash.	37145	11	3.4	0.1	4.7	30
Pasco, Wash.	31314	13	1.4	0.6	5.2	35

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TABLE VII (contd.)

Location	Total Volume of air sampled m^3	July	August	September	Present Quarter Averages 1952	Previous Quarter Averages 1952
Off Area Locations (contd.)						
Richland, Wash.	34612	19	4.2	5.0	9.3	60
Boise, Idaho	29032	140	21	6.6	54	290
Klamath Falls, Ore.	9099	62	6.2	0.3	21	190
Great Falls, Mont.	8581	220	27	3.2	82	640
Walla Walla, Wash.	9891	79	12	2.1	33	54
Meacham, Ore.	8540	35	9.0	1.1	15	98
Lewiston, Idaho	9026	85	8.1	1.1	30	270
Spokane, Wash.	21403	27	4.5	<0.5	16	73
Kennewick, Wash.	2754	16	1.6	<29.4*	12	21
Yakima, Wash.	37111	15	1.2	0.4	5.6	23

* Although no particles were detected on these filters, the volume of air samples is not believed representative during this period.

Data obtained from counting the filters from off-area locations (Table VII) showed trends comparable to those noted in the immediate environs. September measurements at off area locations which showed average values in the range of 0.5 to 6.6×10^{-3} particles per meter^3 were still 2 to 5 times greater than those normally found. The trace deposition found at remote locations was believed to be due to the nuclear explosion tests rather than to Hanford operation.

The activity density from I^{131} in the atmosphere was determined from the analysis of caustic scrubber solutions through which air flows on the order of 2.0 cfm were passed for daily or weekly periods. The results of these measurements are summarized in Table VIII.

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TABLE VIII

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

JULY, AUGUST, SEPTEMBER

1952

	Units of 10^{-12} μc/cc				
Location	July	August	September	Quarterly Average	Weekly Maximum
200 Areas and Vicinity					
200 East Southeast	0.2	0.7	3.1	1.4	12.0
200 East Tower #16	0.6	11.4	2.1	4.8	11.6
200 West Gatehouse	0.2	1.5	1.8	1.2	5.7
Gable Mountain	<0.1	<0.1	0.2	0.1	0.4
Redox Area	0.7	2.3	3.0	2.0	8.6
200 West Tower #4	<0.1	0.3	0.2	0.2	1.4
Outlying Locations					
100-H Area	<0.1	<0.1	0.2	0.1	0.4
300 Area	<0.1	<0.1	<0.1	<0.1	0.2
Richland	<0.1	<0.1	0.1	<0.1	0.2
North Richland	<0.1	<0.1	<0.1	<0.1	0.1
Benton City	<0.1	<0.1	0.6	0.2	0.1
Pasco	<0.1	<0.1	<0.1	<0.1	0.2
Kennewick	<0.1	<0.1	<0.1	<0.1	0.1

The activity density from I^{131} in the atmosphere at locations in the vicinity of the separation areas was not significantly different than that observed during the previous quarter. Average values during April, May, and June ranged from 2×10^{-13} to 6×10^{-12} μc/cc as compared to current values averaging in the range of 1×10^{-13} to 4.8×10^{-12} μc/cc. The negligible change in air-borne I^{131} concentrations was expected as the total I^{131} emitted from a separation facility was not significantly different during the two quarters (Section I). At outlying locations trace quantities of I^{131} were detected at only two of the seven fixed locations. Maximum measurements which were on the order of 1 to 4×10^{-13} μc/cc were nearly identical to those previously observed (1 to 7×10^{13} μc/cc).

Maximum air-borne concentrations of I^{131} at ground level were measured by analyzing caustic scrubber samples which were obtained from the operation of portable equipment during periods when visual observation indicated dissolver off-gases at the surface. Forty-three samples of this type were obtained when atmospheric dilution ratios were less than 500 to 1. Radiochemical analysis showed detectable quantities of I^{131} in five of these samples; the average of these positive measurements was 7.2×10^{-9} μc/cc and the maximum was 1.4×10^{-8} μc/cc. The latter sample was obtained 1,000 feet downwind from the Redox stack during a 3.5 mph wind.

The activity density from gross alpha emitters in the atmosphere was determined from measurements performed on the small air filters which were used for the beta particle determination (Table IV). The results of these analyses are summarized in Table IX.

TABLE IX

GROSS ALPHA PARTICLE EMITTERS IN AIR

JULY, AUGUST, SEPTEMBER

1952

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

Location	July	August	September	Quarterly Average	Maximum Weekly
200 Area and Vicinity					
200 East Semiworks	< 4	5	-	< 4	5
200 West Tower #4	62	18	27	29	110
200 West Redox Area	7	10	16	11	32
Gable Mountain	26	5	4	8	40
200 East Tower #15	< 4	4	8	4	19
100 Areas and Vicinity					
100-D	17	14	22	17	52
100-H	35	39	30	35	78
Hanford 101 Bldg.	8	< 4	< 4	4	13
Hanford 614 Bldg.	5	< 4	5	4	11
White Bluffs	9	< 4	< 4	< 4	22
300 Area, 614 Bldg.	16	11	14	13	29

TABLE IX (contd.)

Location	July	August	September	Quarterly Average	Maximum Weekly
	Activity Density - Units of 10^{-15} $\mu c/cc$				
Outlying					
Richland	-	-	-	-	-
North Richland	< 4	< 4	< 4	< 4	5
Pasco	33	19	35	28	67
Kennewick	< 4	12	< 4	< 4	41
Benton City	< 4	< 4	< 4	< 4	6
Riverland	6	4	6	5	16

A comparison of the above data with measurements obtained earlier during 1952 shows these values to be well within the expected range. A review of the individual measurements from which the above averages were tabulated shows that with the exception of the two 200 West Areas locations, 100-D, 100-H, 300 Area, and Pasco, over 95% of the values were below the detection limit of 4×10^{-15} $\mu c/cc$. Locations at which positive average values are indicated showed activity repetitively throughout the period. A number of the air filter measurements which showed gross alpha or gross beta activity in excess of expected values, were further analyzed to determine the specific contaminants contributing to the gross emission. The only positive measurements were obtained on four filters removed from the monitoring station near the Redox area. Values for uranium, plutonium, and ruthenium were 1.8×10^{-16}, 3.2×10^{-14}, and 1.6×10^{-11} $\mu c/cc$, respectively.

[redacted]

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

Radioactive contamination in Hanford wastes was determined by analyzing liquid and solid samples for the activity from beta and alpha particle emitters. Spot samples from all waste sources were analyzed specifically for uranium and plutonium; all samples which showed significant alpha particle emission were also analyzed for uranium and plutonium.

Samples were collected daily or weekly, as conditions warranted from the open waste sources in the 100, 200, and 300 Areas. The findings from the analysis of these samples were supplemented with instrument readings obtained from field surveys at locations over and adjacent to the open waste areas. Portable instruments such as VGM's and CP meters were employed in these surveys. The results obtained from these measurements are summarized for the reactor, separations, and metal fabrication areas in the following paragraphs.

100 AREA WASTES

Over 500 samples were obtained from the outlet side of the 107 reactor effluent retention basins at the five reactor areas during the quarter. Table I summarizes the results obtained from the analysis of these samples for the activity density from gross beta particle emitters; the tabulation includes only those samples which were analyzed within sixteen hours after the time of sampling and only those samples which were obtained when the reactors were operating at normal power level.

TABLE I

RADIOACTIVE CONTAMINATION IN THE REACTOR EFFLUENT WATER DURING PERIODS OF NORMAL OPERATION JULY, AUGUST, SEPTEMBER 1952

Location	Total Samples	July Max.	July Avg.	August Max.	August Avg.	September Max.	September Avg.
		Activity Density from Gross Beta Emitters, Units of 10^{-3} $\mu c/cc$					
100-B Area	99	4.1	3.4	4.0	3.5	4.1	3.5
100-D Area	89	3.9	3.1	3.4	2.7	3.7	3.1
100-DR Area	111	3.6	3.1	4.0	3.3	4.3	3.2
100-F Area	104	3.8	3.2	3.6	3.4	4.5	3.9
100-H Area	82	3.3	2.5	3.9	2.8	3.9	3.3

A comparison of the results summarized in Table I with similar measurements obtained during the previous quarter shows an overall increase in the activity density from gross beta particle emitters in reactor effluent. The increase in average values resulted from the application of revised correction factors to the counting rates obtained after radiochemical analysis of the effluent samples. The revised correction factors, which were applied to these data for the first time during this quarter, were derived from detailed studies of the hold-up time in the effluent retention basins and from numerous analyses of decay curves obtained from the inlet and outlet samples at each of the individual reactor areas. The application of factors thus derived (HW-27584) caused the current values to range from fifty to fifty-five per cent higher than those which would have been reported if the old correction factors had been used. Considering the above, a comparison of current measurements with those obtained during the past several months did not reflect any significant change in the activity density from gross beta particle emitters.

For comparative purposes, a complete tabulation of the recomputed values obtained by applying the revised correction factors to past data is presented in Table II. The results summarized in Table II correct the values previously published in quarterly reports of this series.

Special studies designed to determine the effective hold-up time of reactor areas were resumed (HW-19454) during late May and maintained on a spot check basis throughout the balance of the quarter. Representative samples of the effluent water were obtained from the inlet and outlet side of each basin; measurements of the radioactive decay of the inlet samples were made until such time as the activity density of the beta particle emitters in the inlet water equaled the activity density of the beta particle emitters in the water which was being discharged from the basin. The interval required to reach equality was considered as the effective hold-up time in the basin. Work performed by Regional Survey showed the hold-up time to range from 1.5 to 3.5 hours at the various reactor areas; values on the order of 2 hours predominated in these data. A complete summary of the methods and the results obtained at each of the reactor areas during this study will be published in a subsequent report.

Radiochemical analysis of the reactor effluent samples for the activity density from gross alpha particle emitters showed average values to be less than 5×10^{-9} $\mu c/cc$ at each area. Isolated samples which were analyzed specifically for uranium and plutonium showed no detectable activity from these contaminants.

A mud sample obtained from the bottom of the 107-H effluent basin at the time that the basin was empty showed an activity density of 0.9 $\mu c/g$ from yttrium and rare earths.

 [redacted]

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TABLE II

RADIOACTIVE CONTAMINATION IN REACTOR EFFLUENT DURING PERIODS OF NORMAL OPERATION CORRECTED VALUES FOR PREVIOUSLY PUBLISHED DATA GROSS BETA ACTIVITY DENSITY - UNITS OF 10^{-3} μc/cc

	100-B		100-D		100-F	
Period	Maximum	Average	Maximum	Average	Maximum	Average
1947						
May			0.30	0.23		
June			0.24	0.22		
July			1.36	0.22		
August						
September			1.30	0.18	0.21	0.21
October			0.21	0.19	0.22	0.20
November			0.22	0.21	0.28	0.22
December			0.15		0.39	0.31
1948						
January			0.21	0.16	0.37	0.23
February			0.40	0.35	0.42	0.41
March			0.39	0.32	0.48	0.48
April			0.44	0.41	0.68	0.34
May			0.45	0.36	0.44	0.26
June			0.55	0.51	0.60	0.59
July	0.53	0.48	0.57	0.49	0.70	0.60
August	0.73	0.38	0.44	0.35	0.71	0.48
September	0.36	0.31	0.62	0.37	0.63	0.47
October	0.66	0.41	0.44	0.37	0.52	0.48
November	0.46	0.34	0.50	0.36	0.56	0.49
December	0.42	0.36	0.36	0.40	0.76	0.54
1949						
January	1.35	0.79	0.56	0.45	0.80	0.65
February	1.29	0.95	0.49	0.45	0.68	0.51
March	1.45	1.16	0.73	0.57	0.71	0.60
April	1.26	0.82	0.64	0.55	0.78	0.69
May	1.41	0.91	0.60	0.56	0.64	0.49
June	1.14	0.70	0.49	0.37	0.64	0.46
July	1.24	0.58	0.48	0.42	0.58	0.37

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TABLE II (contd.)

GROSS BETA ACTIVITY DENSITY - UNITS OF 10^{-3} $\mu c/cc$

Period	100-B		100-D		100-DR		100-F		100-H	
	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
August	0.54	0.38	0.78	0.43			0.63	0.48		
September	0.85	0.57	0.69	0.54			0.96	0.62		
October	0.81	0.62	0.58	0.49			0.90	0.73	0.12	0.13
November	1.68	0.62	0.78	0.52			1.11	0.80	0.46	0.36
December	0.68	0.59	0.96	0.74			1.01	0.79	0.64	0.52
1950										
January	1.35	0.79	0.98	0.58			1.41	0.85	0.79	0.60
February	1.30	0.95	1.64	1.07			1.35	0.86	1.57	1.15
March	1.45	1.16	1.70	1.33			1.38	1.03	1.64	1.12
April	1.26	0.82	1.48	1.13			1.58	1.21	2.58	1.66
May	1.41	0.91	1.32	0.98			1.78	1.35	2.81	1.76
June	1.14	0.70	1.28	0.99			1.32	1.15	2.16	1.46
July	1.24	0.58	0.89	0.74			1.26	0.90	1.32	0.68
August	1.16	0.52	1.09	0.91			1.70	1.11	1.24	0.66
September	1.73	0.52	1.58	0.87			1.87	1.35	0.96	0.56
October	1.50	0.92	1.42	0.89	1.16	0.91	2.04	1.59	1.09	0.73
November	1.71	1.32	1.68	1.17	1.78	1.25	2.10	1.79	2.46	1.15
December	2.84	1.39	1.82	1.06	3.16	2.02	2.89	1.87	2.76	1.73
1951										
January	2.20	1.07	1.20	1.05	1.98	1.57	3.57	2.40	3.25	1.98
February	1.93	1.25	1.49	0.99	2.47	1.77	2.59	1.70	2.32	1.60
March	1.81	1.41	1.36	0.92	2.50	1.77	2.70	1.99	2.93	1.77
April	2.01	1.16	1.29	0.93	2.12	1.39	2.23	1.66	2.01	1.33
May	3.38	2.00	2.16	1.46	3.81	2.14	2.51	1.66	3.78	1.61
June	2.60	1.75	1.76	1.25	3.84	1.56	2.91	1.70	2.35	1.47
July	2.34	1.73	1.63	1.30	2.94	2.23	2.96	2.18	2.75	1.27
August	2.58	2.00	2.12	1.52	3.47	2.07	4.72	2.37	1.54	1.14
September	2.81	2.37	2.24	1.63	2.70	2.17	4.23	2.28	3.29	2.02
October	3.76	2.24	2.59	1.86	3.49	2.72	2.44	1.63	2.68	1.49
November	3.57	2.18	2.88	2.02	3.76	2.58	2.55	1.56	4.93	2.86
December	3.63	2.20	2.72	2.04	3.53	2.47	2.35	1.55	3.32	2.50
1952										
January	3.52	2.50	2.61	2.08	3.75	2.20	2.45	1.58	2.96	2.37
February	3.48	2.80	3.02	2.32	2.80	1.98	2.86	2.06	2.97	2.26
March	3.94	3.33	2.85	2.56	4.41	3.58	4.65	3.67	3.00	2.51
April	3.97	3.23	4.12	3.45	4.12	3.08	4.58	3.43	4.04	3.28
May	4.99	3.94	3.85	3.32	3.88	3.39	4.87	3.75	4.98	3.26
June	4.29	3.81	3.81	3.11	3.94	3.10	4.43	3.75	3.62	2.82

[redacted]

Composite samples were obtained daily from the sump in the biology farm waste discharge line at the 100-F Area and analyzed for the activity from I^{131}. The average activity density from I^{131} in 81 samples collected during the quarter was 2.8×10^{-6} μc/cc; the maximum measurement was 2.2×10^{-5} μc/cc. Calculations based on the metered volume of waste and the mean value stated above, showed that an average of 0.20 mc of I^{131} was discharged to the river daily. Although the average I^{131} discharge was comparable to that measured during the previous quarter, the amount of I^{131} discharged during October and September was higher by a factor of 2 over the July average; the later average was 0.11 mc/day as compared with average values of 0.26 and 0.22 mc/day during October and September, respectively.

Portable instrument surveys performed on a monthly basis in the burning grounds of the reactor areas indicated trace contamination in isolated instances. VGM readings in the range of 3,000 to 6,000 c/m were found at the 100-B Area and one reading of 25,000 c/m was found at the 100-H Area. Readings at the remaining reactor areas were on the order of natural background which ranges from 60 to 150 c/m at these locations.

<u>200 AREA WASTES</u>

Two-hundred fifty-five liquid samples and 121 mud samples collected from waste sources in the separations area were analyzed during the quarter. The results obtained from these measurements are summarized in Table III.

[redacted]

TABLE III

RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS

JULY, AUGUST, SEPTEMBER

1952

LIQUID SAMPLES

Location	No. Samples	Uranium - Plutonium, Units of 10^{-9} µc/cc, Maximum	Uranium - Plutonium, Units of 10^{-9} 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	53	< 5	64	9.8
U Swamp	21	1800	120	2	< 1
Laundry Ditch	22	2600	180	31	4.6
231 Ditch	19	200	25	2	< 1
200-E "B" Ditch	38	8	< 5	11	1.7
200-E "B" Swamp	24	7	< 5	7	2.3
234-35 Ditch	10	3600	330	< 1	< 1
200-E Retention Pond	50	17	< 5	120	4.6
200-W Retention Pond	23	40	< 5	40	14
234 Retention Pond	8	1400	740		
Redox Swamp	11	620	57	100	21

SOLID SAMPLES

Location	No. Samples	Units of 10^{-6} µc/g, Maximum	Units of 10^{-6} µc/g, Average	Units of 10^{-5} µc/g, Maximum	Units of 10^{-5} µc/g, Average
T Swamp	23	250	54	150	42
Laundry Ditch	12	260	110	110	54
200-E "B" Ditch	39	62	8.4	1700	310
200-E "B" Swamp	24	11	2.5	69000	11000
234-35 Ditch	11	22000	2000	7	4
Redox Swamp	12	4.2	2	1100	170

As in the past, considerable fluctuation was noted in the values obtained from individual measurements at locations summarized in Table II. Increases which approached significance were noted in the activity from uranium and plutonium at the laundry ditch in the 200 West Area and the 234-235 ditch. A significant increase was noted in the mean activity density from gross beta particle emitters accumulated in mud at the edge of the 200 East Area "B" Swamp. An increase in the latter activity by a factor of 65 over the average value measured during the previous quarter was largely weighted by one sample which showed 0.69 μc/g.

Twenty-two liquid samples collected from the laundry ditch were analyzed for uranium. The average activity from this contaminant was 1.9×10^{-7} μc/cc including a maximum measurement of 2.1×10^{-6} μc/cc. Similar measurements performed on mud samples collected at the edge of the ditch showed no significant increase during the period; uranium in mud averaged 8.2×10^{-5} μc/g with a maximum measurement of 3.5×10^{-4} μc/g.

Trace amounts of uranium on the order of 6×10^{-8} μc/cc were found in water from the U Swamp. No uranium was detected in solid samples at this location.

All samples which showed significant quantities of uranium and plutonium when analyzed by the ether extraction method, were also analyzed for plutonium. With the exception of the 234-235 ditch where trace quantities of this contaminant were detected, the amount of plutonium in waste at the 200 Areas was below the detection limit of the measurement.

Mud and water samples were collected from the tank farm in the 200 West Area, after one of the pipes in the farm had broken. The activity density of the mud from gross beta particle emitters and uranium-plutonium was 1.3 mc/g and 4×10^{-7} μc/g, respectively. The activity density from gross beta and gross alpha particle emitters in the water samples was 7×10^{-9} μc/cc and 3×10^{-6} μc/cc, respectively. In connection with the survey during the above incident, a mud sample was collected from outside the fence at the southeast corner of the 200 West Area. The activity density from gross beta and gross alpha particle emitters in this sample was 6×10^{-5} μc/g and 3×10^{-7} μc/g, respectively.

[redacted]

Portable instrument surveys along the edge of the open waste ditches and waste ponds in the separation areas showed average readings on the order of 400 c/m. Maximum readings were found along the "B" ditch where values approaching 10,000 c/m were detected. Background in the separation areas normally ranges from 100 to 200 c/m.

300 AREA WASTES

The results obtained from the radiochemical analysis of 86 liquid samples and 25 mud samples which were collected from 300 Area waste sourced are summarized in Table IV.

TABLE IV

RADIOACTIVE CONTAMINATION IN 300 AREA WASTES JULY, AUGUST, SEPTEMBER 1952

Location	Number Samples	Beta Particle Emitters Units of 10^{-7} µc/cc Max.	Beta Avg.	Alpha Particle Emitters Units of 10^{-8} µc/cc Max.	Alpha Avg.	Uranium Units of 10^{-6} µc/cc Max.	Uranium Avg.
Old Pond Inlet Liquid	12	51	11	1600	500	14	3.6
New Pond Inlet Liquid	12	180	23	750	280	11	3.4
300 Area Waste Line	62	180	14	6300	280	69	2.8
		Units of 10^{-4} µc/gram		Units of 10^{-6} µc/gram		Units of 10^{-6} µc/gram	
Old Pond Inlet Solid	13	19	7.3	650	250	280	86
New Pond Inlet Solid	12	53	11	740	190	600	160

[redacted]

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In general, the activity density from gross beta and gross alpha particle emitters in 300 Area waste was on the same order of magnitude as that observed during the previous quarter. The activity density from gross alpha particle emitters was approximately two times higher than that which was observed during the first few months of 1952.

Sixty-eight selected samples collected from the 300 Area waste line were analyzed for plutonium. The average activity from this contaminant was 8.8×10^{-9} $\mu c/cc$ with a maximum measurement of 3.9×10^{-8} $\mu c/cc$. The average amount of plutonium in 300 Area waste during this period was about one-half the amount observed during the previous quarter, and the maximum measurement during April, May, and June of 1952 was ten times higher than that measured during the present period.

Spot mud samples collected at the inlet of the old and new ponds in 300 Area were analyzed for plutonium. The activity from this contaminant was on the order of 3×10^{-6} $\mu c/g$ at the old pond and 8×10^{-5} $\mu c/g$ at the new pond.

[redacted]

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

Nearly 400 samples of Columbia River water were analyzed for the activity density from gross beta and gross alpha particle emitters to determine the extent and magnitude of radioactive contamination admitted to the river in the reactor cooling water. Samples were obtained on a weekly basis from control locations between the upstream project perimeter and Bonneville Dam.

Background studies to determine the contribution from natural radioactive particle emitters were determined by analyzing samples from the Columbia River above the reactor areas and from samples of the Snake and Yakima Rivers. Supplementary data were also obtained from spot samples collected from rivers which discharge into these tributaries and the downstream Columbia River.

Table I summarizes the results obtained from the analysis for the activity density of gross beta particle emitters at all locations which were sampled periodically during the quarter.

TABLE I

AVERAGE CONTAMINATION FROM GROSS BETA PARTICLE EMITTERS IN THE COLUMBIA RIVER

JULY, AUGUST, SEPTEMBER

Activity Density - Units of 10^{-8} μc/cc

Location	July Avg.	Aug. Avg.	Sept. Avg.	Quarter Avg.	Last Quarter Avg.	Maximum Measurement This Quarter
Wills Ranch	< 5	< 5	< 5	< 5	< 5	< 5
100-B 181 Bldg.	< 5	17	< 5	7	14	61
Allard Station	< 5	53	240	120	96	740
100-D 181 Bldg.	33	55	160	92	66	290
100-H 181 Bldg.	130	52	260	170	170	330
Below 100-H	220	340	360	320	330	690
100-F 181 Bldg.	200	330	460	350	300	590
Below 100-F	240	210	570	370	490	1100
Hanford South	290	380	650	450	460	1000
Hanford Middle	180	220	510	330	320	870
Hanford North	65	120	380	180	130	880
300 Area	160	200	230	200	200	370
Richland	83	160	220	160	180	350
Highland Station	80	120	150	120	110	200
Pasco-Kennewick Bridge						
Kennewick Side	67	89	150	100	79	190
Pasco Side	60	100	130	98	99	190
Sacajawea Park	22	57	86	55	43	120
Snake River at Mouth	< 5	< 5	< 5	< 5	6	< 5
McNary Dam	30	48	38	39	38	76
Patterson	19	27	38	29	20	54
Yakima River at Mouth	< 5	< 5	< 5	< 5	< 5	< 5

The decrease in the activity density from beta particle emitters which was observed during the latter part of the previous quarter continued into the month of July. Increases in activity by factors varying from 2 to 5 observed during August and September were caused by a significant decrease in flow rate of the Columbia River. Peak flow observed during the month of July was 1,973,000 gallons per second. As indicated in Figure 5 this flow rate decreased steadily throughout the

the balance of the period to a minimum flow of 413,000 gallons per second during the latter part of September. Average flow rates for July, August, and September were 1,599,000, 837,000 and 481,000 gallons per second, respectively. The lower flow rate of the river caused a reduction in the dilution ratio of river water to reactor cooling water and thereby resulted in increased concentration of beta particle emitters at all monitoring locations below the 100-B Area.

A comparison of the data summarized in Table I with similar measurements obtained during the same period in 1951 show that average values during 1952 were on the order of 25 per cent higher than those observed during 1951. Again this difference was largely caused by the amount of water passing down the Columbia River; maximum flow during this period in 1951 was 2,665,000 gallons per second as compared to a maximum flow of 1,973,000 gallons per second this year. The minimum flow measured during this quarter in 1951 was over 100,000 gallons per second greater than the current minimum flow.

All samples obtained from locations indicated in Table I were also analyzed for the activity density from gross alpha particle emitters. In all instances, the average activity density was less than 5×10^{-9} μc/cc. Trace alpha particle emission on the order of 5×10^{-9} μc/cc to 5×10^{-8} μc/cc was detected in several isolated samples which were collected at random locations; resamples from these locations and from other down-stream locations did not confirm the positive activity indicated in the initial measurement.

Twenty-four samples of river water which were obtained along the south bank near the Hanford Ferry had an average concentration of 7×10^{-8} μc I^{131}/cc; the maximum measurement which was obtained during the month of August was 2.6×10^{-7} μc I^{131}/cc. These values were comparable to those observed during the previous quarter when the average was 5×10^{-8} μc/cc and the maximum was 2.1×10^{-7} μc/cc. The source of I^{131} found in the river is the waste discharge from the Experimental Biology Farm at the 100-F area. Data showing the amount of I^{131} discharged to the river from this source may be referred to in Section IV.

Radiochemical analysis of spot samples which were collected from tributaries which discharge into the Columbia River above and below the Hanford Works showed the activity density from gross alpha and gross beta particle emitters to be less than 5×10^{-9} µc/cc and 5×10^{-8} µc/cc respectively, in all samples analyzed.

The activity density from beta particle emitters in Columbia River mud was determined by analyzing samples collected from on-shore and off-shore locations between the north west project perimeter and McNary Dam. Table II summarizes the results of these measurements.

The higher activity noted in mud samples collected below the 100-F Area and at the Hanford Ferry was largely due to the location at which the samples were collected; each of these locations is directly below the most downstream reactor and the measurements represent the accumulated deposition from the five reactor areas. Except for these two locations, no significant difference was observed between locations or between the on-shore and off-shore samples. In general, the order of magnitude indicated in Table II was in very good agreement with that observed in the past.

Two samples of mud were obtained from the base of Bonneville Dam. The activity density from gross beta particle emitters in these samples was 4.7×10^{-5} and 3.7×10^{-5} µc/g. These values were nearly identical to the average concentrations found at this location during 1952. Analysis of these same samples for gross alpha activity showed values less than 2×10^{-6} µc/g in each case.

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TABLE II

RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES

JULY, AUGUST, SEPTEMBER

1952

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

Location	July Avg.	August Avg.	September Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
Wills Ranch						
Shore	4	4	4	4	4	9
5' Out	3	3	3	3	3	4
Allard Station						
Shore	4	3	6	4	4	9
5' Out	4	3	5	4	3	8
100-H						
Shore	4	6	8	6	4	14
5' Out	4	4	6	5	5	9
Below 100-F						
Shore	5	12	13	11	6	28
5' Out	7	13	14	12	5	35
Hanford Ferry						
Shore	6	13	10	10	4	22
5' Out	7	20	15	14	4	34
300 Area						
Shore	3	8	8	6	5	14
5' Out	3	6	9	6	3	17
Richland Dock						
Shore	5	9	8	8	6	15
5' Out	7	7	10	8	4	13
Kennewick Pump Station						
Shore	3	8	6	6	5	10
5' Out	4	6	7	6	3	10
Pasco Bridge						
Pasco Shore	5	5	4	4	3	6
Pasco 5' Out	4	6	6	6	4	9
Kennewick Shore	2	5	7	5	3	10
Kennewick 5' Out	3	5	5	5	3	8
Sacajawea Park						
5' Out	6	8	14	8	5	24
McNary Dam						
5' Out	6	7	3	6	3	15
Patterson						
5' Out	4	5	4	5	3	6
Snake River at Mouth						
5' Out	6	4	2	4	4	10

[redacted]

DECLASSIFIED

Table III summarizes the results obtained from analyzing samples of raw water for the activity density from beta particle emitters. The raw water which originates from the Columbia River is sampled at each of the operating areas prior to final filtration and purification before consumption.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER RIVER EXPORT LINE

JULY, AUGUST, SEPTEMBER

1952

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

Location	July Avg.	August Avg.	September Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
183-B Bldg.	< 5	< 5	< 5	< 5	< 5	5
183-D Bldg.	< 5	< 5	19	10	9	34
183-DR Bldg.	< 5	5	20	11	9	37
183-H Bldg.	12	6	33	21	26	51
183-F Bldg.	12	28	56	39	41	76
283 Bldg. 200 West Area	< 5	< 5	< 5	< 5	5	< 5
283 Bldg. 200 East Area	5	< 5	< 5	< 5	< 5	9

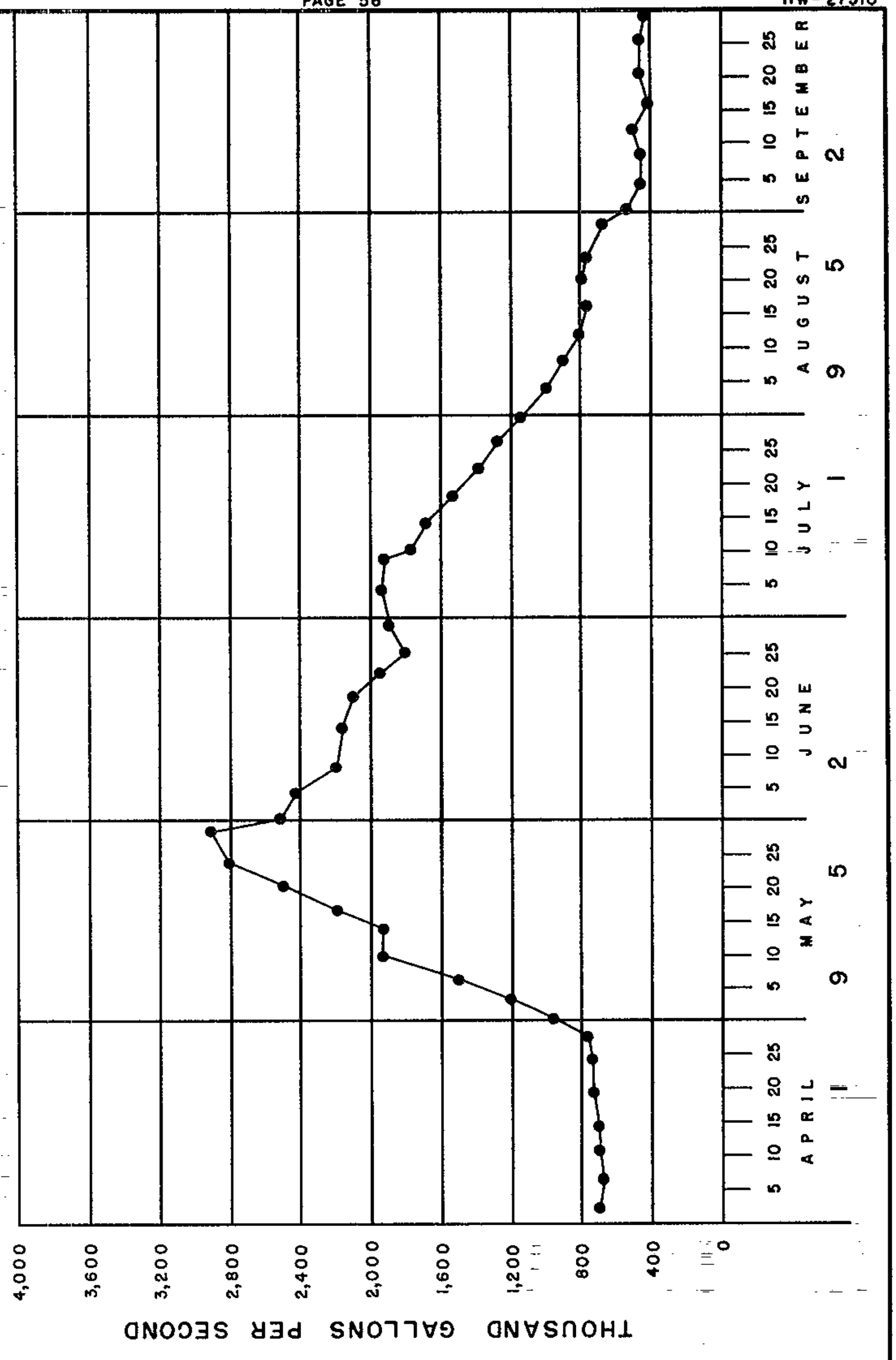
Increases in the activity density toward the latter part of the period were expected since the magnitude of activity in this water is directly dependent on activity concentrations in the Columbia River. The lower values observed during July were a continuation of a trend observed during the latter part of the previous quarter; higher values noted during September were comparable to those measured during April, 1952. The maximum individual sample measurements indicated in Table III were obtained during the last few weeks in September when the flow rate of the Columbia River was below 450,000 gallons per second.

FIGURE — 5

COLUMBIA RIVER FLOW

JULY - AUGUST - SEPTEMBER

1952



SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

The absence of significant amounts of precipitation during the three month period offered very little opportunity to evaluate the activity density from gross beta particle emitters in rainfall. Sixty samples were collected from twenty-seven locations on and adjacent to the Hanford Works. The number of samples collected from an individual location did not exceed four in any event. All of the measurements obtained during the quarter were made during August and September since only a trace of rainfall (< 0.01 inches) fell during the month of July. Table I summarizes the rainfall data as measured at the Meteorology Station near the 200 West Area during this period. Similar measurements obtained during 1950 and 1951 are included for comparison.

TABLE I

PRECIPITATION MEASURED AT HANFORD WORKS JULY, AUGUST, SEPTEMBER

Units - Inches

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

Table II summarizes the results obtained from analyzing the described samples for the activity density from gross beta particle emitters.

As indicated by the results summarized in Table II, very little activity was detected at locations beyond a radius of 8,000 feet from the separations area stacks. A comparison of these data to measurements obtained during the previous quarter show decreases occurring at all locations at which rain collectors were maintained. In general, the above values are lower by a divisor of 3 to 4 from the previous measurements.

Statistical analysis, comparing the average activity density from gross beta emitters in rainfall during July, August, and September in 1952 with similar measurements obtained in 1951 showed a highly significant decrease in this activity. In the region of higher contamination near the separations area, the values obtained in 1951 were approximately 100 times greater than those detected during this year; at perimeter locations and in the residential area bordering the project the mean activity was ten to twenty times greater in 1951. The higher results during 1951 were largely a result of the excessive amount of I^{131} emitted from the separations process stacks at that time.

Several of the rain samples were radio-autographed after they were counted, to determine if any radioactive particles were present. The results of these measurements showed no evidence of particle collection. The sensitivity of this measurement was on the order of two to three disintegrations per minute.

TABLE II

ACTIVITY DENSITY GROSS BETA PARTICLE EMITTERS IN RAIN

JULY, AUGUST, SEPTEMBER

1952

Location	Number Samples	Units of 10^{-6} μc/cc Maximum	Average
In 200 East Area	8	4	2
250' E of stack	2	1	1
2000' E of stack	2	3	2
750' SE of stack	2	4	3
3500' SE of stack	2	2	2
In 200 West Area	10	5	2
1000' E of stack	2	1	1
7000' of stack	2	3	2
8000' SE of stack	2	1	1
4900' SE of stack	2	1	2
Redox Area	2	5	3
100 Area Environs	16	4	< 1
100-B SE	2	< 1	< 1
100-D SW	2	< 1	< 1
100-F SW	4	4	1
Hanford 614	2	< 1	< 1
Hanford 101	2	< 1	< 1
White Bluffs	2	< 1	< 1
100-H SE	2	1	< 1
Perimeter Locations	12	< 1	< 1
Richland	2	< 1	< 1
Pasco H and R	3	< 1	< 1
Benton City	3	< 1	< 1
Riverland	2	< 1	< 1
3000 A. North	2	< 1	< 1
Intermediate Locations	14	3	< 1
Route 4S, Mile 6	2	1	< 1
300 Area	4	3	1
200 North	1	< 1	< 1
Gable Mountain	2	< 1	< 1
Batch Plant	1	< 1	< 1
Meteorology	4	< 1	< 1

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

Radioactive contamination in drinking water supplies was determined by analyzing 900 samples of drinking water obtained from wells on and adjacent to the Hanford Works. Over 700 of these were 500 ml samples which were analyzed for the activity density from gross beta and gross alpha particle emitters. Locations which indicated detectable quantities of alpha particle emitters based on the 500 ml sample analysis, were resampled, using a large volume sample (11.7 liters) to increase the sensitivity of the measurement from 5×10^{-9} μc/cc to 2×10^{-10} μc/cc. Over 100 of the latter type samples were also analyzed for the activity density from plutonium and/or uranium.

Sampling frequencies based on the probability of contamination and on the trend of current results varied from daily to monthly with the bulk of the wells being sampled on a weekly basis.

Table I summarizes the results obtained at locations where the activity density from alpha particle emitters averaged above the individual sample detection limit of 5×10^{-9} μc/cc during the quarter.

As in the past, trace alpha particle emission was detected in the Benton City drinking supply and in several of the Richland wells. Four Richland wells which showed positive alpha particle emission during the previous quarter did not give similar indications during the present period. In general, the magnitude of the results indicated in Table I were not significantly different from those measured during the last several quarters. All wells which showed trace alpha particle emission also showed trace quantities of uranium which presumably occurs naturally in the water table below the Benton City-Richland Area.

[redacted]

TABLE I

CONTAMINATION FROM ALPHA PARTICLE EMITTERS IN DRINKING WATER JULY, AUGUST, SEPTEMBER 1952

500 ml samples

Location	Number Samples	Alpha Particle Emitters Units of 10^{-9} $\mu c/cc$ Max.	Avg.	Number Samples	Uranium Units of 10^{-3} $\mu g/cc$ Max.	Avg.
Richland Well #2	9	13	8	11	16	8
Richland Well #4	21	19	5	60	18	3
Richland Well #12	12	9	5	12	11	5
Richland Well #14	12	17	5	13	11	4
White Bluffs Tele. Exchange	7	11	5	--	--	--
Benton City Store	13	16	11	14	16	9
Benton City Water Co. Well	12	19	10	12	23	11

Many of the drinking water supplies which are not included in Table I showed trace quantities of alpha particle emitters during some portions of the quarter. In most cases, the activity density was in the range of 2×10^{-10} to 5×10^{-9} $\mu c/cc$; except for isolated cases, these positive measurements were not confirmed by resamples and the average activity density over the three month period was well below the detection limit for an individual sample. Table II and III summarize the results obtained from all wells sampled during this period.

TABLE II

SUMMARY OF ALPHA AND BETA PARTICLE EMITTERS MEASURED IN WATER SUPPLIES

500 ml samples

JULY, AUGUST, SEPTEMBER

1952

Location	Samples	Alpha Particle Emitters, Units of 10^{-9} µc/cc: Max.	Alpha: Average	Beta Particle Emitters, Units of 10^{-8} µc/cc: Max.	Beta: Average
Richland Well #2	9	13	8	2	< 1
Richland Well #4	58	18	5	10	1
Richland Well #5	13	4	2	2	< 1
Richland Well #12	12	9	5	< 1	< 1
Richland Well #13	12	6	3	4	1
Richland Well #14	12	17	5	3	< 1
Richland Well #15	13	7	4	2	< 1
Richland Well #18	13	8	4	2	1
Tract House J-685	13	23	3	3	1
3000 Area Well "A"	13	3	2	2	< 1
3000 Area Well "B"	13	5	2	3	< 1
3000 Area Well "C"	12	38	5	2	< 1
3000 Area Well "D"	9	9	4	3	< 1
3000 Area Well "E"	13	2	< 2	1	< 1
Durand Well #5	12	6	2	2	< 1
Columbia Field Well "A"	13	19	3	6	1
Columbia Field Well "B"	12	4	< 2	2	< 1
Columbia Field Well "C"	13	12	2	1	< 1
Hanford Well #1	12	4	< 2	1	< 1
Hanford Well #4	12	5	< 2	< 1	< 1
Hanford Well #7	13	3	< 2	1	< 1
Headgate Well	13	7	2	< 1	< 1
1100 Area Well #8	13	21	3	1	< 1
Midway	12	2	< 2	3	< 1
Riverland	12	7	< 2	2	< 1
Lower Knob	12	6	< 2	2	< 1
Pistol Range	13	9	4	2	< 1
White Bluffs Fire Hall	13	9	4	6	1
White Bluffs Tele. Exch.	7	11	5	4	2

TABLE II (contd.)

Location	Samples	Alpha Particle Emitters Units of 10^{-9} µc/cc Max.	Alpha Particle Emitters Units of 10^{-9} µc/cc Average	Beta Particle Emitters Units of 10^{-8} µc/cc Max.	Beta Particle Emitters Units of 10^{-8} µc/cc Average
Benton City Store	13	16	11	1	< 1
Benton City Water Co. Well	12	19	10	1	< 1
Cobb's Corner	12	4	< 2	1	< 1
Enterprise Well	13	4	<2	4	1
Kennewick Std. Station	11	19	2	22	9
100-B Sanitary	12	3	< 2	4	< 1
100-D Sanitary	12	< 2	< 2	13	3
100-DR Sanitary	12	4	< 2	8	3
100-H Sanitary	11	6	< 2	18	6
100-F Sanitary	11	5	< 2	66	16
200 East Sanitary	13	5	< 2	2	< 1
200 West Sanitary	12	3	< 2	4	1
300 Area Sanitary	12	13	3	1	< 1
251 Building Sanitary	13	2	< 2	3	< 1
Redox Administration Bldg.	13	< 2	< 2	6	1
Sacajawea Park	11	7	5	2	< 1
McNary Dam	10	3	< 2	26	4
Patterson	10	3	< 2	3	< 1
Plymouth	10	3	< 2	< 1	< 1
Pasco Sanitary	13	--	--	100	44
Prosser	10	2	< 2	2	<1

TABLE III

SUMMARY OF ALPHA PARTICLE EMITTERS MEASURED IN DRINKING WATER

11.7 liter samples

JULY, AUGUST, SEPTEMBER

1952

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

Location	Number Samples	Maximum	Average
Richland Well #2	4	26	11
Richland Well #4	3	26	11
Richland Well #5	5	17	11
Richland Well #12	5	37	23
Richland Well #13	5	41	19
Richland Well #14	5	27	13
Richland Well #15	4	33	13
Richland Well #18	3	15	9
Tract House J-685	5	12	8
Columbia Field Well "A"	6	13	4
Columbia Field Well "B"	5	14	7
Columbia Field Well "C"	5	7	4
1100 Area Well #8	5	14	10
3000 Area Well "A"	5	19	7
3000 Area Well "B"	4	17	13
3000 Area Well "C"	4	24	15
3000 Area Well "D"	4	14	11
3000 Area Well "E"	4	7	5
3000 Area Durand #5	5	13	6
Benton City Store	5	80	49
Benton City Water Co. Well	6	78	48
Kiona	5	13	7
Enterprise Well	5	6	3
Headgate Well	3	5	3
Kenn. Std. Station	6	9	6
Riverland	5	7	5
Midway	5	4	3
Lower Knob	4	5	2
Wills Ranch	5	9	4
Hanford Well #1	4	14	7
Hanford Well #4	4	8	3
White Bluffs Fire House	3	11	6
Pistol Range	3	23	11
Hanford #7 Sanitary	5	4	3
251 Building Sanitary	5	4	3
Clover Island	1	6	6
3000 Pond Inlet	4	13	10
Bonneville Dam	5	19	10

[redacted]

All 500 ml samples referred to in the previous discussion were also analyzed for the activity density from gross beta particle emitters. The results of these measurements for individual well locations are included in Table II. Consistent with previous observations, the only drinking water supplies showing significant beta particle emission were those which used the Columbia River as an initial source of water. Somewhat higher average values measured at Pasco, Kennewick, and at the 100-F Area were largely weighted by high individual measurements obtained during the latter part of the quarter when the flow rate of the Columbia River was at a minimum for this period. Maximum measurements at Pasco and Kennewick were twice as high as those measured during the previous period.

Weekly samples of different types of filtering media which represented various stages in the filtering process at the Pasco Filter Plant were analyzed for the activity density of gross beta particle emitters. The results of these measurements are summarized in Table IV.

TABLE IV

PASCO FILTER PLANT MEASUREMENTS
JULY, AUGUST, SEPTEMBER

1952

Type Sample	Number Samples	Activity Density Gross Beta Particle Emitters Maximum	Average
Water Entering Plant From River	12	$1.9 \times 10^{-6} \mu c/cc$	$9.8 \times 10^{-7} \mu c/cc$
Sand (surface of sand filter)	12	$1.9 \times 10^{-4} \mu c/g$	$7.3 \times 10^{-5} \mu c/g$
First Backwash Material (liquid)	13	$2.0 \times 10^{-6} \mu c/cc$	$6.6 \times 10^{-7} \mu c/cc$
First Backwash Material (solid)	12	$4.2 \times 10^{-2} \mu c/g$	$1.1 \times 10^{-2} \mu c/g$
Coal (surface of coal filter)	11	$8.7 \times 10^{-4} \mu c/g$	$1.3 \times 10^{-4} \mu c/g$
First Backwash Material (liquid)	11	$1.9 \times 10^{-6} \mu c/cc$	$8.2 \times 10^{-7} \mu c/cc$
First Backwash Material (solid)	11	$2.3 \times 10^{-2} \mu c/g$	$7.8 \times 10^{-3} \mu c/g$
Water Leaving Plant	13	$1.0 \times 10^{-6} \mu c/cc$	$4.4 \times 10^{-7} \mu c/cc$

[redacted]

A comparison of these data with similar measurements obtained during the previous quarter showed very little change occurring in the activity density in the liquid fraction of the backwash material; two-fold increases occurred in the activity density from gross beta particle emitters in the solid fraction of backwash material from the sand and coal filters and in the sand obtained from the surface of the sand filters. Partial explanation of these increases was the higher activity density detected in the Columbia River water when the flow rate of the river decreased during the latter part of the quarter. It is believed that another cause of the increased activity may be related to the increased turbidity in the river during the summer months, although no correlative measurements of this type have been attempted.

Several special samples of foam-like material were obtained from the surface of the water over the coal and sand filters. The activity density from gross beta particle emitters in nine samples from the coal filter averaged 4.2×10^{-3} μc/g; 11 samples from the sand filter averaged 2.9×10^{-3} μc/g; maximum measurements were 1×10^{-2} μc/g and 6.4×10^{-3} μc/g. As expected, the activity in the foam-like material was comparable to that detected in the first backwash material.

In addition to the beta measurements, a number of spot samples from the filter plant were also analyzed for the activity density from alpha particle emitters. The only sample which showed detectable activity from these contaminants was a sample of mud obtained from the bottom of the settling basin; analysis of two aliquot portions of this sample showed the activity density to be 1.2×10^{-5} μc/g.

Approximately 25 drinking water samples were obtained from remote locations in the state of Washington and Oregon. Radiochemical analyses were performed on these samples to determine if significant quantities of alpha or beta particle emitters were present from natural sources in the Pacific Northwest. In all cases, the activity densities from alpha and beta particle emitters were less than 2×10^{-9} μc/cc and 5×10^{-8} μc/cc respectively.

Nearly 200 samples were obtained from test wells on the site. The results obtained from radiochemical analysis of these samples for alpha and beta particle emitters for all locations which showed detectable activity at some time during the quarter are summarized in Table V.

TABLE V

SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN TEST WELLS

500 ml samples

JULY, AUGUST, SEPTEMBER 1952

Location	Number Samples	Alpha Particle Emitters Units of 10^{-9} µc/cc Max.	Alpha Particle Emitters Units of 10^{-9} µc/cc Average	Beta Particle Emitters Units of 10^{-8} µc/cc Max.	Beta Particle Emitters Units of 10^{-8} µc/cc Average
300 Area Well #1	12	180	39	11	8
300 Area Well #3	19	230	120	10	2
300 Area Well #4	12	240	140	8	3
300 Area North Well	4	3,000	2,500	21	14
B-Y Well	12	6	3	2	< 1
McGee Well	13	< 2	< 2	5	2
Ford Well	12	3	< 2	1	< 1
Meeker Well	13	3	< 2	2	< 1

Small changes in the activity density from alpha particle emitters at the 300 Area wells were associated with decreasing river flow and the negligible amount of water used at these sources. Normally, the activity in these wells changes proportionately to river flow; during this period of decreasing flow rate in which the total flow of the river was comparable to the previous quarter, two of the wells showed increases and the remaining well decreased. The net change was within a factor of two in each case. Uranium was identified as the contaminant at each of the 300 Area wells; average concentrations ranged from 4.4×10^{-2} to 0.14 µgU/cc including a maximum measurement of 0.3 µgU/cc at Well #3.

Samples obtained from test wells which were drilled by Geology showed no detectable contamination when analyzed for gross alpha and gross beta particle emitters. From one to three samples were obtained from each of the wells drilled by this group.

Supplementary data was obtained by analyzing several samples from various creeks and springs in the immediate environs. The activity density from gross alpha and gross beta particle emitters in these random water supplies was below the detection limit of 2×10^{-9} µc/cc, and 5×10^{-8} µc/cc, respectively.

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