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RADIOACTIVE CONTAMINATION IN THE HANFORD ENVIRONS FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1956

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Regional Monitoring Operation
Radiation Protection Operation

[redacted]

December 7, 1956

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Work performed under Contract No. W-31-109-Eng-52 between the Atomic Energy Commission and General Electric Company

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ABSTRACT

SECTION I: RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

Total average I^{131} emission from A-plant, S-plant, and Semi-Works stacks this quarter was 0.28 curie per day compared to 2.0 curies per day during the previous quarter. Approximately 80 per cent of this I^{131} came from the A-plant stack where the quarterly average and maximum were 0.23 and 1.6, curies per day, respectively. Ruthenium emission from the S-plant stack remained at the low rate of less than 0.01 curie per day noted during the previous six months.

Total average tritium oxide emission from all reactor stacks combined was 1.2 curies per day compared to 1.0 curie per day during the previous quarter. Monthly C^{14} and S^{35} measurements at the reactor stacks revealed maximum and average emission rates comparable with past experience, with the majority of the measurements below the respective detection limits.

No significant changes in gross alpha activity density in reactor area stack gases were noted this quarter. The activity density of gross beta particle emitters increased at 100-C and 100-KE Areas this quarter by factors of 10 and 3, respectively, over last quarter's averages. One filter sample collected from the 100-C reactor stack on September 17, 1956, during burning of a metal slug at the rear face, was analyzed by the gamma energy spectrometer and radiochemically. The majority of the activity present at the time of this analysis (on September 19, 1956) was due to isotopes of iodine and Te^{132}. Beta particle emitter activity density of the stack effluent during this 5.3 hour sample was calculated to be 1.4×10^{-2} $\mu c/ft^3$.

SECTION II: RADIOACTIVE CONTAMINATION ON VEGETATION

Very minor amounts of I^{131} were deposited on vegetation this quarter from Hanford sources. Significant amounts of Iodine were deposited during July and August from nuclear detonations with a maximum measurement found of 2×10^{-4} $\mu c/gm$. The deposition patterns are illustrated for July and August with no significant deposition occurring during September. The deposition of non-volatile beta particle emitters continued as a result of bomb fallout.

SECTION III: RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dose rates measured by Victoreen Integrons remained at average values ranging from 0.5 to 5.3 mrad/day. No significant changes were measured by detachable ionization chambers in the average dose rates present at all locations. The particle concentration increased 2 to 5 fold over last quarter's measurements as a result of fallout of debris from nuclear detonations. Average values ranged from 0.022 to 0.23 particles per cubic meter.

SECTION IV: RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The total discharge of radioactive materials to the Columbia River of reactor cooling water was the same as last quarter. Increases and decreases in individual reactor discharge could not be correlated with power levels or flow rates of the water. U-swamp waste waters showed an increase in average alpha particle emitter activity to 2.8×10^{-7} μc/ml compared with 6×10^{-8} μc/ml measured during the previous quarter. There was an increase in the average uranium discharge to the 300 Area Pond from 1.8×10^{-6} to 1.05×10^{-5} μc/ml as a result of accidental release of uranium from the 321 Building.

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

Increases in the activity density of beta particle emitters in the Columbia River this quarter were related to decreased river water flow rates. Activity density ranged from $<5 \times 10^{-8}$ μc/ml above the reactor areas to 4.6×10^{-5} μc/ml at 181-F Area. Average and maximum river flow was 1.3×10^{6} and 2.2×10^{6} gps this quarter compared to 2.2×10^{6} and 4.0×10^{6} gps for last quarter. The September minimum flow of 4.2×10^{5} gps on September 14 was the lowest flow recorded at Hanford for this month since prior to 1948. Beta particle emitter activity density of samples collected from the Columbia River between McNary Dam and Portland ranged from 5×10^{-8} to 2×10^{-7} μc/ml; the maximum measurement was obtained at Arlington, Oregon. These values are not significantly different from those noted in the past.

SECTION VI: RADIOACTIVE CONTAMINATION IN TEST WELLS

The test well program was assumed entirely by the Regional Monitoring Operation in July, 1956. The data from approximately eighty additional wells are available for reporting. A new naming system for all project wells is explained in a document entitled, "Hanford Wells" .(9)

A brief history is given in the text of the more important waste disposal sites and their monitoring wells.

The large-scale water table fluctuations beneath the project which have influenced the movement of radioactive waste in the ground water are reviewed.

Nine tables of analyses for radioactive emitters in well water with appropriate maps of well locations are included. No results of the previous quarter are available for most of these wells, but brief discussions are given on waste disposal sites in which changes have been observed during this quarter.

SECTION VII: RADIOACTIVE CONTAMINATION IN DRINKING WATER

The low Columbia River volume has provided less dilution of wastes added to the river and consequently higher concentrations of radioactivity in the drinking water derived from it. These concentrations are not expected to decrease until the spring freshet and arrangements have been made to analyze the samples for isotopes of long half-life, especially Sr^{90}. The average activity density of water leaving the Pasco Filter Plant was 1.1×10^{-6} $\mu c/ml$. A decontamination factor of 3 was provided by the treatment process.

INTRODUCTION

This document summarizes the results obtained from monitoring the Hanford environs for radioactive contamination during the period July, August, and September, 1956. Samples were collected by Regional Monitoring forces according to procedures previously outlined in documents of this series.[1, 2] These samples were analyzed by Radiological Chemical Analysis forces according to procedures and techniques described in a previously published laboratory manual.[3]

Counting rates obtained from these analyses were corrected for geometry, backscatter, air-window absorption, source size, self-absorption, chemical yield, and collection efficiency by Radiological Chemical Analysis forces using factors described in previous reports.[4, 5] 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. 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

Radioactive contaminants in the separations and reactor area effluent gases released to the Hanford environs were sampled at the stacks and the stack breechings. Daily filter and scrubber samples from the separations areas were analyzed for I^{131} and $Ru^{103-106}$ activity density. Weekly filter, tritium oxide, and C^{14}-S^{35} samples were taken at the reactor areas and analyzed radiochemically. Summaries of the results obtained from measurements in each manufacturing facility are presented below.

SEPARATIONS AREAS

200 EAST AREA - SEMI-WORKS

Filter samples taken from the fifty foot level of the Semi-Works stack were analyzed for total beta particle emitters. The results of these analyses calculated as curies per day emitted from the stack are summarized Table I.

TABLE I

BETA PARTICLE EMITTERS DISCHARGED
FROM THE SEMI-WORKS STACK
JULY, AUGUST, SEPTEMBER
1956

Units of Curie Per Day

Month	Maximum	Average
July	0.003	<0.001
August	<0.002	<0.001
September	<0.001	<0.001
Quarter	0.003	<0.001
Last Quarter	0.53	0.02

The extended shutdown of the Semi-Works facility since June of this year resulted in a continued low emission of gross beta particle emitters from this facility.

The majority of the results obtained from this facility were below the detection limit throughout the quarter.

200 EAST AREA - A-PLANT

A summary of the results of I^{131} measurements at the two-hundred foot level of the A-plant stack is presented in Table II.

TABLE II

IODINE-131 DISCHARGED FROM THE A-PLANT STACK

JULY, AUGUST, SEPTEMBER

1956

Month	Units of Curies Per Day Maximum	Average
July	1.6	0.27
August	0.13	0.03
September	0.99	0.40
Quarter	1.6	0.23
Last Quarter	26	1.2

Several shutdown periods and continued dissolution of longer cooling period metal (100-120 days) reduced the I^{131} emission this quarter to the range of values found during the first quarter of 1956. Maximum and average values this quarter were 1.6 and 0.23 curie per day compared to similar values of 1.3 and less than 0.08 curies per day for the first quarter.[7]

Measurement of filterable gross beta emitters in the A-plant stack effluent by means of filter samples, revealed an average of less than 5.7×10^{-4} curie per day of these emitters were discharged to the

atmosphere this quarter. Gamma energy spectrum measurements on some of these filters indicated a mixture of rare earth, Zr^{95}-Nb^{95}, and Ru^{103} isotopes in descending order of activity density. Ammonium nitrate formed during periods of simultaneous coating removal, and metal dissolution, has made continued operation of this filter sample difficult, especially near the end of September. During the fourth quarter of 1956, a strip filter monitor employing an intermittently moving filter tape, a scintillation counter, and a strip chart recorder will be installed in the Purex stack Building to overcome the heavy ammonium nitrate deposit collected on the present stationary filter.

200 WEST AREA - S-PLANT

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

TABLE III

IODINE-131 DISCHARGED FROM THE S-PLANT STACK

JULY, AUGUST, SEPTEMBER

1956

Month	Units of Curies Per Day Maximum	Average
July	0.18	0.02
August	0.28	0.05
September	0.15	0.07
Quarter	0.28	0.05
Last Quarter	3.4	0.81

I^{131} emission from S-plant decreased this quarter to an average of 0.05 curie per day compared to the average of 0.81 curie per day obtained last quarter. (8) This quarterly average is the lowest obtained since 1952 and resulted from the dissolution of longer cooling periods, smaller MWD metal, and from several periods of extended shutdown.

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

TABLE IV

RADIOACTIVE RUTHENIUM DISCHARGED
FROM THE S-PLANT STACK
JULY, AUGUST, SEPTEMBER
1956

Units of Curie Per Day

Month	Maximum	Average
July	0.04	<0.01
August	<0.03	<0.01
September	<0.04	<0.02
Quarter	0.04	<0.01
Last Quarter	0.17	<0.01

No change in the average ruthenium emission was noted this quarter when compared with the results of the previous three quarters.[6, 7, 8] Very few positive measurements were obtained this quarter; the maximum value was 0.04 curie per day.

Installation of a new type of stack effluent monitor at Redox is nearing completion and should be in operation during the fourth quarter of 1956. This monitor utilizes a continuously moving strip filter in series with a counter-current caustic scrubbing column. The radioactive material collected by these two samplers are monitored by beta and gamma scintillation crystals and recorded through electronic integrators as individual emission rates of I^{131}, Ru^{103}, and Ru^{106} isotopes. After calibration of the equipment, laboratory analysis of the collected samples will no longer be necessary.

200 WEST AREA - U-PLANT

Table V summarizes the results from filter monitoring at the ten foot level of the U-plant stack.

TABLE V

RADIOACTIVE PARTICULATE MATERIALS
DISCHARGED FROM THE U-PLANT STACK
JULY, AUGUST, SEPTEMBER
1956

Month	Alpha Particle Emitters, Units of 10^{-8} curie/day		Beta Particle Emitters, Units of 10^{-5} curie/day		Radioactive Particle Concentrations, Units of 10^{5} Particles/day	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
July	1.7	0.5	0.2	0.1	16	7.9
August	4.1	0.9	0.7	0.1	18	9.3
September	73	16	95	17	15	5.5
Quarter	73	5.7	95	5.7	18	7.8
Last Quarter	110	5.1	270	12	>19	>4.4

Gross alpha and beta particle emitters collected on the U-plant stack filter sampler returned to normal levels during July and August after the unusually high emission noted during June. However, the unusually high measurements of September 21, 1956 increased the average values for the month of September. Without these high values, the average gross alpha and beta particle emitter activity densities for September and for the quarter would be only about one-half of those recorded in Table V.

Isotopic analysis on the filter removed on September 21, 1956, revealed the following composition: 46% Ru^{106}, 40% rare earths, 3% Sr^{90}, and less than 1% Zr^{95}-Nb^{95}. This is an expected composition based on the age and type of material processed at U-plant.

Although the activity density of the U-plant effluent decreased during July and August, no significant reduction in the concentration of radioactive particles were noted during this period. These data indicate that the activity per particle decreased while the number of particles remained about the same as that noted during June.

REACTOR AREAS

Results of measurements at the reactor area stacks for tritium oxide, C^{14}, S^{35}, and particulate materials are summarized in Tables VI through XI.

TABLE VI

TRITIUM OXIDE DISCHARGED FROM REACTOR STACKS
JULY, AUGUST, SEPTEMBER
1956

Units of Curie/day

	July		August		September		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	0.10	0.10	0.20	0.20	0.07	0.07	0.20	0.12
100-C	0.12	0.10	0.09	0.08	0.50	0.36	0.50	0.18
100-KW	0.08	0.07	0.04	0.03	0.05	0.04	0.08	0.05
100-KE	0.10	0.07	0.03	0.03	0.04	0.04	0.10	0.04
100-D	0.41	0.41	0.28	0.28	0.35	0.35	0.41	0.35
100-DR	0.02	0.02	0.03	0.03	0.05	0.05	0.05	0.03
100-H	0.05	0.05	0.04	0.04	0.22	0.22	0.22	0.10
100-F	0.20	0.20	0.23	0.23	0.40	0.40	0.40	0.28

TABLE VII

CARBON-14 DISCHARGED FROM REACTOR STACKS
JULY, AUGUST, SEPTEMBER
1956

Units of 10^{-3} Curie Per Day

	July		August		September		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	<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-KW	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-KE	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-D	--	--	<4.5	<4.5	8.1	8.1	8.1	6.1
100-DR	<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	5.0	5.0	5.0	<4.5
100-F	<4.5	<4.5	<4.5	<4.5	5.3	5.3	5.3	<4.5

TABLE VIII

SULFUR-35 DISCHARGED FROM REACTOR STACKS
JULY, AUGUST, SEPTEMBER
1956

Units of 10^{-4} Curie Per Day

	July		August		September		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	15	15	<4.5	<4.5	--	--	15	8.6
100-C	<4.5	<4.5	<4.5	<4.5	--	--	<4.5	<4.5
100-KW	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-KE	<4.5	<4.5	<4.5	<4.5	6.7	6.7	6.7	<4.5
100-D	--	--	11	11	<4.5	<4.5	11	7.1
100-DR	--	--	<4.5	<4.5	15	15	15	5.8
100-H	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5	<4.5
100-F	<4.5	<4.5	50	50	89	89	89	47

[redacted]

TABLE IX

ALPHA PARTICLE EMITTERS DISCHARGED AS PARTICULATES FROM REACTOR STACKS

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-7} Curie Per Day

	July		August		September		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	1.7	0.29	17	0.27	0.71	0.23	17	0.26
100-C	0.40	0.14	0.74	0.16	0.62*	0.20*	0.74*	0.17*
100-KW	0.82	0.38	1.2	0.44	2.4	0.67	2.4	0.50
100-KE	0.96	0.33	0.48	0.29	1.1	0.30	1.1	0.31
100-D	0.84	0.21	2	0.41	0.69	0.17	2	0.26
100-DR	0.53	0.15	1.4	0.38	0.60	0.11	1.4	0.21
100-H	0.95	0.51	0.67	0.21	0.82	0.18	1	0.30
100-F	1.6	0.36	1.7	0.84	1.6	0.48	1.7	0.56

* These values do not include one sample collected on September 17, 1956. (See text for explanation.)

TABLE X

BETA PARTICLE EMITTERS DISCHARGED AS PARTICULATES FROM REACTOR STACKS

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-5} Curie Per Day

	July		August		September		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	4600	720	1200	470	1300	510	4600	570
100-C	230	30	4.8	1.8	240*	38*	240*	23*
100-KW	6.1	1.8	5.8	2.8	4	1.5	6.1	2.1
100-KE	18	12	5.9	3.4	110	19	110	11
100-D	160	75	150	110	150	81	160	89
100-DR	0.34	0.2	1	0.57	0.67	0.38	1	0.38
100-H	2.9	1.3	2.5	1.5	6.4	2.8	6.4	1.9
100-F	110	31	92	45	100	48	110	41

* These values do not include on sample collected on September 17, 1956. (See text for explanation.)

TABLE XI

RADIOACTIVE PARTICLES DISCHARGED
FROM REACTOR STACKS
JULY, AUGUST, SEPTEMBER
1956

Units of 10^5 Particles Per Day

	July		August		September		Quarterly	
Stack	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	10	6.1	56	36	1.3	0.9	56	12
100-C	450	81	46	16	320 *	64 *	450*	51*
100-KW	23	8.1	15	5.2	6.9	1.8	23	4.8
100-KE	2.6	0.5	29	4	170	25	170	11
100-D	76	19	<0.8	<0.2	0.9	0.2	76	4.9
100-DR	0.9	0.1	2.7	0.8	2.7	0.6	2.7	0.5
100-H	5.8	1.3	1.7	0.5	1.9	0.7	5.8	0.8
100-F	39	12	79	15	100	15	100	14

* These values do not include one sample collected on September 17, 1956. (See text for explanation.)

Total average tritium oxide emission from the eight reactor area stacks was 1.2 curies per day this quarter compared to 1.0 curie per day for the previous quarter. The above data do not reflect the significant changes that occurred at individual reactor area stacks this quarter. Increases by factors of 1.5 to 3 were noted at 100-C, 100-D, 100-H, and 100-F Areas and decreases by factors of 2 to 6 were noted at 100-KW and 100-KE Areas this quarter. Maximum emission of 0.50 curie per day from 100-C Area stack occurred on September 20, 1956.

The emission rates of C^{14} and S^{35} from the reactor area stacks this quarter were nearly comparable to the values obtained for the previous quarter. One exception occurred at 100-F Area where two high S^{35} measurements were obtained in August and September. Occasional values of this order of magnitude have been noted at various reactor areas in the past. The maximum measurement of 8.9×10^{-3} curie per day was obtained on September 17, 1956.

No significant changes in gross alpha activity density of reactor stack gases were noted this quarter. Gross beta activity density increased significantly at 100-C and 100-KE Areas. Average and maximum values at 100-KE Area this quarter were 1.1×10^{-4} and 1.1×10^{-3} curie per day compared to values of 3.8×10^{-5} and 9.4×10^{-5} curie per day for the previous quarter. Similar values for 100-C Area were 2.3×10^{-4} and 2.4×10^{-3} curie per day this quarter and 2.2×10^{-5} and 1.3×10^{-4} curie per day for last quarter.

One sample not included in Tables IX, X, and XI was collected on September 17, 1956 from 100-C reactor stack during burning of a uranium slug on the rear face. This filter sample was found to contain 2.3 μc of beta particle emitters two days after sample collection. Average activity density of the 100-C Area stack gases during this period (based on the 48-hour analysis) was calculated to be 1.4×10^{-2} μc of beta emitters per cubic foot or a total emission over the period of 0.6 curie. About one-third of this activity was due to I^{131} at the time of analysis. Original gamma energy spectrum measurements indicated the presence of I^{131}, I^{132}, I^{133}, and Te^{132} and probably several relatively short half-life isotopes shortly after collection of the sample.

Ground surveys indicated only local deposition within and immediately south of 100-B Area. One particle picked up during the ground

survey was measured on the gamma spectrometer. Results indicated that greater than 90 per cent of the activity in this particle was due to Np^{239}.

General increases in the concentration of radioactive particles in the stack gases were noted again this quarter at all reactor areas except 100-DR and 100-H Areas. The increases ranged from factors of 1.5 at 100-F to 12 at 100-KE Area. Maximum concentration of 4.5×10^{7} particles per day was measured during July at 100-C Area. The special sample collected from this area on September 17, 1956, was not autoradiographed because of the isotopic analyses performed on it; but the concentration during the period of the uranium fire probably did not exceed this maximum value.

300 AREA

327 BUILDING

Weekly filter and scrubber samples collected from the plenum of the 327 Building stack were analyzed for gross beta particle emitters. Monthly average values for July, August, and September were 6.6×10^{-5}, 9.2×10^{-5}, and 1.1×10^{-4} curie of beta particle emitters per day. Quarterly average and maximum values were 8.0×10^{-5} and 2.8×10^{-4} curie per day. This quarter's average compares favorably with that obtained last quarter.

SECTION II

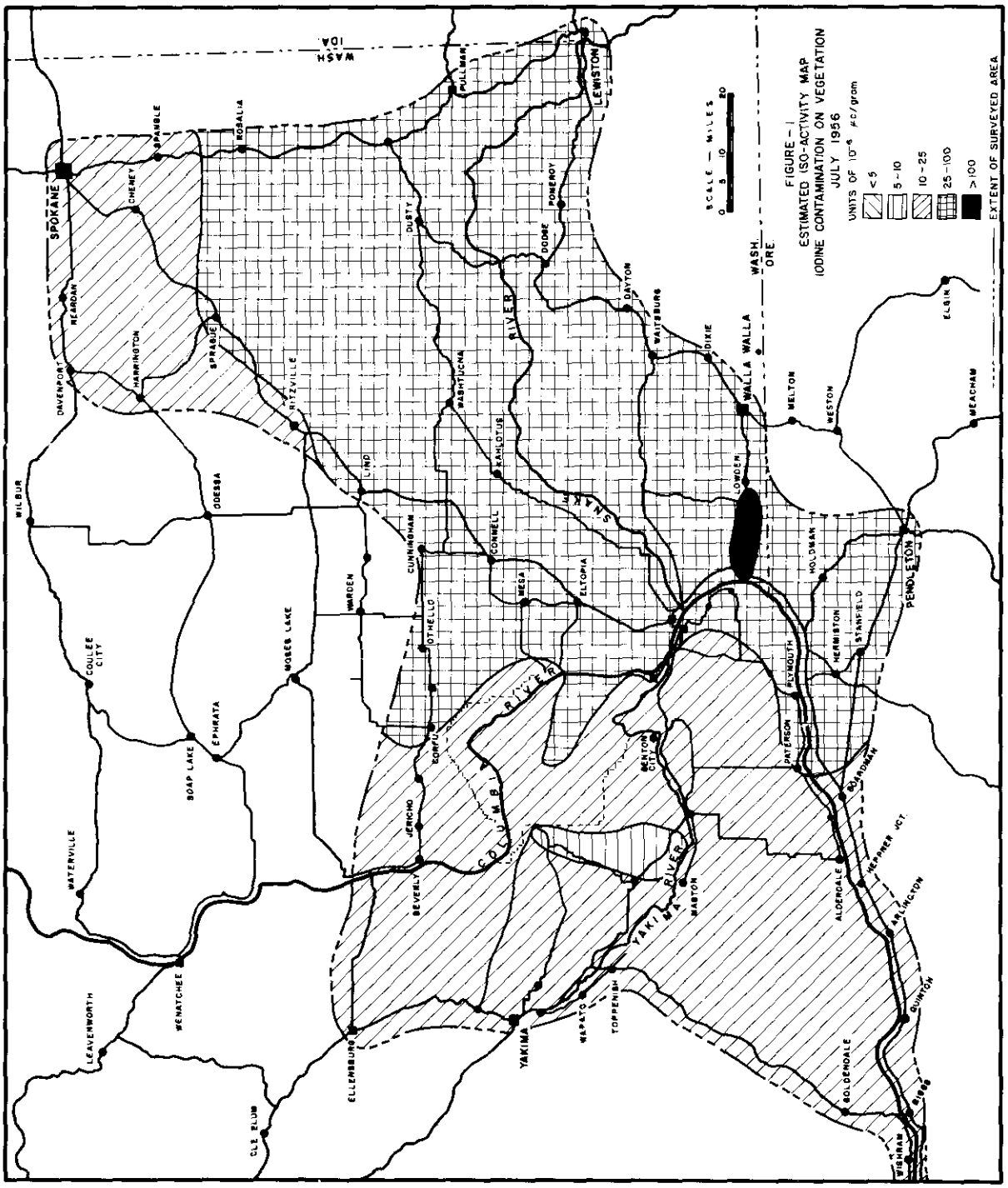
RADIOACTIVE CONTAMINATION ON VEGETATION

Determination of the radioactive contamination of vegetation in the environs was made by the radiochemical analysis of 2600 vegetation samples. More than 2000 of the samples 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}; 1400 were analyzed for non-volatile beta particle emitters. Fifty samples from selected locations were analyzed for alpha particle emitters.

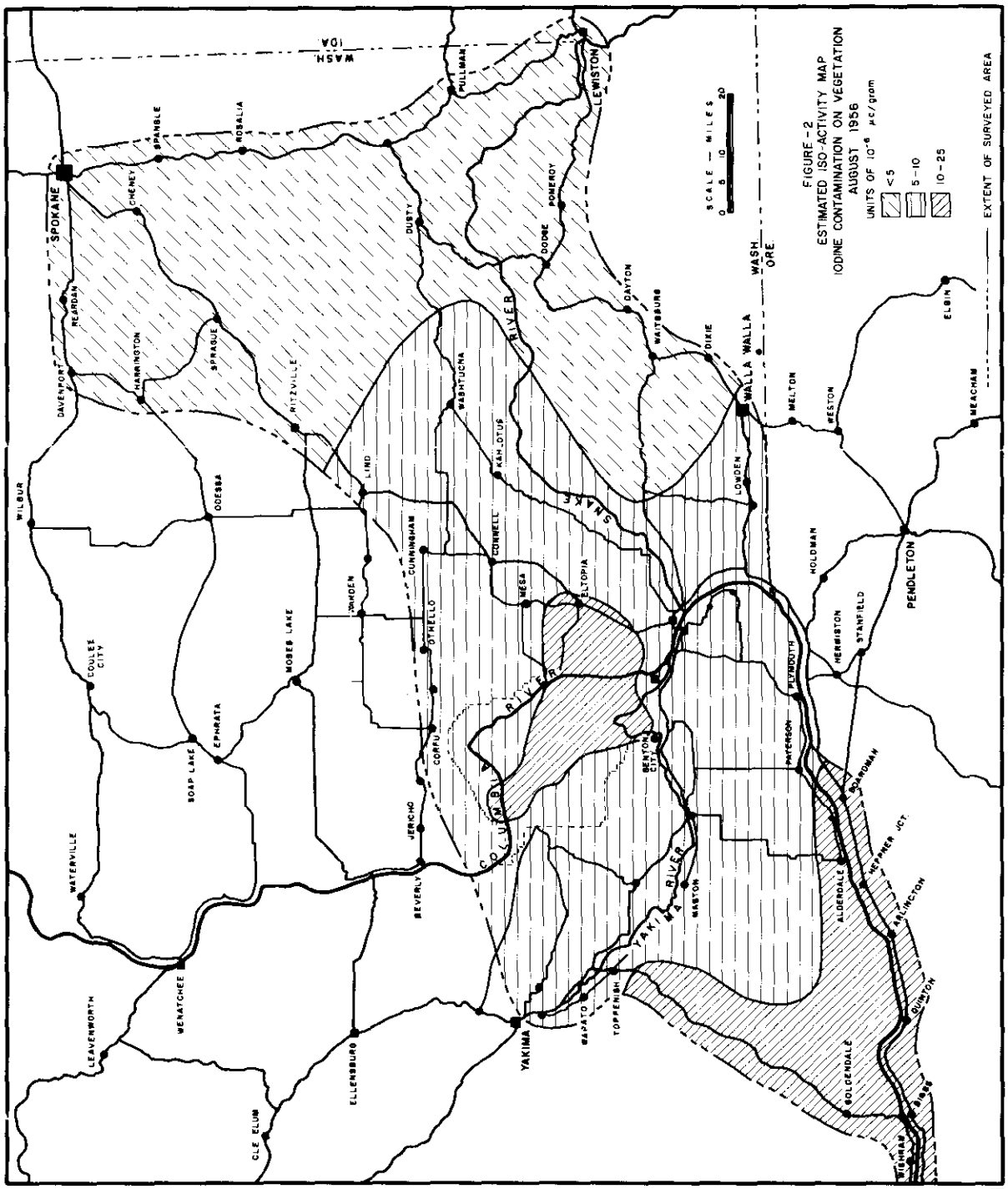
Averages for the present and previous quarter are compared in Table I. Tables II and III show by months the average iodine and non-volatile beta particle contamination measured at each general location. The concentrations of alpha particle emitters on vegetation are summarized in Table IV.

The amount of I^{131} deposited on vegetation this quarter was insignificant when compared to iodine deposited as a result of bomb fallout. The major portion of the iodine was deposited during the month of July with a maximum measurement of 2×10^{-4} μc/gm found at Route 4S-Mile 20 on July 10. Off-reservation maximum measurements during this same period ranged from 1.5×10^{-5} to 1×10^{-4} μc/gm over most of the Pacific Northwest. The deposition decreased as the quarter progressed so that the average deposition during September was less than 3×10^{-6} μc/gm at all off-area locations and at most project locations. The deposition patterns for July and August are illustrated in Figures 1 and 2; no significant deposition occurred in September.

The concentrations of non-volatile beta emitters on vegetation were similar to that noted for iodine and resulted primarily from bomb fallout.



[redacted]



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A gradual decrease occurred as the quarter progressed and near normal values were found during September.

The average concentration of alpha particle emitters on vegetation decreased to one-half of the previous value or decreased to near the detection limit of 1×10^{-9} $\mu c/gm$.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-6} μc/gm

Location	Iodine				Non-Volatile Beta Emitters		
	No. Samples	Max.	Avg.	Avg. Last Qtr.	Max.	Avg.	Avg. Last Qtr.
Project							
200 West Area	78	120	12	4	1300	210	170
200 West - Redox	26	99	16	4	750	260	57
200 West - Gate	63	81	14	<3	1400	200	60
Route 3	13	36	7	4	---	---	---
Meteorology Tower	13	32	7	<3	740	190	68
Batch Plant	13	42	12	3	480	150	71
200 East Area	52	83	13	4	800	180	79
200 East - Purex	81	92	12	5	1500	170	86
Near 200 Areas	309	84	9	4	1600	190	72
North of 200 Areas	248	68	9	<3	880	180	68
South of 200 Areas	389	200	11	3	1100	150	80
PSN 50-51-61	37	57	9	3	410	170	69
Goose Egg Hill	99	190	18	<3	1900	190	48
Wahluke Slope	152	83	8	<3	1100	140	57
Off Project							
Pasco to Ringold	117	150	14	<3	2100	210	92
Richland	123	95	13	<3	910	180	57
Benton City-Kiona	26	61	8	<3	640	160	53
Richland "Y"	13	64	13	<3	---	---	---
Kennewick Environs	172	73	7	<3	540	110	64
Pasco Environs	125	84	10	<3	470	110	61
Prosser to Paterson - McNary	60	47	6	<3	480	99	67
Eastern Washington	195	150	17	<3	930	170	110
So. Washington and No. Oregon	174	35	4	<3	430	63	120

TABLE II

RADIOACTIVE CONTAMINATION FROM IODINE ON VEGETATION

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-6} μc/gm

Location	July		August		September	
	Max.	Avg.	Max.	Avg.	Max.	Avg.
Project						
200 West Area	120	24	34	10	12	<3
200 West - Redox	97	32	36	13	6	<3
200 West - Gate	81	27	37	12	8	3
Route 3	36	10	30	9	<3	<3
Meteorology Tower	32	10	28	10	<3	<3
Batch Plant	42	12	34	14	26	8
200 East Area	83	26	31	10	6	<3
200 East - Purex	92	23	50	12	5	<3
Near 200 Areas	84	15	43	12	9	<3
North of 200 Areas	68	15	41	9	6	<3
South of 200 Areas	200	18	62	12	5	<3
PSN 50-51-61	57	15	31	9	8	3
Goose Egg Hill	190	43	28	8	4	<3
Wahluke Slope	83	17	29	6	4	<3
Off Project						
Pasco to Ringold	150	31	32	8	4	<3
Richland	95	29	33	10	8	<3
Benton City - Kiona	61	13	20	8	<3	<3
Richland "Y"	64	32	19	6	<3	<3
Kennewick Environs	73	14	38	7	3	<3
Pasco Environs	84	23	32	6	3	<3
Prosser to Paterson - McNary	47	13	35	4	<3	<3
Eastern Washington	150	46	20	5	5	<3
So. Washington and No. Oregon	10	<3	35	9	<3	<3

TABLE III

RADIOACTIVE CONTAMINATION FROM NON-VOLATILE BETA PARTICLE EMITTERS ON VEGETATION

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-6} μc/gm

Location	July		August		September	
Project	Max.	Avg.	Max.	Avg.	Max.	Avg.
200 West Area	1300	270	1000	260	96	160
200 West - Redox	750	370	680	290	160	100
200 West - Gate	1400	270	880	220	330	120
Meteorology Tower	710	220	740	250	130	110
Batch Plant	480	150	390	210	130	99
200 East Area	800	240	600	180	360	110
200 East - Purex	1500	220	600	210	170	95
Near 200 Areas	1600	220	540	210	400	140
North of 200 Areas	880	230	600	210	180	94
South of 200 Areas	1100	190	800	180	280	82
PSN 50-51-61	350	230	400	190	97	92
Goose Egg Hill	1900	330	250	150	150	80
Wahluke Slope	1100	220	420	120	610	89
Off Project						
Pasco to Ringold	2100	400	530	180	150	65
Richland	910	280	800	220	68	54
Benton City - Kiona	640	200	300	180	140	100
Kennewick Environs	540	150	320	120	240	63
Pasco Environs	470	150	350	120	94	56
Prosser to Paterson - McNary	480	180	270	74	89	47
Eastern Washington	930	350	240	86	170	62
So. Washington and No. Oregon	110	39	430	100	110	45

TABLE IV

RADIOACTIVE CONTAMINATION FROM ALPHA PARTICLE EMITTERS ON VEGETATION

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-8} μc/gm

Location	July Average	August Average	September Average	Quarter Maximum	Quarter Average
Near 200 Areas					
200 West Gate	<10	21	11	27	14
Meteorology Tower	<10	<10	<10	18	<10
Batch Plant	<10	16	<10	17	11
Route 4S, Mi. 4	<10	21	16	24	14
Route 4S, Mi. 6	<10	11	<10	20	<10
Outlying					
Pasco	<10	<10	--	10	<10
Benton City	<10	<10	<10	<10	<10

SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

The magnitude and extent of airborne contamination in the Hanford 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 by 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 dosage rates for the three month period is given in Table I.

TABLE I

AVERAGE DOSE RATES MEASURED BY VICTOREEN INTEGRONS

JULY, AUGUST, SEPTEMBER

1956

Units of mrad per 24 hours

Location	No. of Units	July	August	September	Quarterly Average
100 Areas and Vicinity					
100-B Area	3	3.8	0.8	2.9	2.5
100-K Area	3	3.4	1.9	0.8	2
100-D Area	3	0.2	0.7	0.6	0.5
100-H Area	3	0.6	0.8	0.6	0.7
White Bluffs	1	3.3	2.8	2.5	2.9
100-F Area	3	3.2	1.1	4.8	3
Hanford	1	2.1	0.3	3.7	2
200 Areas and Vicinity					
200-West Area	2	1.2	1.6	1.4	1.4
200-West - Redox	1	1.3	1.1	6.7	3
200-East Area	3	4.2	1.6	2	2.6
200-East - Semi-Works	1	4.4	2.7	2.6	3.2
300 Area	1	3.3	0.8	1.6	1.9
Outlying Areas					
1100 Area	1	1.8	2	1.7	1.8
Richland	1	0.5	0.7	0.7	0.6
Kennewick	1	7.7	0.4	2.6	3.6
Pasco	1	2.3	1.8	11.1	5.1
Benton City	1	9.4	0.7	5.9	5.3
Riverland	1	3	1	2.6	2.2

The average dosage rates remained at the same level as the values reported for the previous quarter.

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

TABLE II

AVERAGE DOSE RATES MEASURED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
JULY, AUGUST, SEPTEMBER
1956

Units of mrad per 24 hours

Location	July	August	September	Quarterly Average	Group Average
100 Areas and Environs					
Route 1, Mile 8	0.6	0.7	0.8	0.7	
Route 2N, Mile 5	0.7	0.6	0.5	0.6	
Route 11-A, Mile 1	1.7	0.8	1.4	1.3	
Intersection, Rt. 1 and 4N	0.7	0.6	0.7	0.7	
Military Camp, PSN 3	1.1	1.2	0.9	1.1	
Military Camp, PSN 21	0.8	1	1.1	1	0.9
200 Areas and Environs					
Route 3, Mile 1	1.3	1.3	0.8	1.1	
Route 2S, Mile 4	1.7	1.1	1.8	1.5	
Route 4S, Mile 2.5	1.1	1	0.9	1	
Route 4S, Mile 6	1.3	0.8	1.7	1.3	
Route 4S, Mile 10	1	1.3	1.3	1.2	
Route 10, Mile 1	1.6	1.7	1	1.4	
Route 11-A, Mile 6	0.8	0.5	0.4	0.6	
Military Camp, PSN 42	7.2	2.9	1.5	3.9	
Military Camp, PSN 50	1	1.2	1	1.1	
Military Camp, PSN 51	1.2	1.6	1.7	1.5	
Military Camp, PSN 61	0.9	1.1	0.9	1	
Military Camp, PSN 70	0.8	0.8	1	0.9	1.4
300 Areas and Environs					
Route 4S, Mile 16	2.4	1	1.1	1.5	
Route 4S, Mile 22	1	1.1	1.2	1.1	
Military Camp, PSN 60	0.6	1	1.7	1.1	1.2

The average dosage rates measured at the given grouped locations were not significantly different from the values reported for the previous period.

Filters were used to measure the activity density of beta particle emitters in the atmosphere. Air was passed through the filters at flow rates of 2 to 2.5 cfm for daily or weekly periods. These samples were analyzed and counted several days after their removal from the sampling location 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 quarter is given in Table III.

TABLE III

CONCENTRATIONS OF BETA PARTICLE EMITTERS FILTERED FROM AIR

SINGLE UNIT MONITORS

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-14} μc/ml

Location	July	August	September	Quarterly Average	Weekly Maximum
100 Areas and Vicinity					
100-K Area No. 1	52	56	170	91	310
100-K Area No. 2	75	37	110	75	230
100-K Area No. 3	44	47	110	67	230
100-D Area	85	95	270	150	490
100-H Area	33	48	90	57	140
White Bluffs	29	40	160	76	200
Hanford	43	60	150	85	270
200 Areas and Vicinity					
200 East Semi-Works	22	53	100	58	210
200 West West Center	39	32	130	68	230
200 West - Redox	70	44	120	79	290
Gable Mountain	< 4	6	69	26	150
Military Camp, PSN 50	46	42	110	67	200
200 West East Center	32	44	110	62	240
300 Area	28	30	62	40	140
Outlying Areas					
1100 Area	53	59	150	87	310
Pasco	71	93	150	100	210
Benton City	72	90	53	71	140
Riverland	16	40	85	47	160

The average concentration of beta particle emitters in air increased significantly at most locations this quarter. The general increases were the result of continuing bomb fallout during each month of the quarter.

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

TABLE IV

CONCENTRATIONS OF BETA PARTICLE EMITTERS FILTERED FROM AIR

DUAL UNIT MONITORS

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-14} μc/ml

Location	July	August	September	Quarterly Average	Weekly Maximum
200-ESE No. 1	21	35	130	62	370
200-ESE No. 2	26	34	92	51	220
Richland No. 1	9	11	59	26	100
Richland No. 2	24	45	68	46	97

The quarterly averages shown in Table IV show the same increases as similar measurements included in Table III.

The number of radioactive particles in the atmosphere was determined by autoradiographing air filters through which air flow rates of 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 separations areas is given in Table V; results of similar measurements made outside the separations areas and at remote locations are given in Table VI.

TABLE V

SUMMARY OF PARTICLE CONCENTRATIONS
NEAR THE SEPARATIONS AREAS
JULY, AUGUST, SEPTEMBER
1956

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

Location	July	August	September	Quarterly Average	Last Quarterly Average
200 East Vicinity					
2704 Outside	89	190	140	140	33
BY - SE	45	270	170	160	59
"B" Gate	69	200	150	140	44
2704 Inside	52	87	96	80	41
2 EWC, 614 Building	58	210	140	140	40
2701-E Inside	89	120	160	130	47
2701-E Outside	69	410	190	110	43
200 West Vicinity					
2701 Outside	69	310	180	180	65
2722	110	150	160	140	79
"T" Gate	52	120	140	110	74
222-T Outside	93	130	170	140	80
231	90	100	220	140	71
Redox	66	220	220	170	67
2701 Inside	73	110	180	120	34
272	72	66	130	96	47
2-WWC, 614 Building	41	96	240	130	49
"U" Gate	54	70	250	130	56
222-U Lab, Inside	21	40	82	56	38
Meteorology Tower					
3'	22	13	29	22	6
50'	23	21	42	30	9
100'	28	31	49	37	11
150'	28	40	56	43	12
200'	34	29	62	43	14
250'	18	33	55	37	6
300'	18	27	64	38	9
350'	17	43	55	40	8
400'	25	64	87	61	9

[redacted]

TABLE VI

SUMMARY OF PARTICLE CONCENTRATIONS
OUTSIDE THE SEPARATIONS AREAS
JULY, AUGUST, SEPTEMBER
1956

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

Location	July	August	September	Quarterly Average	Last Quarterly Average
Area Locations					
100-B Area	36	100	69	70	27
100-K No. 3 Area	39	140	110	99	18
100-D Area	30	110	93	81	15
White Bluffs	36	140	76	83	20
100-F Area	34	81	130	89	28
300 Area	25	130	99	87	13
Off Area Locations					
Benton City, Wn.	44	83	59	62	15
Pasco, Wn.	73	140	150	120	28
Richland, Wn.	47	200	200	150	33
Boise, Idaho	89	340	210	210	55
Klamath Falls, Ore.	65	340	200	200	66
Great Falls, Mont.	210	400	120	230	41
Walla Walla, Wn.	130	190	190	170	66
Meacham, Ore.	99	240	74	140	34
Lewiston, Idaho	56	300	140	170	19
Spokane, Wn.	100	280	250	210	42
Kennewick, Wn.	69	200	180	150	29
Yakima, Wn.	72	130	100	100	17
Seattle, Wn.	36	54	38	42	22

The results listed in Tables V and VI show a significant increase in particle deposition from two to six times the deposition noted during the previous quarter. These values show a continuation of fallout from nuclear detonations and verify results from other air monitoring stations as reported in previous tables in this section and in non-volatile beta particle emitter results reported in Section II of this report.

[redacted]

The activity density of radioactive iodine in the atmosphere was determined from the radiochemical analysis of caustic scrubber solutions through which air was passed at rates of 2 to 2.5 cfm for periods ranging from one to seven days. The results obtained from these measurements are summarized in Table VII.

TABLE VII

CONCENTRATIONS OF IODINE DETECTED BY AIR SCRUBBERS

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-12} μc/ml

Location	July	August	September	Quarterly Average	Weekly Maximum
200 Areas and Vicinity					
Gable Mountain	0.1	< 0.1	<0.1	<0.1	0.2
200 East South East	0.6	< 0.1	0.8	0.5	1.6
200 West East Center	<0.1	< 0.1	0.3	0.2	0.8
200 West West Center	<0.1	< 0.1	0.3	0.1	0.8
200 East Semi-Works	1.9	0.1	0.2	0.8	4.3
Redox Area	0.1	0.1	0.2	0.1	0.5
Outlying Areas					
White Bluffs	0.1	0.1	0.5	0.2	1.0
100-H Area	<0.1	<0.1	0.2	0.1	0.5
100-K No. 3	<0.1	---	0.3	0.1	0.5
300 Area	0.2	<0.1	0.2	0.2	0.6
Richland	<0.1	<0.1	0.1	<0.1	0.3
1100 Area	<0.1	0.2	<0.1	<0.1	0.1
Benton City	<0.1	<0.1	0.2	<0.1	0.3
Pasco	0.1	<0.1	<0.1	<0.1	0.4

No significant amounts of I^{131} from plant sources were detected in the air. Significant amounts of radioactive iodine from nuclear detonations were detected in September.

The concentration of alpha particle emitters in the atmosphere was determined by counting the same filters used for beta particle emitter measurements which are summarized in Table III and IV. A summary of the alpha measurements is given in Table VIII.

TABLE VIII

CONCENTRATIONS OF ALPHA PARTICLE EMITTERS FILTERED FROM AIR

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-15} µc/ml

Location	No. of Samples	Weekly Maximum	Quarterly Average
100 Areas and Vicinity			
100-K No. 1 Area	13	9	< 4
100-K No. 2 Area	13	10	5
100-K No. 3 Area	13	6	< 4
100-D Area	13	27	6
100-H Area	13	4	< 4
White Bluffs	11	< 4	< 4
Hanford	12	4	< 4
200 Areas and Vicinity			
Gable Mountain	13	4	< 4
200-E Semi-Works	12	4	< 4
200 West West Center	13	< 4	< 4
200 West East Center	13	< 4	< 4
Redox Area	13	10	< 4
Military Camp, PSN 50	13	< 4	< 4
300 Area	13	4	< 4
Outlying Areas			
1100 Area	13	5	< 4
Benton City	11	12	< 4
Pasco	11	76	12
Riverland	13	27	< 4
Dual Unit Monitors			
200 East South East No. 1	13	7	< 4
200 East South East No. 2	13	5	< 4
Richland No. 1	13	< 4	< 4
Richland No. 2	13	< 4	4

[redacted]

The average concentrations of alpha particle emitters remained at or near the detection limit of 4×10^{-15} μc/ml.

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The magnitude and extent of radioactive contamination in Hanford wastes were determined from the results of over 2700 measurements. Solid and liquid samples were obtained directly from open waste areas at frequencies varying from daily to monthly; these samples were analyzed radio-chemically for the activity densities of gross alpha and beta particle emitters. Specific isotopic analyses were performed when measurements indicated unusual contamination and were carried out routinely on samples from locations which have a high probability of containing unusual quantities of certain contaminants. These measurements were supplemented with data obtained from portable instrument surveys around the perimeter of the waste storage areas and over open terrain at various locations on the plant.

The results of these measurements are summarized for each of the manufacturing areas.

100 AREA WASTE

Radioactive contamination discharged to the Columbia River from the reactor areas was determined by analyzing samples collected daily from the outlets of the effluent water retention basins. The samples were analyzed within twelve hours after collection and the measured counting rates of beta particle emitters were corrected for decay. A summary of the activity of beta particle emitters discharged to the river per unit of time is given in Table I.

TABLE I

BETA PARTICLE EMITTERS DISCHARGED TO RIVER
IN REACTOR EFFLUENT WATER
JULY, AUGUST, SEPTEMBER
1956

Units of 10^3 μc/sec

Location	No. Samples	July		August		September		Quarterly	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
100-B	41	24	20	26	21	20	19	26	20
100-C	48	30	22	50	32	36	27	50	27
100-KW	55	17	15	26	17	27	22	27	18
100-KE	54	32	29	35	15	21	17	35	20
100-D	56	19	6	13	9	9	7	19	7
100-DR	63	20	17	34	17	100	28	100	21
100-H	52	10	6	10	6	38	12	38	8
100-F	44	10	8	35	10	8	7	10	8

A comparison of the average activity of beta particle emitters discharged to the river during this period with the results of the previous quarter showed minor fluctuations in the activity released from all areas except 100-B, 100-C, and 100-DR which showed significant increases. The reason for these increases is not known and may be a result of sampling errors caused by sampling when the reactor was operating and using average power levels for comparison.

No positive uranium measurements were found in 178 samples analyzed specifically for uranium.

One significant measurement of 4.3×10^{-2} μc/sec in the 100-C reactor cooling water was noted in 27 samples analyzed for plutonium.

Significant quantities of polonium were found in samples of effluent water from 100-C and 100-KE Areas, with values ranging from 0.003 to 0.012 μc/sec.

The activity density of I^{131} in waste discharged to the Columbia River from the Biology Farm at 100-F Area was measured by analyzing composite samples collected from the sump in the waste discharge line. An average of 13.9 μc/day was discharged to the river during the quarter.

200 AREA WASTES

Liquid and solid samples were collected directly from the waste sources in the separations areas and analyzed for gross alpha and beta particle emitters. A summary of the results is given in Table II.

TABLE II

RADIOACTIVE CONTAMINATION IN 200 AREA WASTE SYSTEMS

JULY, AUGUST, SEPTEMBER

1956

Liquid Samples

Location	No. Samples	Alpha Particle Emitters Units of 10^{-8} μc/ml Maximum	Alpha Particle Emitters 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	13	<0.5	<0.5	2300	430
T-Swamp	10	<0.5	<0.5	700	230
Laundry Ditch	26	91	5.5	22	4
U-Ditch Inlet	13	2.5	0.6	41	10
231-Ditch	26	24	5.4	76	3.2
234-35 Ditch	13	1.2	<0.5	2.5	0.8
U-Swamp	26	230	28	300	64
B-Ditch	12	<0.5	<0.5	6.5	2.5
B-Swamp	24	0.8	<0.5	7.9	1.8
Purex	26	7.5	0.9	12	3.8

[redacted]

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER AND RELATED WATERS

Approximately 500 samples of water were collected from the Columbia, Yakima, and Snake Rivers to determine the radioactive contamination resulting from the discharge of reactor cooling water to the Columbia River. Daily and weekly 500 ml samples were collected at the Hanford Works and downstream to McNary Dam; monthly one gallon samples were collected from the Columbia River between McNary Dam and Portland. All samples were analyzed for gross beta emitters and all 500 ml samples for alpha particle emitters. The activity density of alpha particle emitters averaged below the detection limit of 5×10^{-9} μc/ml for nearly all river water locations sampled this quarter. One exception was the sampling location below 300 Area where one unusually high measurement was obtained on August 27, 1956. The one value of 7.4×10^{-8} μc/ml was sufficient to raise the monthly and quarterly averages to 2.1×10^{-8} and 8.0×10^{-9} μc/ml, respectively. Fluorophotometric analysis confirmed that all of the alpha activity was due to uranium.

Table I summarizes the activity density of beta particle emitters in river water samples.

TABLE II (contd)

RADIOACTIVE CONTAMINATION IN 200 AREA WASTE SYSTEMS

JULY, AUGUST, SEPTEMBER

1956

Solid Samples

Location	No. Samples	Alpha particle Emitters Units of 10^{-6} μc/gm Maximum	Alpha particle Emitters Units of 10^{-6} μc/gm Average	Beta Particle Emitters Units of 10^{-5} μc/gm Maximum	Beta Particle Emitters Units of 10^{-5} μc/gm Average
T-Ditch	12	18	12	6200	2700
T-Swamp	2	31	16	59	31
Laundry Ditch	13	14	7	27	17
234-35 Ditch	13	3300	880	6.9	3.7
B-Swamp	24	17	1.2	12	4.4
Purex	26	42000	2200	9.2	3.7

The various increases and decreases noted when comparing the measurements summarized in Table II with the data collected during the preceding period were caused by the normally wide variation of concentrations in the waste systems.

The most significant changes were an increase in alpha particle emitter activity in the laundry ditch and 231 ditch waters which feed into the U-swamp where the increase was from 6×10^{-8} to 2.8×10^{-7} μc/ml.

There was a significant decrease in beta particle emitter activity in the same waste system with decreases ranging from 1/3 to 1/50 of the previous measurements.

The results from specific analysis of 200 Area waste for uranium are reported in Table III.

TABLE III

RADIOACTIVE CONTAMINATION IN 200 AREA WASTE SYSTEMS

JULY, AUGUST, SEPTEMBER

1956

Liquid Samples

Location	No. Samples	Uranium Units of 10^{-9} µc/ml Maximum	Uranium Units of 10^{-9} µc/ml Average
U-Swamp	26	2600	270
231 Ditch	26	90	9
Laundry Ditch	27	930	47
U-Ditch Inlet	13	20	5

Solid Samples

		Units of 10^{-6} µc/gm	
Purex Chemical Waste	14	6	2
234-5 Ditch Pipe Outlet	14	77	18

The values listed in Table III for uranium in liquid and solid wastes increased significantly in the waste system that feeds U-swamp corresponding to total alpha measurements reported in Table II.

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 200 to >80,000 c/m at 200 West Area locations, with a maximum of 500 mrad around U-swamp. All 200 East locations showed counting rates of less than 500 c/m above background.

Readings obtained over the waters at the edge of the swamps and ditches ranged from 200 to 60,000 c/m at 200 West Area with background readings obtained in 200 East.

300 AREA WASTE

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

TABLE IV

RADIOACTIVE CONTAMINATION IN 300 AREA POND INLETS
JULY, AUGUST, SEPTEMBER
1956
Units of 10^{-8} μc/ml

Liquid Samples	No. Samples	Maximum	Average
Beta Particle Emitters	61	3000	140
Alpha Particle Emitters	61	47000	1100
Uranium	63	53000	1050
Plutonium	58	2.2	0.4

Individual samples from the 300 Area pond inlet varied widely in activity density as was expected in this waste stream. There was an increase in the average uranium discharge to the 300 Area Pond from 1.8×10^{-6} to 1.05×10^{-5} μc/ml as a result of several hundred pounds of uranium being released to the pond from the 321 Building on September 21. The maximum measurement for uranium was 5.3×10^{-4} μc/ml in a sample taken twenty-five minutes after the discharge occurred.

 [redacted]

ENVIRONS - GROUND CONTAMINATION

A small emission occurred on September 17 from the 105-C stack as a result of a slug catching fire on the rear face. The radioactive particles were deposited directly south of the 100-B Area within the area bound by Routes 1, 4N, 11-A, and Route 6. Decay and weathering action reduced the levels of contamination in this area to levels generally not detectable by portable instruments the following month.

Ground surveys of selected locations in the Tri-city Area showed an average frequency of particles detectable by portable instruments of one particle per 10,000 square feet. This is only an approximation, since it is not practical to survey enough area to provide an accurate result.

Surveys of the plots around Purex revealed one particle per 800 square feet with 65 per cent of the plots showing no particle deposition. The maximum number of particles found at any one plot was four with a slight pattern downwind or south and west of the Purex stack.

[redacted]

TABLE I

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RIVER WATER

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-8} μc/ml

Location	July	August	September	Quarter	Last Quarter	Maximum This
Columbia River	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
Will's Ranch	8	<5	<5	<5	16	26
181-B	<5	<5	<5	<5	<5	<5
181-C	<5	<5	<5	<5	<5	<5
Allard Station	<5	9	19	10	6	54
181-KW	31	91	430	180	48	680
181-KE	90	79	400	190	55	520
181-D	140	550	1270	650	215	1560
181-H	310	920	1800	1010	410	2110
Below 100-H	910	970	1720	1200	980	2460
181-F	680	890	3040	1540	860	4560
Below 100-F	600	740	1510	950	950	2070
Hanford	630	1150	1820	1200	910	2810
300 Area	310	480	730	510	410	1050
Byer's Landing	130	260	370	250	210	610
Richland	320	380	580	430	310	860
Kennewick Highlands Pumping Station	230	270	400	300	170	620
Pasco Bridge (Kenn. side)	160	230	340	240	160	430
Pasco Bridge (Pasco side)	200	220	380	270	220	540
Pasco Filter Plant Pumping Station	220	270	490	320	250	690
Sacajawea Park	170	160	230	190	160	270
Below McNary Dam	14	24	34	24	31	83
Paterson	29	21	37	29	27	42
Snake River						
Mouth	<5	<5	<5	<5	<5	<5
Yakima River						
Prosser	<5	<5	<5	<5	<5	<5
Horn	<5	<5	<5	<5	<5	<5
Mouth	<5	<5	<5	<5	5	6

[redacted]

General increases in the beta particle emitter activity density of the Columbia River water were noted this quarter. These increases reflected the seasonal drop in Columbia River flow rates, especially during September, which resulted in decreased dilution of the reactor cooling water discharged to the river. There were no significant changes in the activity density of beta particle emitters in the samples collected from the Snake and Yakima Rivers this quarter.

Average river flow rates for July, August, and September were 2.2×10^6, 1.1×10^6, and 5.6×10^5 gps, respectively. Average and maximum flow rates this quarter were 1.3×10^6 and 2.9×10^6 gps compared to values of 2.2×10^6 and 4.0×10^6 gps for the previous quarter. Unusually low flows were noted during the middle of September. The minimum of 4.1×10^5 gps on September 14 was lower than any September minimum since prior to 1948. River flow rates for the period April to September, 1956, are shown in Figure 3.

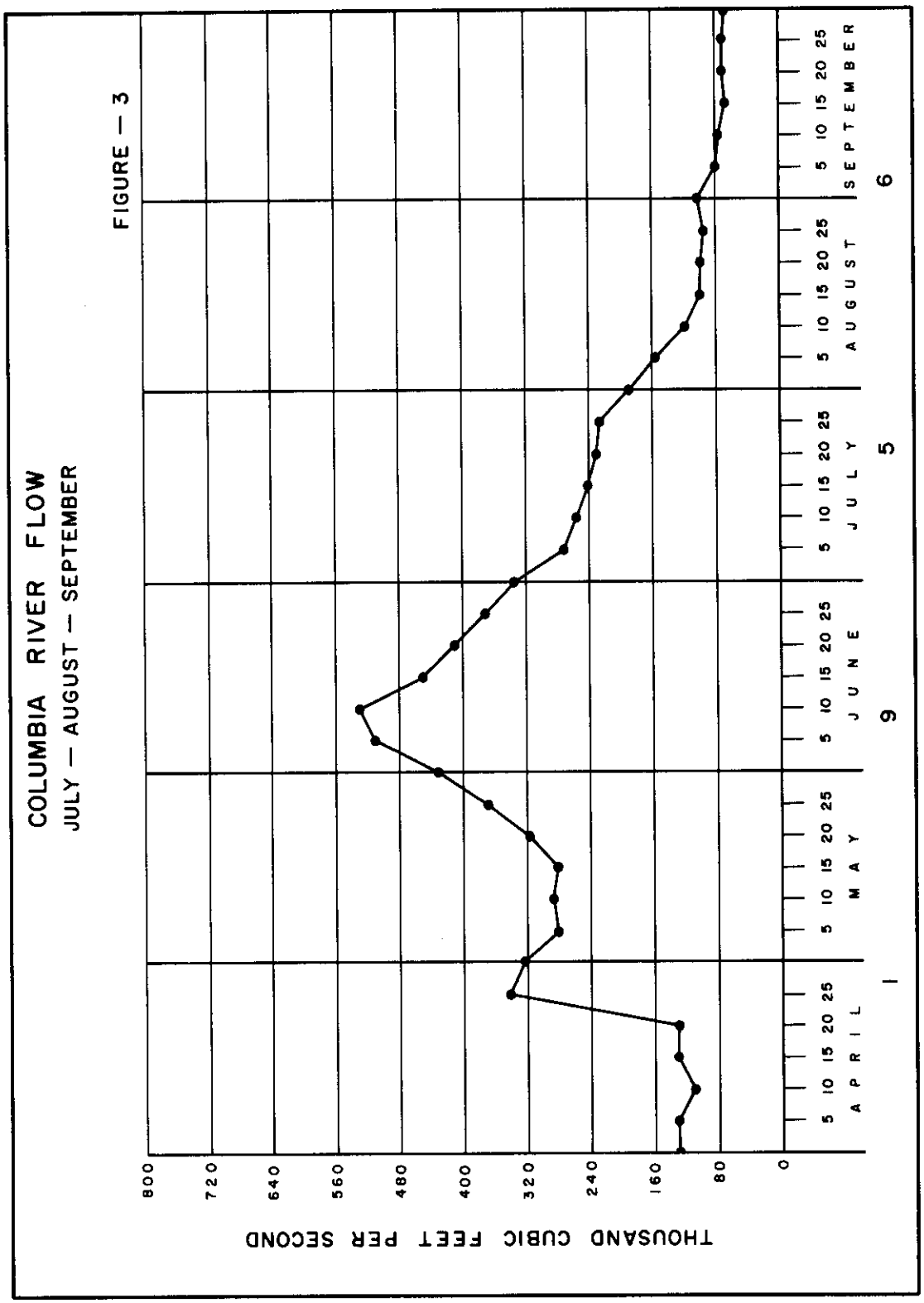

FIGURE — 3

AEC-GE RICHLAND, WN.

The monthly one gallon samples collected from the Columbia River between McNary Dam and Portland revealed gross beta activity densities ranging from 5×10^{-8} to 2×10^{-7} μc/ml. This range is not significantly different from that found during the previous surveys. The maximum value of 2×10^{-7} μc/ml occurred at Arlington, Oregon, during July.

Thirteen water samples collected from the south bank of the Columbia River at the Hanford Ferry landing were analyzed for the activity density of I^{131}. Average and maximum results for the present quarter were 6.5×10^{-8} and 1.6×10^{-7} μc/ml, respectively, compared to values of 2.9×10^{-8} and 5.6×10^{-8} μc/ml, respectively, obtained during the previous quarter. These increases resulted from the decreased river flow rates mentioned above. This quarter's values compare favorably with those noted during the first quarter of 1956.

Over 300 river mud samples were collected from the Columbia River and nearby tributaries for measurement of gross alpha and beta particle emitters. All alpha particle emitter concentrations were below the reporting limit of 3×10^{-6} μc/gm. The highest quarterly average was obtained at the Will's Ranch shoreline sample location above 100-B Area. The average measurement was 1.4×10^{-6} μc of gross alpha per gram of mud, with a maximum of 7.7×10^{-6} μc/gm on September 11, 1956. Naturally occurring uranium originating upstream of the Hanford project is responsible for the occasional positive results found at this location. Table II summarizes the results of the gross beta activity density measurements.

TABLE II

CONCENTRATION OF BETA PARTICLE EMITTERS IN RIVER MUD SAMPLES

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-6} μc/gm

Location	July Avg.	August Avg.	September Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
Columbia River						
Will's Ranch						
Shore	22	19	23	21	24	38
5' Out	21	20	23	22	23	32
Allard Station						
Shore	17	21	19	19	20	30
5' Out	16	21	19	19	21	28
100-H Area						
Shore	54	85	61	67	39	180
5' Out	44	55	63	54	34	140
100-F Area						
Shore	31	75	59	55	45	110
5' Out	33	280	56	120	48	1170
Hanford Ferry						
So. Shore	41	30	74	48	25	140
5' Out	19	340	59	140	31	1590
300 Area						
Shore	26	34	61	40	31	120
5' Out	25	43	65	45	38	97
Byer's Landing						
Shore	22	37	33	31	27	66
Richland						
Shore	11	41	24	25	27	65
5' Out	23	68	29	40	26	90
Kennewick Highlands Pumping Station						
Shore	11	16	21	16	19	29
5' Out	19	19	23	20	19	32
Pasco-Kennewick Bridge (Kenn. Side)						
Shore	17	26	20	21	16	43
5' Out	33	19	17	23	23	37
Sacajawea Park						
5' Out	23	22	25	23	22	35
Below McNary Dam						
5' Out	18	15	18	17	19	26
Paterson						
5' Out	25	20	25	23	21	29

TABLE II (contd.)

CONCENTRATION OF BETA PARTICLE EMITTERS IN RIVER MUD SAMPLES JULY, AUGUST, SEPTEMBER 1956

Units of 10^{-6} μc/gm

Location	July Avg.	August Avg.	September Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
Snake River						
Near Mouth 5' Out	23	26	21	23	21	39
Yakima River						
Horn Shore	22	20	26	23	22	29
Horn 5' Out	15	17	19	17	20	32
Prosser 5' Out	18	25	19	21	20	45

The activity density of beta particle emitters in Columbia River mud samples increased this quarter at most locations from 100-H Area to Pasco. No significant changes were noted in the activity density of mud samples collected above 100-H Area, below Pasco, or from the Snake and Yakima rivers.

Increases were related to increased river water activity density and shifting shore lines caused by decreased river flow rates.

Nearly 150 samples of raw water were collected from the 183 and 283 Buildings in the reactor and separations areas for gross alpha and beta analysis. The activity density from gross alpha emitters was below the detection limit of 5×10^{-9} μc/ml for all raw water samples analyzed. Table III is a summary of the results of the gross beta particle emitter analysis.

TABLE III

CONCENTRATIONS OF BETA PARTICLE EMITTERS IN RAW WATER

RIVER EXPORT LINE

JULY, AUGUST, SEPTEMBER

1956

Units of 10^{-8} μc/ml

Location	July Avg.	August Avg.	September Avg.	Quarter Avg.	Last Quarter Avg.	Maximum This Quarter
183-B	<5	<5	<5	<5	<5	10
183-C	<5	<5	<5	<5	<5	10
183-KW	21	74	280	120	30	480
183-KE	25	82	320	140	33	600
183-D	150	350	750	410	140	1250
183-DR	180	340	800	440	170	1100
183-H	230	620	890	580	270	1180
183-F	370	600	1170	710	460	1570
283-East	38	140	210	130	140	360
283-West	86	20	53	53	84	170

The raw water samples represent water just prior to purification for drinking purposes; the activity generally follows the fluctuations in the activity density of the river water from which it is derived. The increased activity density of beta particle emitters in raw water this quarter reflects the increase in Columbia River water activity.

The maximum activity density of 1.6×10^{-5} μc/ml was found at 183-F Building on September 19, 1956, during a period of near-minimum river flow rate this quarter.

SECTION VI

RADIOACTIVE CONTAMINATION IN TEST WELLS

INTRODUCTION

The test well sampling program was assumed by the Regional Monitoring Operation in July, 1956. The data from approximately eighty additional wells are available for reporting. These may be supplemented as drilling progresses. Each table of wells contains those grouped originally to monitor a specific waste disposal unit or plant area. The old well names, using numbers and letters to denote tank farms or crib sites and area location, and the new names are explained in a document entitled, "Hanford Wells".(9)

The detection limit for total beta (direct plating) is regarded as 2×10^{-7} μc/ml for a single well water result and 1×10^{-7} μc/ml is probably valid for a series of sample results from a well. For uranium, a result greater than 5×10^{-9} μc/ml is considered significant. A result greater than 1 ppm for NO_3 concentration in ground water is considered significant. About 20 wells are of such beta activity density that fission products can be detected; however, no results above the detection limits of 2×10^{-7} μc/ml for Sr^{90} and 7.4×10^{-7} μc/ml for Cs^{137} are noted this quarter.

BRIEF HISTORY OF DISPOSAL SITES AND MONITORING WELLS

The 241-B-361 and 241-T-361 reverse wells in 200 East Area (Table I wells) and 200 West Area (Table VI wells), respectively, were used for disposal of radioactive waste, mainly ruthenium, which has decayed below detection limits. Test wells monitoring these sites have been useful in detecting the spread of waste in the ground water from the respective B and T 2nd cycle crib sites.

The B-plant and T-plant 2nd cycle units in 200 East Area (Table II wells) and 200 West Area (Table V wells), respectively, have only been used intermittently for the last six months, but adjacent wells show that the ground water still contains significant concentrations of radioactive particle emitters.

The eight 216-BY cribs in 200 East Area, were built to dispose of TBP scavenged waste and are monitored by a series of wells listed in Table II. When high activity wastes containing Cs and Co were detected in the ground water, the cribs were removed from service late in 1955. This waste then went to newly built 216-BC cribs and trenches about 1000 feet south of the 200 East Area. Evidently, no wastes have reached ground water from the BC site. The monitoring wells are listed in Table IV.

The Redox cribs in 200 West Area have received more high activity wastes than any other ground disposal units. High beta emitter activity has reached the ground water table, but remains fairly well fixed even under a high ground water gradient due to the high ion-exchange capacity and low permeability of the soil. It is generally of less concern than the BY or T wastes which move more freely in more permeable soils under lesser gradients. The Redox Area is monitored by wells listed in Table VII.

The Purex cribs in 200 East Area have been used for less than a year. They are monitored by the wells in Table III which indicate that no Purex crib waste has yet reached the ground water.

The wells in Table VIII monitor the 321 crib about five miles north of 300 Area. Uranium wastes from 300 Area were discarded at the 321 crib until about 1950. Several of the monitoring wells still show detectable amounts of uranium activity.

A number of smaller units exist which may contribute to the ground water contamination. Several are scheduled for exploration by drilling, notably the 216-ER and 216-WR cribs.

Table IX includes some of the wells located in the 100 Areas which have been listed in previous reports.

HISTORY OF THE GROUND WATER INFLUENCING MOVEMENT OF WASTES

The disposal of cooling water from the T, U, and Redox plants to swamps along the west side of 200 West Area built up the ground water level about 80 feet above the original water table. The 241-T and Redox crib wastes in the ground water were moved south then eastward by the imposed gradients. A barrier to extensive eastward movement existed until about 1955 in the ground water mound east of 200 East Area. It was raised about 20 feet above the natural ground water level by the addition of B-plant cooling water to the water table.

The B-plant was shut down in 1952 and the mound subsided until the Purex plant began operation in 1956. In 1955, wastes probably from 200 West Area were detected in wells near 200 East Area and wastes from the BY site in 200 East Area were traced thirteen miles southeast of their source.

The Purex cooling water has raised the water table several feet higher since the beginning of 1956 than did the B-plant effluent in eight years. The eastward movement of wastes from both areas has evidently stopped. The T-plant 2nd cycle wastes are apparently moving northward since the shutdown of the T-plant and its cooling water early in 1956. The BY wastes are probably being moved into the saddle between the two ground water mounds by the local westward gradient from the rising mound east of the 200 East Area.

200 EAST AREA AND VICINITY

The locations of the wells in Table I through IV are shown in Figure 4. The following Table includes wells which were drilled to monitor the 241-B-361 reverse well site.

TABLE I

361-B REVERSE WELL AND 5-6 CRIB SITE
ACTIVITY DENSITIES
JULY, AUGUST, SEPTEMBER
1956

	Beta Emitters		Uranium	
	Units of 10^{-8} μc/ml		Units of 10^{-9} μc/ml	
Well	Max.	Avg.	Max.	Avg.
361-B-1 (299-E28-1)	<10	<10	3.2	2.5
361-B-2 (299-E28-2)	<10	<10	<2	<2
361-B-3 (299-E28-3)	55	10	2.1	<2
361-B-4 (299-E28-4)	14	<10	2	<2
361-B-5 (299-E28-5)	<10	<10	3.2	<2
361-B-6 (299-E28-6)	29	<10	<2	<2
361-B-7 (299-E27-1)	11	<10	<2	<2
361-B-9 (299-E28-7)	<10	<10	20	18
361-B-11 (299-E26-1)	<10	<10	<2	<2

The level of beta emitter density in well 361-B-3 (299-E28-3) may indicate the spreading of the wastes from the nearby BY cribs. Well 361-B-9 (299-E28-7) shows alpha activity, probably originating in the reverse well a few feet away. This is about one-third uranium activity, as shown by the difference in gross alpha and uranium results.

Table II lists wells which monitor the B 2nd cycle cribs, and the BY scavenged metal recovery waste cribs.

TABLE II

241-B 2nd CYCLE AND BY CRIB SITES ACTIVITY DENSITIES AND NON-RADIOACTIVE SALT CONCENTRATIONS

JULY, AUGUST, SEPTEMBER

1956

Well	Beta Emitters Units of μc/ml Max.	Beta Emitters Units of μc/ml Avg.	Uranium Units of 10^{-9} μc/ml Max.	Uranium Units of 10^{-9} μc/ml Avg.	NO_3 Concentration
224-B-4 (299-E33-18)	1.4×10^{-6}	1.1×10^{-6}	<2	<2	1060
241-B-5 (299-E33-16)	2.8×10^{-2}	2.0×10^{-2}	8.5	7.6	7360
241-B-11 (299-E33-15)	2.5×10^{-2}	2.1×10^{-2}	5	4.1	8340
241-B-15 (299-E33-12)	3.7×10^{-2}	2.3×10^{-2}	4	2.8	3790
241-B-16 (299-E33-17)	3.4×10^{-2}	1.9×10^{-2}	5.2	3.9	7850
241-B-17 (299-E33-13)	2.2×10^{-2}	2.0×10^{-2}	4	3	6080
241-B-18 (299-E33-14)	1.1×10^{-4}	7.0×10^{-5}	<2	<2	1050
241-B-19 (299-E33-11)	1.4×10^{-3}	1.2×10^{-3}	2.2	2.2	6670
241-B-20 (299-E33-19)	1.0×10^{-6}	8.2×10^{-7}	130	130	10300
241-B-21 (299-E33-20)	8.8×10^{-4}	2.9×10^{-4}	220	110	6000
241-BY-8 (299-E33-8)	2.0×10^{-5}	4.2×10^{-6}	<2	<2	3.3
241-BY-9 (299-E33-1)	8.4×10^{-2}	4.7×10^{-2}	3.2	2.3	7300
241-BY-10 (299-E33-2)	1.6×10^{-2}	7.2×10^{-3}	2.6	<2	1940
241-BY-11 (299-E33-3)	2.8×10^{-1}	1.4×10^{-1}	6.9	5.7	6170
241-BY-12 (299-E33-4)	7.0×10^{-1}	3.7×10^{-1}	5.3	2.9	59300
241-BY-13 (299-E33-7)	6.5×10^{-2}	4.7×10^{-2}	4	3.7	4760
241-BY-14 (299-E33-10)	7.5×10^{-7}	1.8×10^{-7}	<2	<2	4.2
241-BY-15 (299-E33-6)	1.1×10^{-5}	5.3×10^{-6}	<2	<2	<1
241-BY-16 (299-E33-5)	6.8×10^{-3}	4.5×10^{-3}	--	--	6.7

No averages are available for the previous quarter, however results of the wells west of the BY cribs during this quarter have shown significant increases in beta emitter density. This indicates a shift of the crib wastes

in the ground water to the west with the rise of the gound water mound beneath the Purex cooling water disposal site. Slight changes in ground water gradients could send it into the permeable Gable Mountain channels and thence into the Columbia River. The high uranium activity in 241-B-20 (299-E33-19) and 241-B-21 (299-E33-20) are evidently from the 242-B waste evaporator cribs.

The wells in Table III were drilled to monitor the Purex cribs, but were found contaminated with BY crib wastes before Purex operation.

TABLE III

PUREX AND ADJACENT WELL ACTIVITY DENSITIES
AND NON-RADIOACTIVE SALT CONCENTRATIONS
JULY, AUGUST, SEPTEMBER
1956

Well	Beta Emitters Units of 10^{-8} μc/ml Max.	Beta Emitters Units of 10^{-8} μc/ml Avg.	Uranium Units of 10^{-9} μc/ml Max.	Uranium Units of 10^{-9} μc/ml Avg.	NO_3 Concentration
241-A-1 (299-E25-1)	<10	<10	3.3	3.3	20
216-A-1 # 6 (299-E25-2)	35	<10	3	3	19
216-A-5 # 12 (299-E24-1)	16	<10	2.5	2.2	22
216-A-6 # 17 (299-E25-3)	24	<10	2.8	2.5	1.7
216-A-10# 1 (299-E17-1)	62	18	2.9	2.3	38
216-A-8 # 1 (299-E25-4)	25	11	2.3	2.1	2
216-A-9 # 3 (299-E24-5)	<10	<10	2.8	2.5	17
38-43 (699-38-43)	<10	<10	<2	<2	<1
28-41 (699-28-41)	<10	<10	--	--	4.1
19-43 (699-19-43)	21	<10	<2	<2	<1
25-56 (699-25-56)	<10	<10	2	<2	1
34-51 (699-34-51)	<10	<10	<2	<2	1.5
36-61 (699-36-61)	<10	<10	19	6.8	<1
47-60 (699-47-60)	<10	<10	<2	<2	<1
54-57 (699-54-57)	<10	<10	<2	<2	1
35-70 (699-35-70)	27	<10	2.4	2.4	4
45-69 (699-45-69)	19	<10	<2	<2	15
31-30 (699-31-30)	<10	<10	2.4	2.4	8
42-42 (699-42-42)	<10	<10	<2	<2	--
2-3 (699-2-3)	11	<10	2.5	2.5	--
55-70 (699-55-70)	<10	<10	<2	<2	--
49-79 (699-49-79)	<10	<10	<2	<2	--
60-60 (699-60-60)	<10	<10	<2	<2	--
34-39 (699-34-39)	<10	<10	2	<2	--

[redacted]

The activity levels in these wells are at background or near background levels, indicating that the contamination originating in the BY site has been diluted or displaced by the addition of Purex cooling water to the water table and that Purex crib wastes have not reached ground water in significant quantities.

The wells listed in Table IV monitor the 216-BC crib and specific retention trench disposal of similar wastes to those which formerly went to the BY cribs.

TABLE IV

216-BC CRIB SITES ACTIVITY DENSITIES
AND NON-RADIOACTIVE SALT CONCENTRATIONS
JULY, AUGUST, SEPTEMBER
1956

	Beta Emitters Units of 10^{-8} µc/ml		Uranium Units of 10^{-9} µc/ml		NO_3 Concentration
Well	Max.	Avg.	Max.	Avg.	
241-BC-1 (299-E13-1)	<10	<10	<2	<2	--
241-BC-2 (299-E13-2)	<10	<10	<2	<2	--
241-BC-3 (299-E13-3)	<10	<10	<2	<2	3
241-BC-4 (299-E13-4)	<10	<10	<2	<2	--
241-BC-5 (299-E13-5)	<10	<10	<2	<2	--
241-BC-6 (299-E13-6)	<10	<10	<2	<2	--
241-BC-8 (299-E13-8)	13	<10	<2	<2	--
241-BC-9 (299-E13-9)	<10	< 10	<2	<2	--

All results of water samples from wells monitoring the BC site are below the detection limit for total beta or uranium analysis methods. The scintillation probe, lowered inside the BC well casings, showed the wastes to be more than 200 feet above ground water in July.

200 WEST AREA

The locations of wells in Table V through VII are shown in Figure 5. The wells in Table V monitor the T-plant 2nd cycle crib and tank farm area.

TABLE V

241-T CRIB SITE ACTIVITY DENSITIES
AND NON-RADIOACTIVE SALT CONCENTRATIONS
JULY, AUGUST, SEPTEMBER
1956

Well	Beta Emitters Units of μc/ml		Uranium Units of 10^{-9} μc/ml		NO_3 Concentration
	Max.	Avg.	Max.	Avg.	
224-T-4 (299-W10-1)	1.0×10^{-6}	3.4×10^{-7}	<2	<2	<1
224-T-10 (299-W10-2)	8.2×10^{-4}	3.4×10^{-4}	21	12	8300
241-T-15 (299-W10-3)	1.1×10^{-5}	9.8×10^{-6}	15	14	1550
241-T-16 (299-W10-4)	3.9×10^{-5}	2.2×10^{-5}	9.2	7.9	2400
241-T-17 (299-W11-11)	7.3×10^{-5}	5.5×10^{-5}	29	29	4200
241-T-18 (299-W11-12)	4.6×10^{-7}	2.9×10^{-7}	<2	<2	32
241-T-19 (299-W11-14)	1.8×10^{-6}	1.3×10^{-6}	3.5	3.5	1400
241-T-20 (299-W10-5)	2.6×10^{-6}	4.1×10^{-7}	<2	<2	120
241-T-21 (299-W15-2)	1.7×10^{-7}	$<1.0 \times 10^{-7}$	<2	<2	13
231-2 (299-W15-1)	1.5×10^{-7}	$<1.0 \times 10^{-7}$	<2	<2	1
241-TY-2 (299-W15-3)	2.4×10^{-5}	1.4×10^{-5}	19	18	3400
241-TY-5 (299-W14-2)	7.4×10^{-6}	3.6×10^{-6}	20	18	2760
241-TX-12 (299-W15-4)	2.9×10^{-5}	2.4×10^{-5}	<2	<2	1380

A northward gradient is developing in this area as the ground water beneath the former T-plant cooling water swamp subsides, but though some indications of these wastes appear in wells north of 200 West Area, no changes of significance are readily apparent in the activity levels of the above wells.

The following wells were drilled around the 241-T-361 reverse well, but contain radioactive emitters which have moved beyond the area monitored by wells in Table V.

TABLE VI

361-T REVERSE WELL SITE ACTIVITY DENSITIES AND NON-RADIOACTIVE SALT CONCENTRATIONS

JULY, AUGUST, SEPTEMBER

1956

Well	Beta Emitters Units of 10^{-8} μc/ml Max.	Beta Emitters Units of 10^{-8} μc/ml Avg.	Uranium Units of 10^{-9} μc/ml Max.	Uranium Units of 10^{-9} μc/ml Avg.	NO_3 Concentration
241-T-361 (299-W11-51)	15	<10	<2	<2	46
361-T-12 (299-W11-1)	31	15	<2	<2	20
361-T-14 (299-W11-2)	73	29	<2	<2	110
361-T-15 (299-W11-3)	230	73	<2	<2	190
361-T-16 (299-W11-4)	32	27	6.4	5.5	950
361-T-17 (299-W11-5)	26	17	3.7	3.7	750
361-T-18 (299-W11-6)	32	21	5.1	4	830
361-T-19 (299-W11-7)	14	<10	2	<2	49
361-T-22 (299-W11-8)	10	<10	<2	<2	380
361-T-23 (299-W11-9)	57	37	<2	<2	220
361-T-24 (299-W11-10)	30	14	<2	<2	33
361-T-25 (299-W12-1)	110	21	<2	<2	<1

Radioactivity in these wells is mainly that which originated in the T-plant 2nd cycle site. The activity has been decreasing since a northward gradient developed in the ground water table, moving contaminants away from these wells.

The wells in Table VII were drilled to investigate the extent of ground and ground water contamination around the 216-S cribs, the 216-S-7 cribs, and 241-S and 241-SX tank farms.

TABLE VII

241-S CRIB SITES ACTIVITY DENSITIES

JULY, AUGUST, SEPTEMBER

1956

Well	Beta Emitters Units of μc/ml Maximum	Beta Emitters Units of μc/ml Average	Uranium Units of 10^{-9} μc/ml Maximum	Uranium Units of 10^{-9} μc/ml Average
241-S-6 (299-W23-1)	$<1.0 \times 10^{-7}$	$<1.0 \times 10^{-7}$	2.8	2.8
241-S-12 (299-W22-4)	8.6×10^{-6}	4.3×10^{-6}	2.2	<2
241 S-13 (299-W22-64)	1.5×10^{-2}	1.1×10^{-2}	2.9	2.9
241-S-14 (299-W22-5)	2.2×10^{-2}	1.8×10^{-2}	4.6	2.7
241-S-15 (299-W22-6)	$<1.0 \times 10^{-7}$	$<1.0 \times 10^{-7}$	6.7	6.7
241-S-16 (299-W22-7)	4.3×10^{-7}	3.0×10^{-7}	<2	<2
241-S-17 (299-W22-8)	1.1×10^{-7}	$<1.0 \times 10^{-7}$	2.1	2.1
241-S-18 (299-W22-9)	$<1.0 \times 10^{-7}$	$<1.0 \times 10^{-7}$	<2	<2
241-S-19 (299-W22-10)	1.0×10^{-3}	5.0×10^{-4}	<2	<2
241-S-20 (299-W22-11)	8.0×10^{-7}	3.0×10^{-7}	2.9	2.9
241-S-21 (299 W22-15)	9.2×10^{-3}	8.0×10^{-3}	12	18
241-S 22 (299-W22-16)	4.4×10^{-4}	2.2×10^{-4}	12	11
241-S-23 (299-W22-17)	6.1×10^{-4}	3.2×10^{-4}	4.2	4.2
241-SX-5 (299-W23-2)	2.7×10^{-4}	8.9×10^{-5}	3.2	3.2
241-SX-12 (299-W23-3)	7.6×10^{-6}	2.1×10^{-6}	4.7	4.7
241-S-7#1 (299-W22-12)	2.8×10^{-3}	1.7×10^{-3}	10	4.9
241-S-7 #2 (299-W22-13)	3.4×10^{-3}	3.2×10^{-3}	5	4.5
241-S-7 #3 (299-W22-14)	2.7×10^{-3}	2.6×10^{-3}	9.1	8.3
Redox Crib #2 (299-W26-2)	5.8×10^{-7}	3.1×10^{-7}	<2	<2
Redox Crib #3 (299-W26-3)	9.2×10^{-6}	1.6×10^{-6}	<2	<2

The activity levels of these well water results are generally inversely proportional to their distance down gradient from the 216-S-1 and 2 cribs. Although BY crib contaminants were found at high levels nearly two miles from their source, these wastes are hardly detectable more than 1000 feet away. The only wells which are not relatively stable in this group are wells 241-SX-5 (299-W23-2) and 241-SX-12 (299-W23-3). They monitor surges of waste from the 216-SX-1 and S-4 cribs which have a very short soil column providing little ion-exchange capacity. These cribs are nearly flooded by the TBP waste cooling water disposal nearby, and wastes are carried directly down-gradient to the SX-5 and SX-12 wells.

OUTLYING SAMPLING LOCATIONS

The locations of wells in the following two tables are shown in Figure 6. The following wells monitor the 321 crib.

TABLE VIII

321 CRIB SITE ACTIVITY DENSITIES

JULY, AUGUST, SEPTEMBER

1956

	Beta Emitters		Uranium	
	Units of 10^{-8} µc/ml		Units of 10^{-9} µc/ml	
Well	Max.	Avg.	Max.	Avg.
321-2 (699-S6-4B)	<10	<10	<2	<2
321-4 (699-S6-4D)	<10	<10	<2	<2
321-5 (699-S6-4E)	<10	<10	7.2	6.9
321-6 (699-S6-4F)	<10	<10	18	14
321-7 (699-S6-4G)	<10	<10	<2	<2
321-8 (699-S6-4H)	<10	<10	17	13
321-9 (699-S6-4J)	<10	<10	<2	<2

No significant changes are shown in well water samples taken from this site.

[redacted]

The following wells are located in the several reactor areas.

TABLE IX

CONCENTRATIONS OF ALPHA AND BETA PARTICLE EMITTERS IN TEST WELLS JULY, AUGUST, SEPTEMBER 1956

Well	No. Samples	Alpha Particle Emitters Units of 10^{-9} µc/ml Maximum	Alpha Particle Emitters 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
107-B-1 (199-B3-1)	2	<2	<2	190	160
107-B-2 (199-B3-2)	2	<2	<2	150	130
108-B-1 (199-B4-1)	2	<2	<2	290	200
108-B-2 (199-B4-2)	2	<2	<2	270	210
107-D-1 (199-D8-2)	2	<2	<2	390	220
107-F-1 (199-F5-1)	2	<2	<2	47	33
108-F-1 (199-F5-4)	2	<2	<2	19	32
108-F-2 (199-F5-5)	3	--	--	63,000	47,000
199-F5-6	2	--	--	120	62
107-H-1 (199-H4-1)	2	<2	<2	26	16
107-KE-4 (199-K-19)	2	<2	<2	<10	<10
107-KE-5 (199-K-20)	2	<2	<2	35	19
107-KE-6 (199-K-21)	2	<2	<2	160	82
107-KE-7 (199-K-22)	1	--	--	170	170

These wells monitor the pile cooling water retention basins and trenches for the disposal of waste water in the event of slug rupture. Well 107-F-2 is locatedabout 50 feet from the outflow line from the 100-F retention basin. The line leaks badly and is probably the cause of the result of 4.7×10^{-4} µc/ml.

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[redacted]

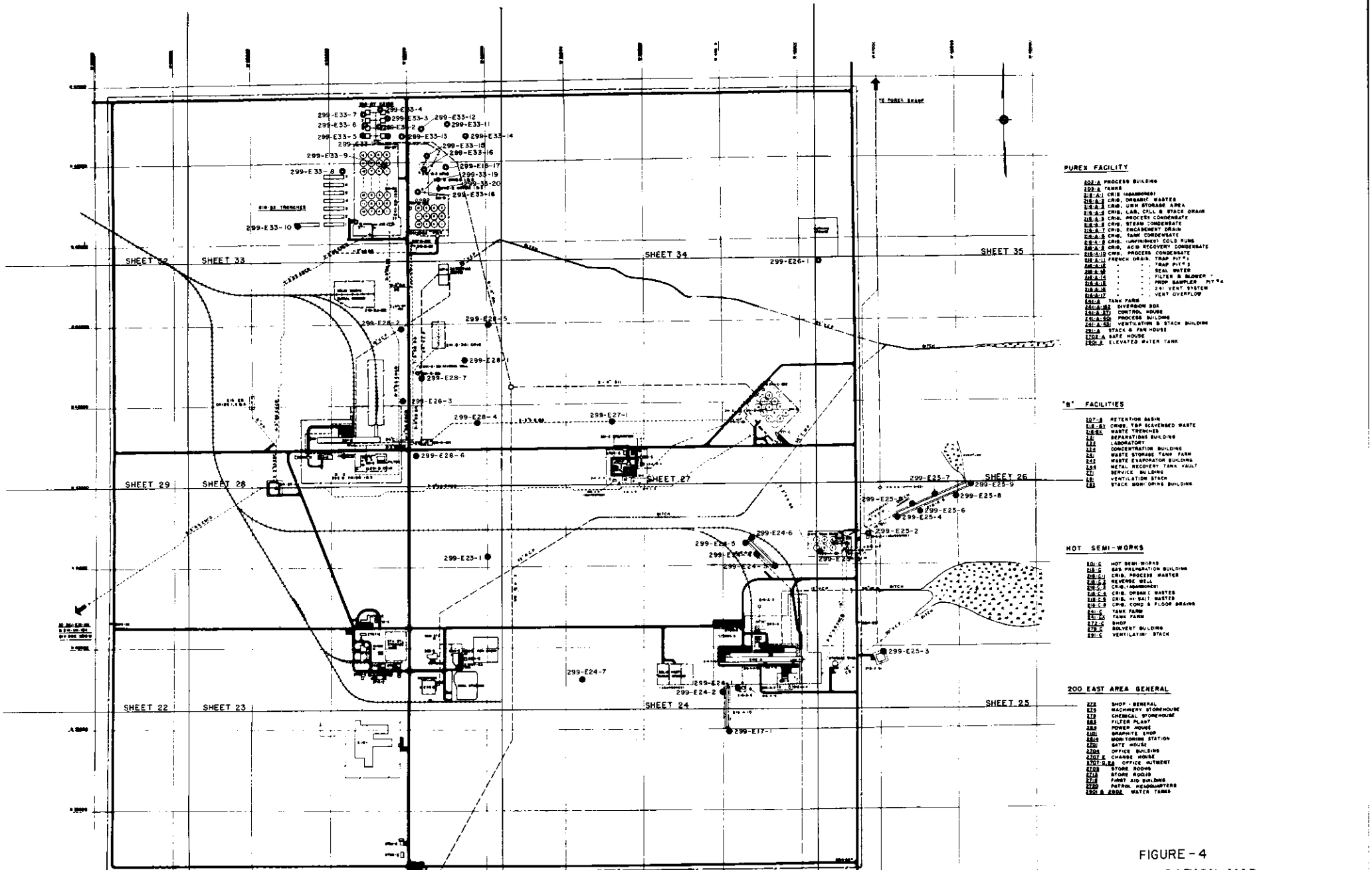

FIGURE - 4

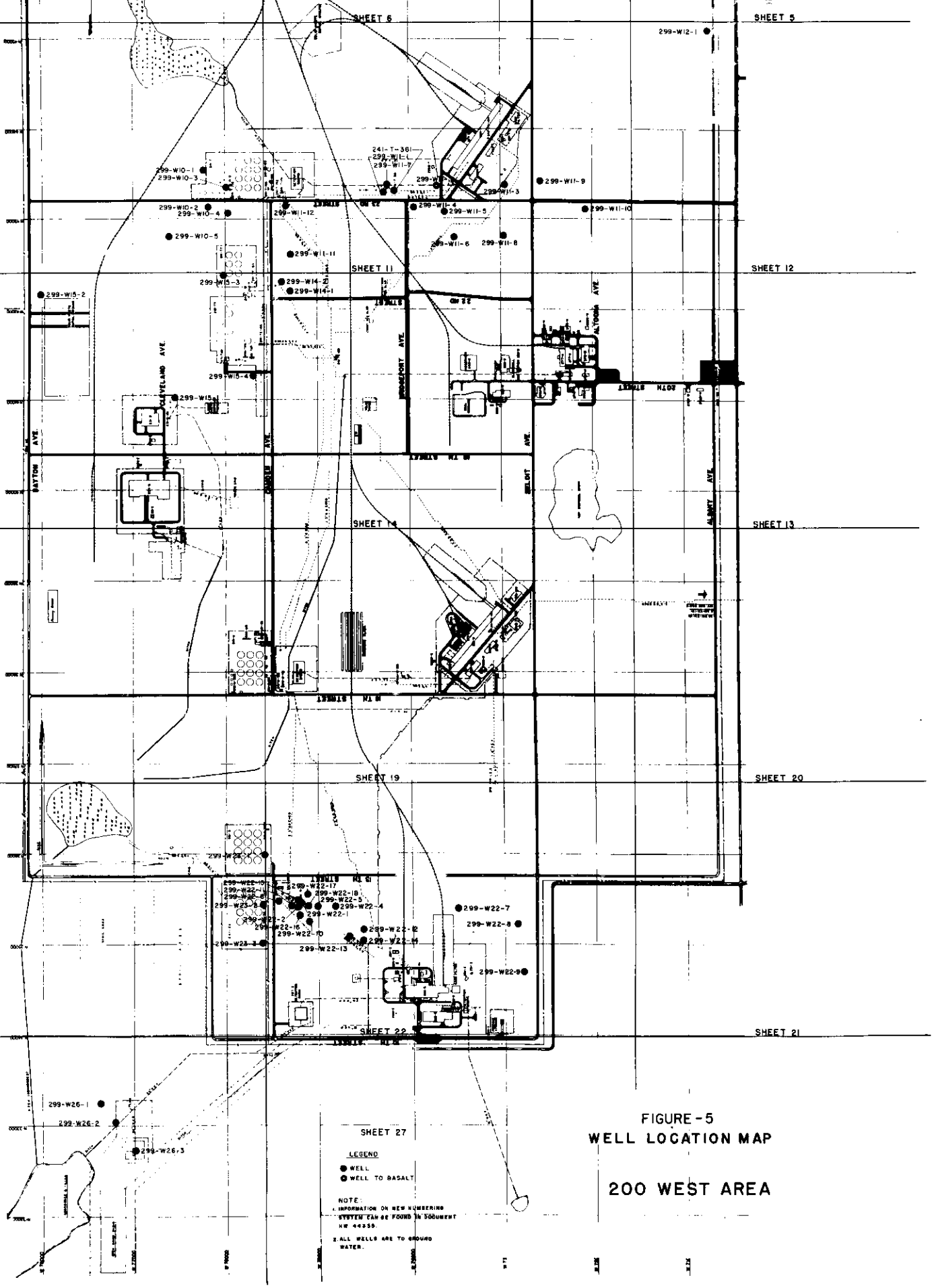

FIGURE-5
WELL LOCATION MAP

200 WEST AREA

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER

The results of 540 samples of drinking water analyzed for gross alpha and beta particle emitters are presented in Table I.

TABLE I

CONCENTRATIONS OF ALPHA AND BETA PARTICLE EMITTERS IN WATER SUPPLIES JULY, AUGUST, SEPTEMBER 1956

Location	No. Samples	Alpha Particle Emitters, Units of 10^{-9} μc/ml		Beta Particle Emitters, Units of 10^{-8} μc/ml	
		Max.	Avg.	Max.	Avg.
Midway and Vicinity	33	13	<5	8	<5
100-B (San)	13	< 5	<5	31	11
100-C (San)	12	< 5	<5	34	11
100-K (San)	13	< 5	<5	350	70
100-D (San)	13	< 5	<5	470	150
100-DR (San)	13	< 5	<5	470	180
100-H (San)	12	< 5	<5	330	150
100-F (San)	13	< 5	<5	620	270
White Bluffs Fire Hall	13	< 5	<5	79	31
Pistol Range	12	< 5	<5	6	<5
251 Building	14	< 5	<5	17	8
200-East (San)	38	< 5	<5	330	52
200-West (San)	51	< 5	<5	64	16
300 Area Wells	13	19	<5	12	<5
No. Richland Wells	37	20	<5	5	<5
Byers Landing	13	< 5	<5	7	< 5
Larson Farm	13	5	<5	<5	< 5
Richland Wells	19	16	<5	6	< 5
Kennewick	36	6	<5	160	76
Sacajawea	13	8	6	7	< 5
Pasco H and R Depot	13	< 5	<5	82	60
Pasco Filter Plant	13	< 5	<5	260	110
McNary	12	< 5	<5	12	< 5
Plymouth	12	< 5	<5	8	< 5
Paterson Store	12	12	<5	9	< 5
Enterprise	13	< 5	<5	<5	< 5
Headgate	14	< 5	<5	9	< 5
Benton City	39	16	8	<5	< 5
Prosser	12	7	<5	6	< 5
B-Y Well	3	6	<5	<5	< 5

The beta particle emitter results of drinking water samples from the Columbia River are almost all higher; those of 100-D and DR Area being more than twice the levels of the previous quarter. These higher beta emitter concentrations are probably the result of the low Columbia River water volume (Section V).

Analyses will be made for the detection of Sr^{90} (1/10 MPC is 8×10^{-8} μc/ml) in selected drinking water samples originating in the Columbia River for presentation in the fourth quarterly report.

A summary of the alpha particle emitter activity densities in selected drinking water samples is presented in Table II.

TABLE II

CONCENTRATIONS OF ALPHA PARTICLE EMITTERS IN DRINKING WATER JULY, AUGUST, SEPTEMBER 1956

Location	Alpha Particle Emitters			Uranium		
	No. Samples	Units of 10^{-9} μc/ml Max.	Avg.	No. Samples	Units of 10^{-9} μc/ml Max.	Avg.
Pistol Range	12	<5	< 5	12	3	2
B - Y Well	2	6	< 5	1	3	3
Lee Boulevard (San)	13	16	5	13	5	4
Richland Well No. 4	6	5	< 5	7	5	3
Benton City Store	13	16	11	13	14	10
Benton City Water Company	13	16	11	13	13	11
Sacajawea Park	13	8	6	11	8	6
Paterson Store	12	11	< 5	13	5	2

These locations have shown natural uranium activity in the past. Uranium activity accounts mainly for the alpha particle emitter activity found in these samples.

Samples collected from various stages of the water treatment process of the Pasco Filter Plant were analyzed for beta particle emitter activity density. Results of these samples appear in Table III.

TABLE III

CONCENTRATIONS OF BETA PARTICLE EMITTERS
AT THE PASCO FILTER PLANT
JULY, AUGUST, SEPTEMBER
1956

Type Sample	No. Samples	Maximum	Average
Water Entering Plant From River	37	6.9×10^{-6} μc/ml	3.2×10^{-6} μc/ml
Filter Bed Material	13	2.1×10^{-4} μc/gm	7.4×10^{-5} μc/gm
Backwash Activity (Soluble)	12	2.3×10^{-6} μc/ml	1.3×10^{-6} μc/ml
Backwash Activity (Insoluble)	12	5.0×10^{-2} μc/gm	1.6×10^{-2} μc/gm
Water Leaving Plant	13	2.6×10^{-6} μc/ml	1.1×10^{-6} μc/ml

The average activity density of beta particle emitters is slightly higher than last quarter, as a result of the lower diluting volume of river water. The beta activity in water leaving the plant was 1.1×10^{-6} μc/ml, which is slightly higher than that recorded for the previous period. The filters evidently remove an approximately constant percentage of the activity. They provide a decontamination factor of 3 over the river water entering the plant.

Alpha particle emitters were detected in the solid material from the filter backwash water, but not in the liquid portion, nor in the sanitary water leaving the plant. The activity density of alpha particle emitters in the solids average 2.8×10^{-6} μc/gm compared with 7.1×10^{-6} μc/gm obtained during the previous quarter.

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