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HW - 24203

BIOPHYSICS SECTION

RADIOLOGICAL SCIENCES DEPARTMENT

RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD

OCTOBER, NOVEMBER, DECEMBER

1951

April 22, 1952

GENERAL ELECTRIC

NUCLEONICS DIVISION

HANFORD WORKS

RICHLAND, WASHINGTON

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HW-24203

Health & Safety

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER, 1951

April 22, 1952

by

H. J. Pars

HANFORD WORKS
RICHLAND, WASHINGTON

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ABSTRACT

SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES:

Daily monitoring at the separation areas stacks indicated that approximately 5 curies of I-131 were discharged to the atmosphere daily from these facilities. The activity density from beta particle emitters other than I-131 ranged from 2 x 10^{-3} to 2 x 10^{-2} curies per day. Less than 1 mg of plutonium per day was emitted to the atmosphere. Spot measurements for uranium indicated that from 1 to 25 mg per day was leaving the stacks. Monitoring at the 105-D and 105-F Stacks showed detectable quantities of tritium oxide in nearly every instance. This activity was indicated at several environmental locations during the quarter. Reactor stack samples analyzed for S-35 showed this activity to average less than 1 x 10^{-10} µc/cc. Similiar samples analyzed for C-14 showed average values of 4 x 10^{-10} µc/cc at the 100-F and 100-D areas.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

Significant decreases in the activity density from I-131 were observed at all general sampling locations during this quarter. This decrease ranged from a factor of 4 to 8 in the region of maximum deposition and from a factor of 3 to 4 at residential communities near the plant. Maximum deposition was detected near the 200 West area where the average activity density of I-131 was 1.3 x 10^{-4} µc/gm with maximum measurements approaching 6.0 x 10^{-4} µc/gm. Except for 4 small isolated areas, the activity density from I-131 was less than 5 x 10^{-6} µc/gm at off-area locations in eastern and southern Washington and in northern Oregon. General increases on the order of a factor of 2 to 3 were observed in the activity density of non-volatile emitters deposited on vegetation. This increase was general in nature and was associated with the influx of particulate contamination from the Nevada bomb tests. Trace quantities of alpha emitters were found on vegetation samples collected near the 200 Areas. Iso-activity maps which show the estimated deposition during each month of the quarter, along with tabular summaries of these data, are included in the text.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Average dosage rates from air-borne contaminants as determined from Victoreen Integrons and detachable ionization chambers were not significantly different when compared to measurements from the previous quarter. Significant increases in the mean activity density of filterable beta emitters in the atmosphere were attributed to the influx of particulate contamination from the Nevada bomb tests. These increases ranged from a factor of 2 to 6 at most locations; maximum average measurements were on the order of 1 to 2 x 10^{-12} µc/cc near the operating areas. General decreases on the order of a factor of 10 in the amount of I-131 in the atmosphere were associated with the reduction in the amount of I-131 admitted to the atmosphere at the separation areas. Average values for I-131 were in the range of 1 x 10^{-13} to 1 x 10^{-11} µc/cc throughout the environs. Spot measurements obtained during periods of maximum ground concentration showed maximum values of 6.2 x 10^{-9} µc/cc. Highly significant increases in particulate contamination were noted at all monitoring locations during the Nevada Tests. In extreme cases, particle concentrations over one day periods ranged from 6 to 10 p/m^3. The magnitude of increase observed at remote stations was not significantly different than that noted at environmental locations and indicated that these increases were entirely due to sources other than the Hanford operation.

ABSTRACT (CON'T)

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

The general increase in the mean activity density from gross beta emitters noted at the 107 basins during the previous 6 months continued during this period. Average values at the 5 reactor basins ranged from 1.3 to 1.9 x 10^{-3} μc/cc; the maximum was 8.9 x 10^{-3} μc/cc. The activity density of alpha emitters in the pile effluent averaged less than 5 x 10^{-9} μc/cc at all areas. Trace indications of uranium were noted in isolated samples, however, this activity did not exceed 6 μg/U/liter in any event. Approximately 0.2 mc of I-131 were discharged to the river from the Biology Farm daily. Analysis of liquid and solid samples obtained at 200 and 300 Area waste sources showed that the activity density of gross alpha and beta particle emitters was comparable to that noted in the past. Portable instrument surveys over open terrain and along the edges of open waste areas showed radiation levels to be on the order of natural background in the majority of instances.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER:

General increases in the activity density from gross beta emitters in the Columbia River were attributed to the decrease in flow rate of the river during this period. Maximum activity was detected in the region between the 100-H Area and the Hanford Ferry; average values in this region were on the order of 4 to 6 x 10^{-6} μc/cc with maximum measurements slightly over 1 x 10^{-5} μc/cc. The latter values were among the highest measurements obtained during 1951. Increases were also noted in the activity density of beta emitters in the raw water supplies pumped from the river. Measurements for alpha particle emitters in river and raw water indicated negligible activity from this source. Analysis of Columbia River mud samples for alpha and beta particle emitters showed no change when comparing current measurements to the values obtained during the previous quarter.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN:

The mean activity density from gross beta emitters in rain was 7 x 10^{-6} μc/cc inside the separation areas and ranged from 1 to 3 x 10^{-6} μc/cc at perimeter locations. Maximum measurements showed 3.0 to 4.0 x 10^{-5} μc/cc at locations near the stacks. In general, the current measurements represented a decrease on the order of a factor of 10 to 20, when compared to measurements from the previous quarter.

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

Uranium was detected in all drinking water supplies in the Richland - Benton City region which showed detectable alpha activity. Maximum measurements were found at Benton City where two wells averaged 1.2 x 10^{-2} μc/U/cc with maximum individual samples showing 2.4 x 10^{-2} μg/U/cc. Drinking supplies which indicated trace activity from beta emitters include sanitary water supplies at the Hanford Areas, Pasco, and Kennewick. Mean values at these locations were on the order of 3 x 10^{-7} μc/cc, with maximum measurements of 6 x 10^{-7} μc/cc. The results obtained from monitoring drinking water supplies other than those mentioned above and test wells showed negligible activity from alpha and beta emitters. In general, the positive results obtained during this period were not significantly different from those found during the previous quarter and were not indicative of any significant trend. Weekly samples obtained from various filtering media and backwash processes at the Pasco Filter Plant showed significant quantities of beta particle emitters in all samples collected. Average and maximum results from the latter samples were not significantly different from those found earlier in 1951.

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SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

200 AREAS

Estimations of the amount of radioactive contamination discharged to the atmosphere from the Separations Areas stacks were obtained by sampling at the 50 foot level of the stack. Samples were also obtained at the downstream side of the sand filter to determine the amount of contamination emitted from other plant processes. The amount of I-131 was measured on a daily basis at each area and periodic measurements were performed to determine the activity density of beta particle emitters other than I-131, and to determine the amount of plutonium and uranium emitted.

Approximately, 5 curies total of I-131 were discharged to the atmosphere daily; the activity density from beta particle emitters other than I-131 ranged from 2×10^{-3} to 2×10^{-2} curies per day; the amount of plutonium discharged daily was less than 1 mg and the uranium emitted ranged from 1 to 25 mg per day. The results obtained from measurements at each of the two Separations Areas are discussed below.

200 EAST AREA

Table I summarizes the results obtained from the measurement for I-131 discharged from the 200-East Area.

TABLE I
SUMMARY OF RESULTS FROM STACK MONITORING
200 EAST AREA STACK
OCTOBER, NOVEMBER, DECEMBER
1951

Month	Curies of I-131 Dissolved per 24 hrs		Curies I-131 Emitted Daily		Curies Emitted Through Sand Filter Daily	
	Maximum	Average	Maximum	Average	Maximum	Average
October	3880	1260	10.6	3.9	6.8	2.3
November	3440	1480	3.7	2.2	2.5	1.2
December	2190	1150	1.5	0.7	2.6	0.7
Quarter	3880	1340	10.6	2.0	6.8	1.2

The average amount of two curies of I-131 per day is a significant decrease compared to the emission rate between September 8 and September 22 (range from 18 to 135 curies per day), and is attributed to the regeneration of the silver reactor in the 4-5L line during the week ending September 15. The addition of mercury salts to the dissolvers after September 29, 1951, also contributed significantly toward the decrease in I-131 emission.

Periodic measurements obtained during the latter part of November showed the activity density from beta particle emitters other than I-131 was on the order of 1.3×10^{-2} curies per day. Analysis of filters, inserted in the off-gas line, indicated the amount of plutonium and uranium discharged daily to the atmosphere was on the order of 0.3 mg and 25.0 mg, respectively.

During October, three tests were performed to determine reactor efficiency. Scrubber samples collected during peak I-131 emission indicated a reactor efficiency of 99.99%. During these tests, less than .003% of the dissolved I-131 was emitted to the atmosphere.

200 WEST AREA

A summary of the results obtained from monitoring for I-131 at the 200-West Area are presented in Table II.

TABLE II
SUMMARY OF RESULTS FROM STACK MONITORING
200 WEST AREA STACK
OCTOBER, NOVEMBER, DECEMBER
1951

Month	Curies of I-131 Dissolved per 24 hrs		Curies I-131 Emitted Daily		Curies Emitted Through Sand Filter Daily	
	Maximum	Average	Maximum	Average	Maximum	Average
October	2800	1220	30.0	9.0	28.0	11.0*
November	1980	1080	3.3	1.3	2.0	0.8
December	2250	1440	6.0	1.8	2.4	1.1
Quarter	2800	1230	30.0	3.0	28.0	3.0*

* These values were weighted by measurements obtained during the first week of October when the sand filter emission averaged 14 curies; the emission out of the stack was not measured during this period due to equipment repair.

A general decrease in the amount of I-131 emitted at the 200 West Area during this period was largely attributed to an increase in the concentration of mercury salts added to the dissolvers for the purpose of retaining the I-131 in solution. During the week ending October 6, mercury salt concentrations were increased from 1.0×10^{-4} molar to 1.5×10^{-4} molar. A small increase in daily emission during the month of December was accounted for by a decrease in the cooling period of the irradiated metal from an average of 48 days in November to 44 days in December.

It was interesting to note that no significant increase in the amount of I-131 emitted occurred after the over-heating of both silver reactors in the 200-West Area on November 22, 1951.

Tests performed during the latter part of October to determine the efficiency of the silver reactors at the 200 West Area showed values of 99.96% and 99.98%. These tests were made during the period of peak emission from the dissolvers and represented normal dissolving conditions; the coolong period of the dissolved metal during the tests was 42 days.

Spot measurements obtained during the latter part of November and early December indicated from 0.3 to 1.0 mg of plutonium were discharged daily from the 200 West Area stack. Similiar samples obtained from the downstream side of the sand filter showed that 0.1 mg of plutonium per day was entering the stack from this source.

Continuous sampling between November 20 and December 4 was maintained by the filter method to measure the amount of uranium discharged from the 200 West Area stack and from the sand filter. Radiochemical analyses indicated that between 8.3 and 19.5 mg of uranium were discharged daily; of this total, about 1.3 mg entered the stack through the sand filter.

REDOX AREA

Monitoring equipment was installed in the various off-gas lines at the Redox Area during the quarter. The equipment was tested for leaks and the recorders were calibrated with respect to a range of orifices which will be used for monitoring after start-up.

100 AREAS

Over 1,000 samples were collected at various environmental locations and from the off-gas lines of 100 Area stacks for the purpose of evaluating the activity density of tritium oxide in the atmosphere. The sampling methods (HW-23133) and analytical techniques (HW-20136) have been outlined elsewhere. A location map showing the monitoring stations at which the air sampling equipment was maintained may be referred to in the previous quarter report. (HW-23133).

A summary of the results obtained from this type of measurement for the period October, November, December, 1951 is presented in Table III.

TABLE III
SUMMARY OF TRITIUM OXIDE MEASUREMENTS
OCTOBER, NOVEMBER, DECEMBER
1951

Location	ACTIVITY DENSITY x 10^9 μc/cc				
	October Average	November Average	December Average	Quarter Average	Maximum Measurement
Pistol Range	10	5	21	12	162
105-F Stack	34	36	36	35	225
White Bluffs	7	13	10	10	133
105-D Stack	60	46	35	48	161
100-D SE	16	9	<4	10	62
Richland	<4	<4	<4	<4	12
Riverland	23	21	5	17	64
C. Area #1	6	<4	<4	<4	24
C. Area #2	6	<4	<4	<4	18
C. Area #4	9	<4	<4	5	38
100-B 614 SW	11	<4	<4	5	28
100-B 614 SE	6	5	<4	4	30
100-B 614 NE	9	<4	<4	6	35
183-B SE corner	11	5	<4	6	26
1701-B Main Gate	8	<4	5	6	42
107-B Inlet End	6	<4	9	6	66
181-B Roof	10	<4	8	7	60

The results summarized above indicate trace quantities of tritium oxide were detected at nearly all environmental locations during October; the measurements obtained at many of the same locations during November and December showed negligible activity. The positive averages over the three-month period (greater than 4×10^{-9} μc/cc) were weighted by the October values. A comparison of these data with similiar measurements obtained during the previous three-month period showed no significant differences.

Daily monitoring at the 105-F and 105-D stacks showed detectable quantities of tritium oxide in nearly every instance. The amount of tritium oxide leaving the stacks (2 to 6×10^{-8} μc/cc) was comparable to that measured in the past although one individual measurement showed 2.3×10^{-7} μc/cc at the 105-F stack representing one of the highest concentrations measured at this location during the past 5 months.

Twenty-two samples collected from the 105-D and 105-F stacks were analyzed for S-35 and with the exception of one measurement all results showed this activity to average less than 1×10^{-10} μc/cc. On October 8, 1951, a sample collected from the 105-D stack showed the activity density from S-35 to be 2.7×10^{-10} μc/cc of air.

Twenty-five samples from the 105-F and 105-D stacks were analyzed for C-14. A summary of the results obtained from this measurement is presented in Table IV.

TABLE IV
ACTIVITY DENSITY FROM C-14 IN 100 AREA STACKS
OCTOBER, NOVEMBER, DECEMBER
1951

units of 10^{-10} μc/cc

Location	October Average	November Average	December Average	Quarter Average	Last Quarter Average	This Quarter Maximum
105-F	5.1	2.8	3.7	4.0	10.1	16.6
105-D	6.1	3.1	3.5	4.4	10.9	13.4

In general, the average activity density from C-14 in the 100 Area sticks decreased by about a factor of 2 when comparing current measurements to those of the previous quarter. The maximum measurement of 1.7×10^{-9} μc/cc also represented a significant decrease when compared to the highest value of the previous quarter which was 1.3×10^{-8} μc/cc. Approximately 50% of the C-14 samples analyzed showed detectable activity from this source.

SECTION I

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION

Approximately, 2,000 samples of vegetation were collected from locations on and immediately adjacent to the Hanford Works and about 500 samples were collected from locations in the states of Washington, Idaho, and Oregon to determine the gross deposition of beta particle emitters on vegetation. These samples were analyzed specifically for I-131 and for the specific activity density of non-volatile emitters. Analytical methods used for these analyses followed standard procedures used at the control laboratory (HW-20136). The counting rates were corrected for decay, counting efficiency, and weight, by factors normally applied to this calculation (HW-22682). Periodic samples were also obtained from 5 nearby locations to determine the amount of Pu on vegetation during the month of December.

Table I summarizes the results obtained from the measurements for the activity density from I-131 and from non-volatile beta emitters during the three-month period; average values obtained from similiar measurements during the previous quarter are included for comparison.

TABLE I

RADIOACTIVE CONTAMINATION ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

1951

Location	No. Samples	I-131 Activity Density x 10^6 µc/gm Maximum	I-131 Activity Density x 10^6 µc/gm Average	I-131 Activity Density x 10^6 µc/gm Previous Average	Non-Volatile Activity Density x 10^6 µc/gm Maximum	Non-Volatile Activity Density x 10^6 µc/gm Average	Non-Volatile Activity Density x 10^6 µc/gm Previous Average
North of 200 Areas	214	190	10	26	257	47	15
Near the 200 Areas	168	90	22	87	284	58	20
Route 3	13	282	105	400	141	67	33
200 West Gate	122	595	128	1000	451	68	120
200 East Tower #16	123	437	70	220	278	56	27
Batch Plant	123	187	50	370	238	58	34
Meteorology Tower	13	176	71	290	168	54	33
South of 200 Areas	268	65	8	53	258	42	16
Richland & Kadlec Hosp.	210	99	6	29	186	40	16
Pasco, Sacajawea Pk. & Jct. U.S. Hwy 410	70	21	4	16	195	36	16
Kennewick & Kenn. Highlands	106	46	5	17	124	32	14
Benton City & Cobb's Corner	37	11	4	36	194	41	15
Richland "Y"	10	23	6	14	146	48	15
Hanford	26	21	8	25	122	44	17
200 East Area	48	212	48	150	256	57	24
200 West Area	64	192	31	280	425	94	37
Redox Construction Area	81	128	39	600	390	72	48
Wahluke Slope	109	75	6	25	215	45	11
Goose Egg Hill	48	38	15	140	117	51	24
Rattlesnake Mountain	78	54	10	27	170	57	17
PSN 300-310-320	33	44	12	35	120	43	44
200-W - 242 Bldg. (Nov.)	22	41	20	-	133	65	-
Off-Area Sampling							
Prosser, Prosser to Patterson, Plymouth, McNary & Plymouth to Kennewick	227	41	4	12	232	38	15
Pasco to Ringold	69	18	4	18	214	44	11

Significant decreases in the activity density from I-131 were observed at all general sampling locations during this period. In the region of higher contamination, such as near the 200 West Area gatehouse and nearby Route 3, this decrease ranged from a factor of 4 to 8 and, in residential communities near the plant, the magnitude of the decrease was on the order of 3 to 4. This decrease occurred as a result in the amount of I-131 emitted from the stacks (see Section I).

Figure 1 is an estimated iso-activity map showing the extent and magnitude of the deposition pattern from I-131 in the immediate environs during the three-month period. As indicated, trace amounts of I-131 (5.0×10^{-6} to 2.5×10^{-5} μc/gm) were detected throughout the entire project during the period. Beyond the project perimeter, the only areas showing detectable I-131 were Kennewick, Washington and a smaller region approximately 4 miles wide extending due East of the project to and including the community of Eltopia, Washington. A comparison of this iso-activity map with a similiar estimation for the previous quarter (HW-23133) shows a highly significant reduction in the area on which trace deposition was detected. During the previous quarter, the activity density from I-131 exceeded 5×10^{-4} μc/gm at many locations between the two separation areas, whereas during the current period, the maximum deposition was on the order of 1×10^{-4} μc/gm at only 2 locations in that region.

Table II shows a more detailed summary of the results obtained from the I-131 measurements and is presented to show a lack of a significant trend or change within the three-month period. (Please refer to Table II on following page.)

A comparison of the average values tabulated in Table II on a month to month basis showed the magnitude of the measurements deviated less during this period than during any three-month period since March of 1951.

Figures 2, 3, and 4 are estimated iso-activity maps based on measurements determined from individual samples collected at the general locations summarized in Table II. A comparison of the three maps shows that the general deposition pattern was nearly identical from month to month with the only exceptions occurring at the perimeter of the region in which the activity density was in the range of 5×10^{-6} μc/gm to 2.5×10^{-5} μc/gm. The presence and absence of I-131 at these perimeter locations was largely accounted for by the trace quantity of activity at the perimeter; in general, values were on the order of 5×10^{-6} to 1.0×10^{-5} μc/gm throughout the Wahluke Slope, Rattlesnake, Benton City, Pasco, and Kennewick areas.

TABLE II
ACTIVITY DENSITY FROM I-131 ON VEGETATION
OCTOBER, NOVEMBER, DECEMBER
1951

units of 10^{-6} μc/gram

Location	October		November		December	
	Maximum	Average	Maximum	Average	Maximum	Average
North of 200 Area	48	10	52	10	27	11
Near the 200 Areas	90	23	71	18	86	26
Route 3	282	148	111	76	172	79
200 West Gate	482	141	595	109	428	133
200 East Tower	158	67	135	66	437	78
Batch Plant	187	60	90	35	164	53
Meteorology Tower	176	114	36	29	109	60
South of 200 Areas	48	7	48	8	65	9
Richland	23	6	25	5	99	6
Pasco Environs	12	4	13	5	9	<3
Kennewick Environs	29	5	119	42	10	4
Benton City	7	3	10	5	11	4
Richland "Y"	23	9	<3	<3	9	5
Hanford	10	9	16	7	21	8
200 East Area	116	57	212	62	192	49
200 West Area	134	33	192	34	70	24
Redox Const. Area	113	38	112	39	128	41
Wahluke Slope	75	8	16	5	17	4
Goose Egg Hill	29	14	30	15	38	16
Rattlesnake Mountain	54	10	20	12	15	6
PSN-300-310-320	21	9	23	12	44	19
Prosser, Prosser to Patterson, Plymouth, McNary, Plymouth to Kennewick	41	4	22	6	17	<3
Pasco to Ringold	18	4	17	4	-	-
200 W - 242 Bldg.	-	-	41	20	-	-

Due to the adverse weather and road conditions and to the significant reduction in the amount of I-131 deposited over the Pacific Northwest, off-area sampling during the three-month period was confined to the months of October and November. Two general regions were covered during this period; one to the northeast including Lewiston, Idaho and Spokane, Washington and the other extending to the southeast along the Columbia River gorge to and including Bonneville. Tables III and IV and Figure 5 show the results obtained from analyzing vegetation samples collected from these points for the activity density from I-131.

TABLE III
RADIOACTIVE CONTAMINATION ON VEGETATION
OFF AREA SURVEY
OCTOBER 3-4 1951

Location	I-131 Activity Density x 10^6 μc/gm			Non-Volatile Activity Density x 10^6 μc/gm	
	No. Samples	Maximum	Average	Maximum	Average
Wallula	4	<3	<3	21	11
Touchet	2	<3	<3	24	14
Lowden	2	<3	<3	12	<10
Walla Walla	4	6	<3	12	<10
Dixie	2	<3	<3	19	11
Waitsburg	4	5	<3	19	12
Dayton	4	6	3	21	13
Dodge	2	7	7	19	15
Pomeroy	4	5	<3	22	15
Lewiston	4	5	<3	12	<10
Uniontown	2	6	<3	<10	<10
Pullman	4	<3	<3	14	<10
Colfax	4	<3	<3	21	13
Steptoe	2	<3	<3	13	11
Rosalia	2	<3	<3	11	<10
Spangle	2	<3	<3	38	31
Spokane	4	12	4	22	15
Cheney	4	16	4	26	16
Sprague	4	6	3	22	15
Ritzville	4	9	4	20	13
Lind	4	18	8	30	21
Connel	4	5	<3	42	24

TABLE IV
RADIOACTIVE CONTAMINATION ON VEGETATION
OFF AREA SURVEY
NOVEMBER 6-7 1951

Location	I-131 Activity Density x 10^6 µc/gm			Non-Volatile Activity Density x 10^6 µc/gm	
	No. Samples	Maximum	Average	Maximum	Average
Yakima Barricade to Moxee City	8	18	8	115	62
Moxee City	4	5	4	108	88
Union Gap	2	3	3	77	73
Wapato	4	4	<3	81	60
Toppenish	4	5	4	89	70
Toppenish to Goldendale	9	11	6	116	60
Goldendale	4	5	<3	164	125
Maryhill	2	15	12	264	217
Dalles	4	6	4	274	147
Moser	2	4	<3	214	147
Hood River	2	<3	<3	282	220
Bonneville	4	8	3	271	182
Rufus	2	6	4	118	84
Quinton	2	4	3	31	25
Blalock	2	8	4	32	25
Heppner Jct.	2	4	4	32	30
Arlington	2	8	6	49	33
Boardman	2	<3	<3	25	13
Umatilla	2	<3	<3	28	25

Except for four small isolated areas, the activity density from I-131 was less than 5×10^{-6} µc/gm at all off-area locations sampled during the period. Areas in which detectable activity was noted included Dodge, Lind, and Maryhill, Washington and the region between the Yakima Barricade at the northwest perimeter of the project and the town of Moxee City. The maximum average activity density was noted at Maryhill (1.2×10^{-5} µc/gm) and the maximum individual sample was collected near Moxee City (1.8×10^{-5} µc/gm).

The activity density from non-volatile emitters on vegetation (Table I) showed a general increase on the order of a factor of 2 to 3 at project locations during this quarter. This increase was general in nature throughout the environs and was associated with the influx of particulate contamination from the Nevada bomb tests during the latter part of October and month of November. Samples collected from remote locations also reflected this trend. A highly significant

increase in the activity density from non-volatile emitters was observed in the region between Goldendale, Washington and Bonneville, Oregon during the early part of November. (See Table IV) In general, the activity density ranged from 1.2 to 2.2 x 10^{-4} μc/gm in this region as compared with values on the order of 2 to 7 x 10^{-5} μc/gm at locations adjacent to this small area. Normally, the activity density from non-volatile emitters at off-area locations ranges from 1 to 2 x 10^{-5} μc/gm. Although the source of the contaminant in this small region can not be directly determined, it was assumed that the significant measurements resulted from a passing cloud which carried particulate contamination from the Nevada tests. All increases mentioned above regarding the activity density from non-volatile emitters were associated with the Nevada tests and were not attributed to any change in the Hanford operation.

Several locations in the immediate vicinity of the 200 areas were selected during December to determine the specific activity density from alpha particle emitters on vegetation. The results of these initial measurements are summarized in Table V.

TABLE V
ACTIVITY DENSITY FROM ALPHA EMITTERS ON VEGETATION
DECEMBER, 1951

units of 10^{-8} μc/gm

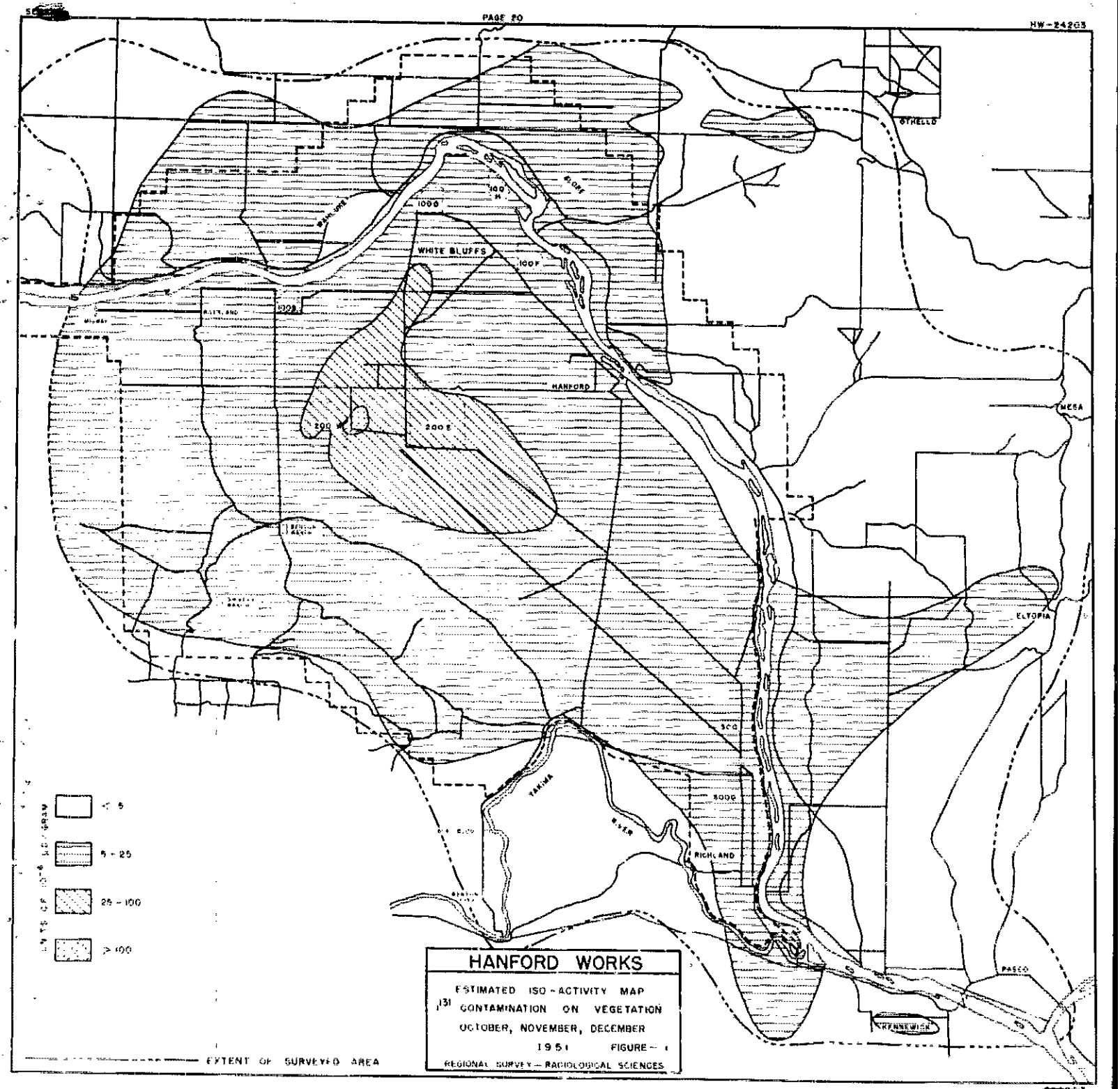
Location	Samples	Maximum	Average
200 Westgate	2	37.0	19.0
Batch Plant	2	10.0	8.4
Rt. 4S, Mile 4	2	46.0	27.0
Metro Tower	2	6.8	5.5
Rt. 4 So., Mile 6	1	6.7	6.7

The measurements summarized above indicate that trace quantities of alpha emitters were found at all locations sampled. Maximum measurements prevailed at the same locations at which the maximum deposition from I-131 was noted. The locations, 200 Westgate and Route 4S, Mile 4, are directly down-wind from the

separation area stacks. As these are the initial measurements, the above results do not lend themselves for comparison or evaluation of trends, however, similiar measurements will be maintained on a monthly basis in the future.

SECTION II

(Please refer to Figures 1, 2, 3, 4 and 5.)



HANFORD WORKS

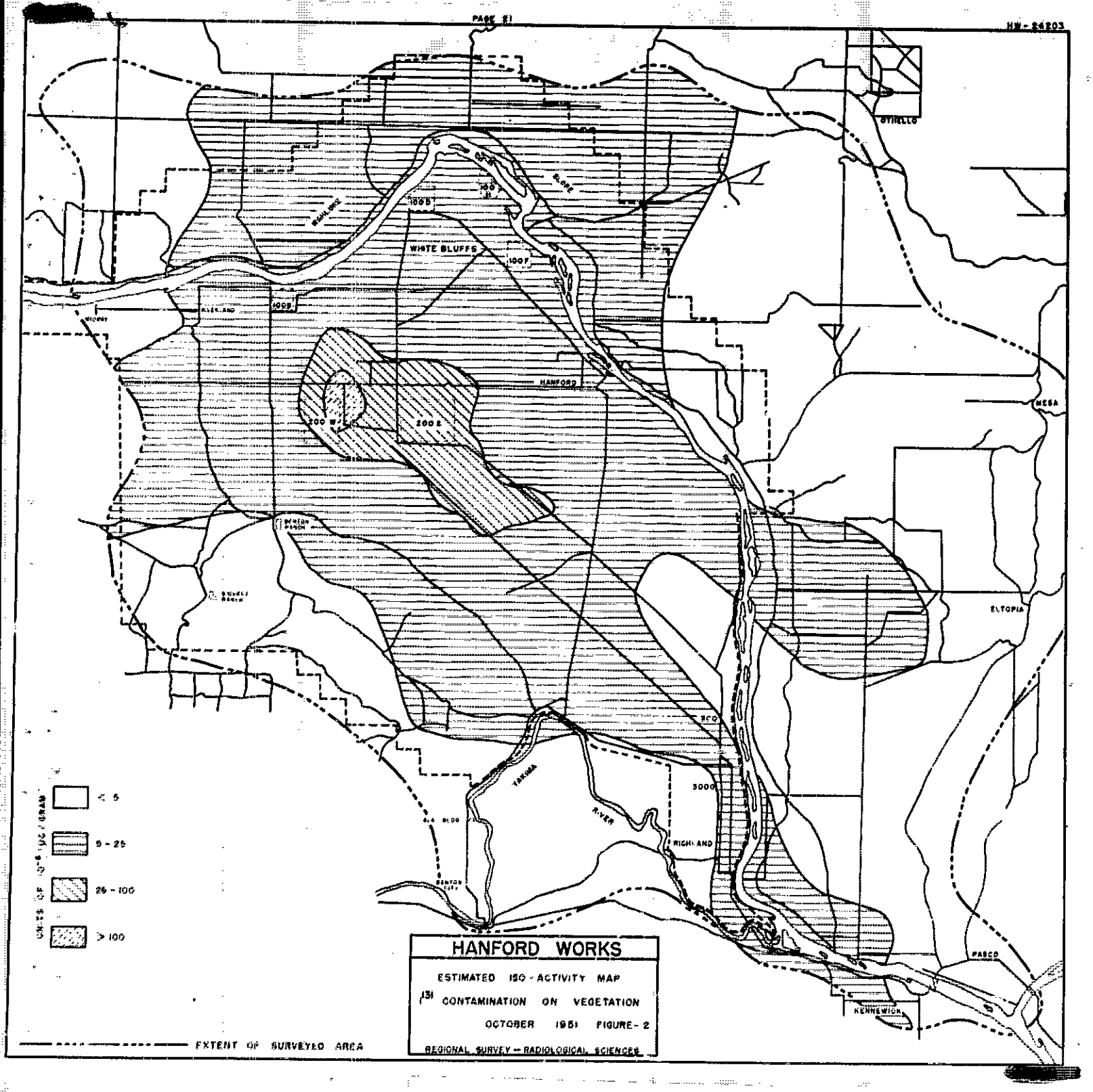
ESTIMATED ISO-ACTIVITY MAP

^{131}I CONTAMINATION ON VEGETATION

OCTOBER, NOVEMBER, DECEMBER

1951 FIGURE - 1

REGIONAL SURVEY - RADIOLOGICAL SCIENCES



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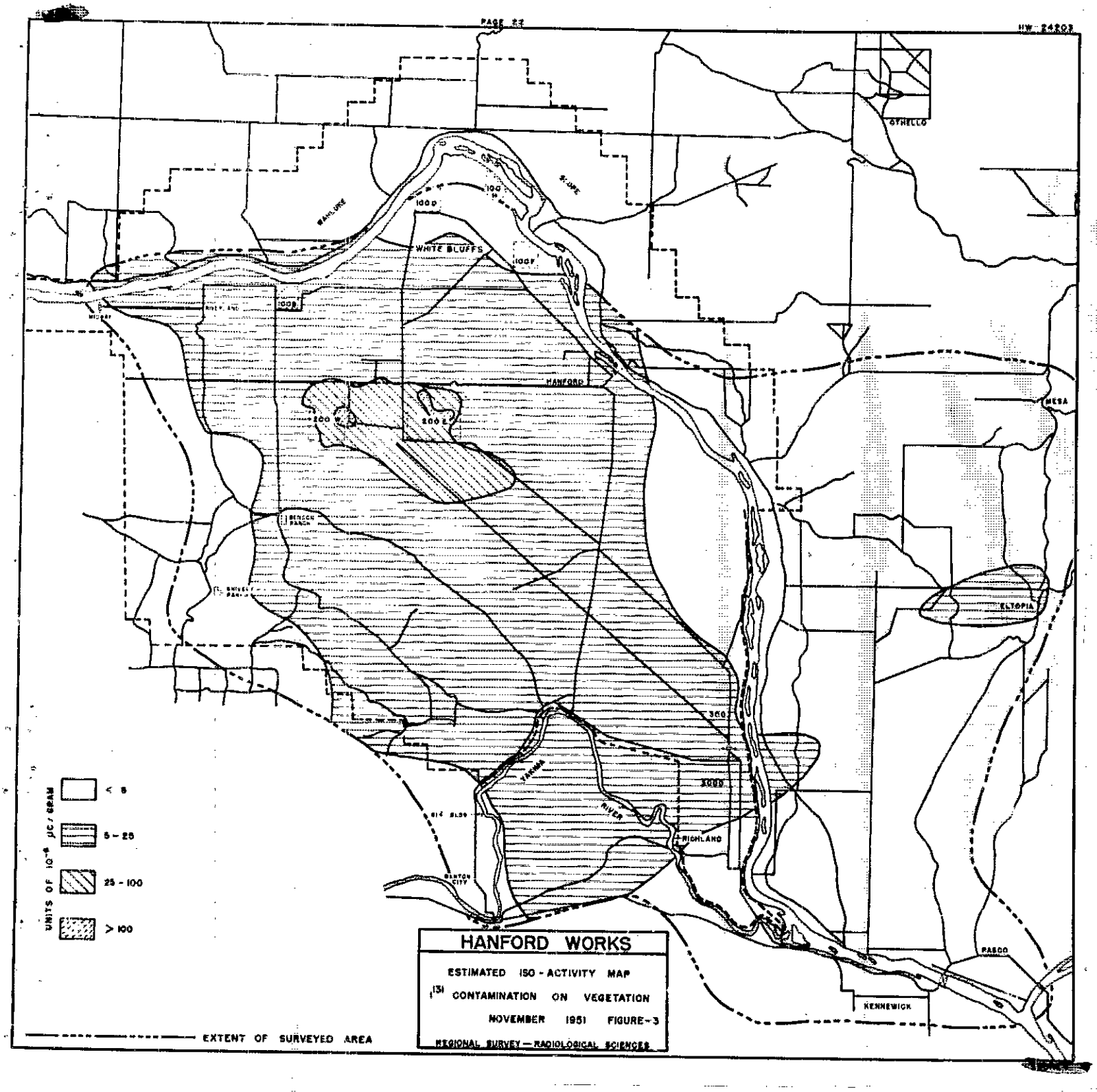

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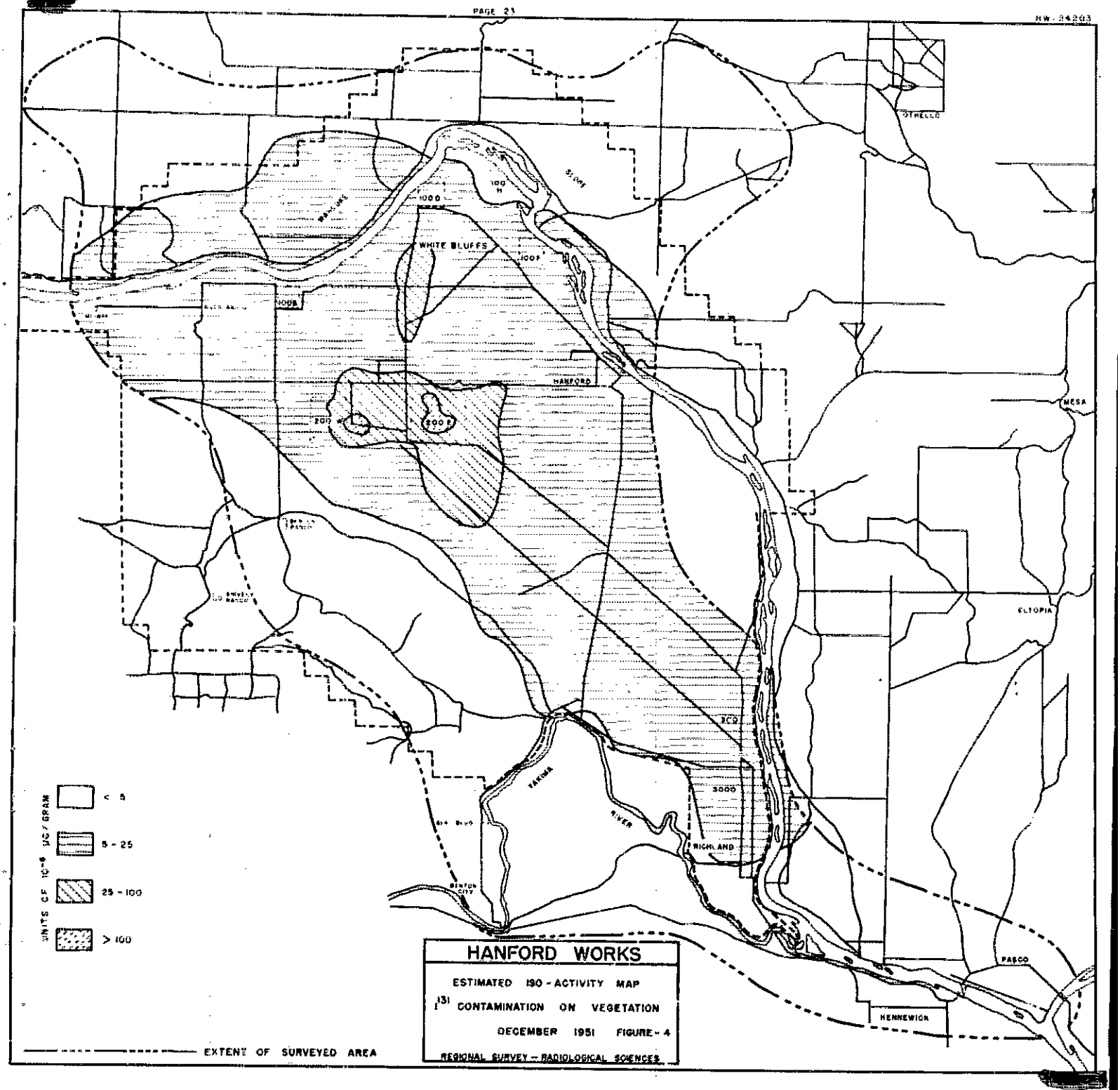


HANFORD WORKS

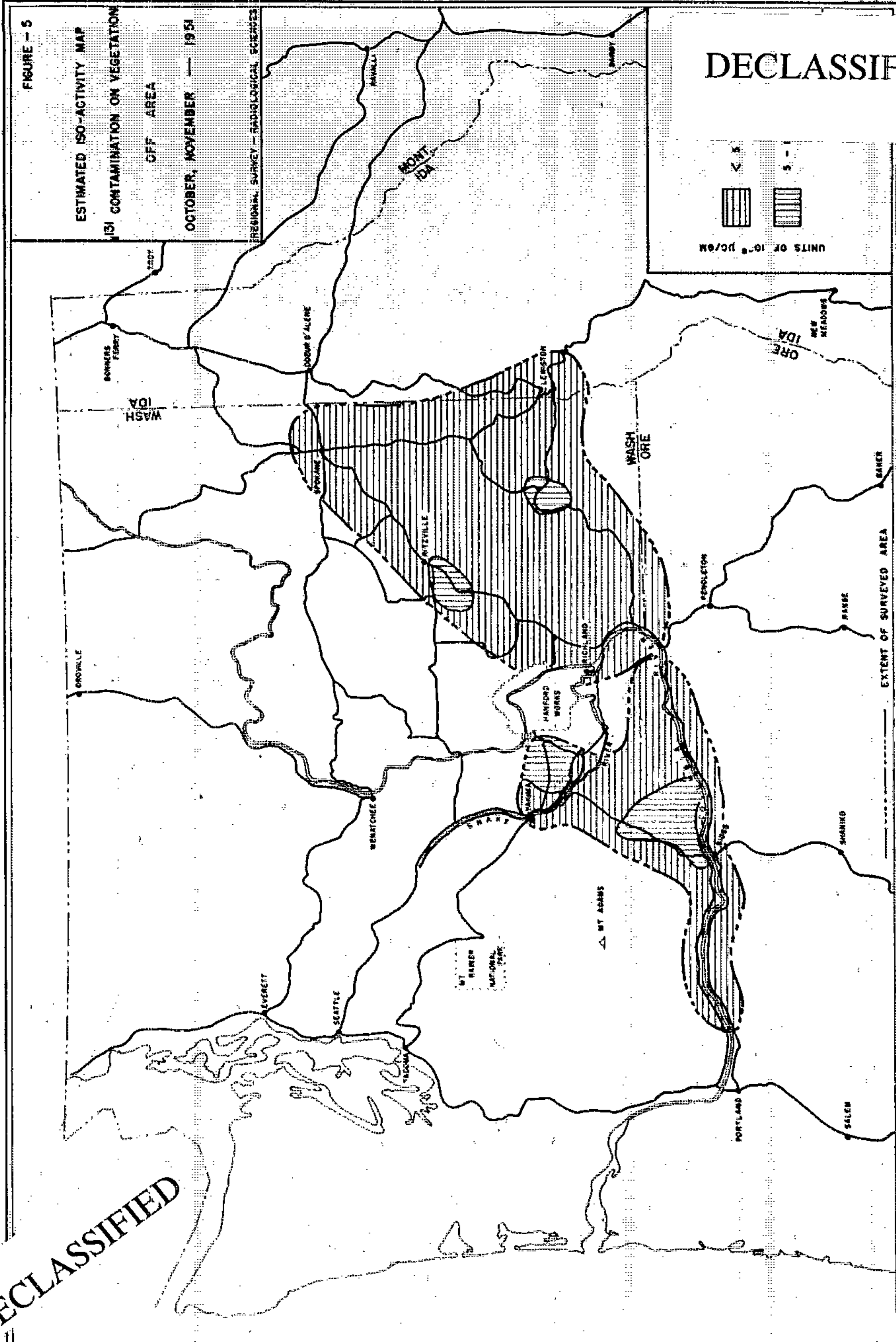
ESTIMATED I^{131} ACTIVITY MAP

I^{131} CONTAMINATION ON VEGETATION

DECEMBER 1951 FIGURE - 4

REGIONAL SURVEY - RADIOLOGICAL SCIENCES

DECLASSIFIED



SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Dosage rates from air-borne contaminants were determined from Victoreen Integrons and detachable ionization chambers. Integron units were operated at monitoring stations located around the perimeter of the Hanford Works operating areas and in each of the nearby residential communities: two to three of these units were used at each area and only one unit was maintained at a residential location. Detachable "C" type ionization chambers were placed at each integron station and detachable "M" and "S" type ionization chambers were used at intermediate field locations between the various operating areas. A map showing the location of these monitoring stations may be referred to in a previous publication (HW-21214).

Table I summarizes the results obtained from Integron readings. The results presented are averages obtained by the summation of individual values from 8 hour exposure periods.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

OCTOBER, NOVEMBER, DECEMBER

1951

Location	No. of units	units of mrep per 24 hours October	November	December	Quarterly Average
100-B Area	3	0.4	0.4	0.3	0.4
100-D Area	3	0.2	0.3	0.3	0.3
100-F Area	3	0.2	<0.1	0.1	0.1
100-H Area	3	0.5	0.4	0.3	0.4
200 West Area	2	0.6	0.2	0.5	0.4
200 East Area	4	<0.1	0.1	0.4	0.2
Redox Area	1	1.9	3.4	0.9	2.0
Riverland	1	<0.1	0.3	0.6	0.3
300 Area	1	1.4	0.3	0.2	0.6
Richland	1	1.3	1.0	1.1	1.4
Pasco	1	1.8	0.2	1.3	1.1
Benton City	1	0.3	0.4	0.3	0.3
North Richland North	1	0.4	1.0	0.6	0.7
North Richland South	1	1.2	1.3	0.8	1.1
Hanford	1	<0.1	0.1	<0.1	<0.1
Kennewick	1	0.9	2.1	0.1	1.0

A comparison of the above averages with the results obtained from similiar measurements during the pervious quarter indicates very little change in average

dosage rates. In general, the bulk of the measurements were within the range of natural background (0.3 to 0.5 mrep per 24 hours) in this region. Several readings obtained at the Richland and Pasco stations were slightly higher than expected, because several questionable readings which may have been attributed to faulty instrumentation were included in the over-all average. A review of the above data on a month to month basis was not indicative of any significant trend occuring during the three-month period.

The results obtained from "C" type ionization chambers at the Integron stations in the Hanford Works operating areas are presented in Table II. The radiation level was evaluated from the minimum reading obtained from two chambers exposed at each location. These chambers were located inside the small wooden structure which contains the integron equipment.

TABLE II
"C" TYPE DETACHABLE IONIZATION CHAMBERS
OCTOBER, NOVEMBER, DECEMBER
1951

Location	units of mrep per 24 hours			Quarterly
	October	November	December	Average
Within 100-B Area	0.3	0.4	0.4	0.4
Within 100-D Area	0.5	0.6	0.8	0.6
Within 100-F Area	0.4	0.4	0.4	0.5
Within 200 West Area	0.4	0.5	0.5	0.5
Within 200 East Area	0.6	0.7	0.8	0.7

"C" chamber readings showed a small but non-significant increase occurring during these three months. The monthly and quarterly averages summarized above were well-within the range of values expected for this type of measurement during this period of the year.

Monitoring at field locations between the various operating areas was accomplished by exposing "M" and "S" type ionization chambers. Two chambers were employed at each monitoring location with the minimum reading used for evaluating the dosage rate. A summary of the results obtained for the period October, November, December, 1951 is presented in Table III.

TABLE III
RADIATION LEVEL OBSERVED WITH
"M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS
OCTOBER, NOVEMBER, DECEMBER
1951

Location	Units-mrep per 24 hours				
100 Areas & Environs	October	November	December	Quarterly Average	Group Average
Route 1, Mile 8	0.48	0.73	0.37	0.53	
Route 2N, Mile 10	0.33	0.68	0.55	0.52	
Route 2N, Mile 5	0.56	0.52	0.29	0.46	
White Bluffs	0.43	0.50	0.25	0.39	
Route 11-A, Mile 1	1.22	1.05	0.72	1.00	
Hanford 614 Bldg.	0.31	1.19	0.46	0.65	0.53
Intersection Rt. 1 & Rt. 4N	0.49	0.53	0.49	0.50	
Hanford 101 Building	0.52	0.47	0.40	0.46	
100-H Area	0.44	0.57	0.47	0.49	
P-11 Area	0.38	0.48	0.42	0.43	
100-B NE Construction	0.71	0.71	0.22	0.57	
100-B SE Construction	0.55	> 0.37	0.42	0.32	
Within 5 Miles of 200 East Area					
Route 4S, Mile 6	1.27	3.50	2.48	2.42	
Batch Plant	0.56	0.85	0.56	0.66	
Route 11-A, Mile 6	1.12	0.84	1.35	1.10	
Route 3, Mile 1	0.98	1.00	1.05	1.01	
Meteorology 200'	0.96	0.86	1.15	0.99	
Route 4S, Mile 2.5	1.27	1.20	1.16	1.21	
Redox Area	1.55	1.07	1.55	1.39	1.26
Route 4S, Mile 4.5	1.42	0.77	0.50	0.90	
Semi-Works #1	1.52	1.67	1.82	1.67	
Semi-Works #2	1.14	0.78	0.22	0.71	
200 East PSN 300	2.42	2.32	0.86	1.87	
PSN 310	0.81	0.97	0.55	0.78	
PSN 320	1.31	1.64	0.92	1.29	
PSN 330	2.22	0.96	1.66	1.61	
Within 10 Miles of 200 East Area					
Route 4S, Mile 10	0.77	> 5.25	1.29	0.69	
Route 10, Mile 1	0.59	1.41	0.77	0.92	
Route 10, Mile 3	0.24	0.78	0.99	0.67	1.09
Route 2S, Mile 4	1.35	1.08	2.29	1.57	
Military Camp, PSN Charlie	1.61	1.61	1.61	1.61	
Near 300 Area					
Route 4S, Mile 16	1.95	2.35	1.09	1.80	
Route 4S, Mile 22	0.92	0.74	1.33	1.00	
North Richland North	0.43	0.42	0.59	0.48	0.92
North Richland South	0.48	0.52	0.56	0.52	
300 Area	0.72	0.59	1.16	0.82	
Outlying					
Richland	0.44	0.87	1.32	0.88	
Benton City	0.47	0.46	0.58	0.50	
Pasco	0.27	0.39	0.51	0.39	0.56
[redacted]ick	0.35	0.40	0.62	0.46	

Dosage rates measured at field locations during this period were not significantly different from those measured during the previous quarter. Small decreases were observed at stations located within a 10-mile radius of the Separations areas, however, the variation noted when comparing the data on a month to month basis was well-within the range expected for these measurements. The maximum radiation level of 2.4 mrep for 24 hours at Route 4S, Mile 6 was only two miles away from the location at which a maximum level was observed during the previous three-month period.

The activity density from filterable beta particle emitters in the atmosphere was measured by passing a 2.5 cfm sample through a CWS type 6 filter paper for one week. The air stream was motivated by a quarter horse-power Motoair pump. The filters were held for two or three days prior to analysis to allow for decay of the daughter products of radon and thoron. Table IV summarizes the results obtained from this program. (Please refer to Table IV on following page.)

Significant increases were noted when comparing the average activity density from filterable beta particle emitters in the atmosphere during this period with results obtained during the latter part of the previous quarter. The magnitude of this increase ranged from a factor of 2 to 6 at most locations; averages for the three-month period were generally higher by at least a factor of 2 over the last quarter. This increase was weighted by higher measurements obtained during October and November when the amount of particulate contamination in the atmosphere increased due to particulate contamination from the Nevada Bomb Tests. Measurements to determine the amount of particulate contamination in the atmosphere during this quarter (HW-23517) indicated that particle concentrations frequently exceeded one particle per cubic meter and in extreme cases approached 6 - 10 p/m^3 at remote locations. The latter fact indicates that the increase in activity density from filterable beta emitters noted during the period was not due to increased emission from Hanford sources. In general, the activity density

TABLE IV
AVERAGE FILTERABLE BETA EMITTERS IN AIR
OCTOBER, NOVEMBER, DECEMBER
1951

Location	BETA EMITTERS - AVERAGE ACTIVITY DENSITY x 10^{14} μc/cc				
	October	November	December	Quarterly Average	Maximum Weekly
200 Areas & Vicinity					
200 East Southeast	118	175	78	123	350
200 East Tower #16	98	208	117	137	309
200 East Semi-Works	268	226	172	225	722
200 West Tower #4	155	257	157	185	381
200 West Gatehouse	126	128	60	106	248
200 West Redox Area	110	139	54	99	248
Gable Mountain	86	116	45	83	283
200 East Tower #15	129	219	142	161	381
100 Areas & Vicinity					
100-D	130	194	69	131	263
100-H	124	202	55	127	351
Hanford 101 Building	152	188	82	141	357
Hanford 614 Building	42	103	50	63	231
White Bluffs	57	153	83	94	261
300 Area 614 Building	89	63	29	64	386
Outlying					
Richland	56	91	13	53	143
North Richland	42	107	47	64	163
Pasco	89	58	25	60	325
Kennewick	92	36	18	40	122
Benton City	37	85	30	50	144
Riverland	38	124	44	66	203

measured during December was significantly lower than that noted during the first two months and was indicative that the contamination levels were decreasing to a value comparable to the expected levels for Hanford operation.

Additional data for evaluating the activity density from filterable beta emitters in the atmosphere was obtained by counting small air filters which were removed from dual air monitors in the environs. Table V summarizes the results of these measurements. (Please refer to Table V on following page.)

TABLE V
AVERAGE FILTERABLE BETA ACTIVITY IN AIR
DUAL UNIT AIR MONITORS
OCTOBER, NOVEMBER, DECEMBER
1951

Location	Beta Emitters - Activity Density x 10^{14} μc/cc				
	October	November	December	Quarterly Average	Maximum Weekly
200 West East Center #1	216	202	113	180	498
200 West East Center #2	152	232	119	166	326
200 East Southeast #1	47	214	110	118	451
200 East Southeast #2	101	182	93	124	332
200 East East Center #1	93	194	91	123	287
200 East East Center #2	139	184	92	139	295
Richland #1	47	66	37	51	142
Richland #2	75	76	54	67	188
Meteorology Tower					
Ground Level	137	206	103	146	291
200' level	64	136	83	93	216
400' level	83	172	86	111	252

The results obtained from analyzing filters removed from dual units reflected general increases in the activity density from filterable beta emitters comparable to those noted when evaluating the data obtained from single unit air monitors. Maximum weekly concentrations summarized in Table V were measured during October and November when particulate contamination from the Nevada tests prevailed in the environs. The December measurements represented a significant decrease when compared to October and November values and were approaching the order of magnitude expected from Hanford operation.

The average activity density from eight-day I-131 in the atmosphere was determined by analyzing caustic scrubber samples through which an air flow of 2.0 to 2.5 cfm had been passed for a one week period. Analytical procedures used for this determination and the composition of the scrubber solution have been described in previous reports of this series (HW-20136 & HW-21214). Table VI summarizes the results of these measurements for the period October, November, and December, 1951. (Please refer to Table VI on following page.)

TABLE VI

AVERAGE ACTIVITY DENSITY OF I-131 DETECTED IN SCRUBBERS

OCTOBER, NOVEMBER, DECEMBER

1951

Location	Activity Density x 10^{12} µc/cc			Quarterly Average	Maximum Weekly
	October	November	December		
200 Areas & Vicinity	6.3	0.6	0.8	2.9	15.8
200 East Southeast	34.0	3.4	1.3	13.7	480.3
200 East Tower #16	7.5	1.2	3.0	4.2	19.9
200 West Gatehouse	1.8	0.5	0.3	0.3	4.9
Gable Mountain	*	0.1	0.2	0.2	0.3
Redox Area					
Outlying Locations					
100-H Area	0.4	0.2	0.2	0.3	0.8
300 Area	0.2	0.1	0.1	0.1	0.5
Richland	1.1	0.6	0.1	0.7	2.1
North Richland	1.2	0.1	0.3	0.6	2.1
Benton City	0.7	0.1	0.1	0.3	2.2
Pasco	*	<0.1	<0.1	<0.1	0.1
Kennewick	4.4	0.3	<0.1	1.1	8.4

* Monitoring facilities were established at these locations during November.

The average activity density from I-131 showed a significant decrease on the order of a factor of 10 compared to the three-month average of the previous quarter. This decrease was a direct result of a significant reduction in the amount of I-131 admitted to the atmosphere from the separation area process. (See Section I.) The decrease was very pronounced during November when the average specific activity density decreased by a factor of from 7 to 10 at area locations and factors of 2 to 5 at the residential communities near the plant.

Maximum aerosol concentrations of I-131 at ground level was spot checked by obtaining portable hand scrubber samples at locations where the stack effluent contacted the surface. Samples obtained in this manner during October showed the mean activity density to be 4.7×10^{-9} µc/cc with maximum measurements on the order of 6.2×10^{-9} µc/cc. With the exception of one or two isolated cases, portable hand scrubber samples obtained during November and December indicated negligible activity from I-131.

Portable mobile equipment was used on several occasions to obtain 30-minute

air samples which were subsequently analyzed for I-131. Such samples collected during October showed values of 1.2×10^{-10} and 3.6×10^{-11} μc/cc. Again, the magnitude of these measurements represented a significant decrease from values obtained during the previous 5 months, at which time, portable scrubber monitoring showed I-131 concentrations on the order of 10^{-8} and 10^{-9} μc/cc predominating near the separation areas.

Particulate contamination in the environs was measured by exposing air filters to Type K X-ray film for a period of one week and then counting the number of darkened spots on the developed film. Air flows through the filter were 2.5 and 10 cfm; the higher volumes were used at remote locations at Washington, Oregon, Idaho, and Montana to increase the sensitivity of this type of measurement. Particle filters removed from Hanford Works locations were usually filmed during the same week that they were removed; filters removed from remote locations were filmed one week after removal from the station. Table VII and VIII summarize the results obtained from the radioactive particle monitoring program during October, November, and December, 1951. (Please refer to Table VII and VIII on following pages.)

Due to the interval of two to three weeks required to transmit filters, expose them to radioautograph, develop the film, and analyze the results, the monthly averages tabulated in Tables VII and VIII represent measurements which cover the period from about the 15th of the previous month to the 15th day of the indicated month.

The particle concentrations in the atmosphere measured during the current three-month period showed a significant increase compared with similiar measurements during the previous quarter. This increase was the greatest noted over a three-month interval since the inception of this type of monitoring in the Regional Survey Program. The over-all increase was attributed to the 7 atomic bombs

TABLE VII
SUMMARY OF PARTICLE DEPOSITION
OCTOBER, NOVEMBER, DECEMBER
1951

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

Location	Total Volume of air sampled m^3	October	November	December	Fourth Quarter Averages 1951	Third Quarter Averages 1951
200 East & Vicinity						
2704 Outside	9174	53.0	320.0	230.0	210.0	19.0
H. I. Garden	8550	160.0	280.0	160.0	210.0	43.0
BY-SE	9176	510.0	1040.0	530.0	870.0	170.0
BY-NE	9171	87.0	520.0	380.0	340.0	18.0
"B" Gate	8900	81.0	320.0	300.0	240.0	49.0
222-B Outside	3300	290.0	450.0	210.0	330.0	92.0
2701 Outside	8318	100.0	1020.0	580.0	650.0	30.0
2704 Inside	9176	75.0	270.0	330.0	230.0	28.0
221-B	7224	28.0	330.0	380.0	250.0	35.0
222-B Hall	9179	160.0	320.0	260.0	250.0	180.0
222-B Lab.	6653	1280.0	1830.0	1170.0	1360.0	1200.0
2701 Inside	9098	57.0	410.0	310.0	270.0	38.0
200 West & Vicinity						
2701 Outside	9170	110.0	300.0	320.0	250.0	170.0
2722	9064	210.0	380.0	220.0	280.0	100.0
"T" Gate	9107	130.0	390.0	440.0	330.0	82.0
222-T Outside	8981	150.0	390.0	270.0	380.0	220.0
231	9165	79.0	420.0	290.0	280.0	54.0
South Guard Tower	4440	<5.5	190.0	200.0	190.0	28.0
West Guard Tower	8666	60.0	290.0	240.0	210.0	25.0
2701 Inside	9164	110.0	300.0	340.0	250.0	120.0
272	9165	120.0	320.0	210.0	230.0	50.0
222-T Hall	9166	190.0	290.0	360.0	280.0	200.0
222-T Lab.	9174	880.0	1280.0	1260.0	1150.0	840.0
Meteorology Tower						
3'	35955	33.0	340.0	150.0	190.0	13.0
50'	33099	37.0	290.0	130.0	160.0	14.0
100'	28553	17.0	270.0	220.0	180.0	15.0
150'	24954	44.0	360.0	180.0	210.0	24.0
200'	23052	33.0	370.0	190.0	220.0	30.0
250'	23051	38.0	350.0	150.0	200.0	19.0
300'	21362	40.0	310.0	160.0	190.0	18.0
350'	19675	31.0	310.0	120.0	170.0	20.0
400'	13401	62.0	460.0	320.0	300.0	24.0

TABLE VIII
SUMMARY OF PARTICLE DEPOSITION
OCTOBER, NOVEMBER, DECEMBER
1951

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

Location	Total Volume of air sampled m^3	October	November	December	Fourth Quarter Averages 1951	Third Quarter Averages 1951
Area Locations						
100-B Area	36397	45.0	490.0	310.0	300.0	10.0
100-D Area	31637	4.1	240.0	160.0	160.0	2.6
White Bluffs	33565	2.2	130.0	190.0	130.0	6.1
100-F Area	35970	39.0	280.0	180.0	180.0	12.0
300 Area	36125	72.0	680.0	460.0	420.0	8.6
Hanford 101 Bldg.	29750	0.5	600.0	410.0	450.0	4.8
Off-Area Locations						
Benton City, Wash.	36533	0.2	230.0	170.0	140.0	6.7
Pasco, Wash.	36601	1.6	330.0	210.0	190.0	9.3
Richland	34927	0.5	700.0	400.0	400.0	5.4
Boise, Idaho	29631	0.2	470.0	760.0	430.0	22.0
Klamath Falls, Ore.	9594	40.4	1260.0	330.0	570.0	17.0
Great Falls, Mont.	9382	0.4	640.0	1270.0	620.0	4.5
Walla Walla, Wash.	9268	4.0	580.0	260.0	310.0	13.0
Meacham, Ore.	9146	3.5	410.0	690.0	370.0	17.0
Lewiston, Idaho	9285	3.5	910.0	940.0	640.0	14.0
Spokane, Wash.	36720	0.4	600.0	600.0	420.0	6.1
Kennewick, Wash.	23103	**	200.0	330.0	250.0	***
Yakima, Wash.	27710	2.8	200.0	170.0	150.0	***

** Data deleted, electrical difficulties.
*** New Installations.

exploded during the Nevada tests between the latter part of October and late November. A substantial increase in particulate contamination was also noticed prior to the first Nevada explosion and was attributed to a nuclear explosion at a foreign source; maximum particle concentrations measured from the latter explosion were 8.3 p/m^3 at Klamath Falls, Oregon on October 6. This value represented the highest measurement obtained from this type of monitoring during the past several years. Particulate contamination decreased rapidly after October 14 and remained at lower values through October 21, after which date significant

increases were noted immediately following each of the Nevada explosions. In general, particulate contamination remained at higher levels throughout the balance of the period with some indication of small decreases occurring after December 5.

Daily monitoring was established at eight stations during the three-month period for the purpose of determining the exact date of maximum particle concentration from the Nevada explosions. In general, each of the explosions were detected in the Pacific Northwest from 2 to 5 days after the detonation. In extreme cases, particulate contamination over one day periods ranged from 6 to 10 p/m^3. As indicated in Table VIII, the number of particles measured in several remote locations such as Boise and Lewiston, Idaho, and Great Falls, Montana far exceeded concentrations measured at locations at the Hanford Works. These measurements along with statistical comparisons between stations using daily and collective data indicated that the higher particle deposition measured during this period was due to sources other than the Hanford Works. Detailed tabular summaries showing the day to day trend of particulate contamination at the eight stations which were operated on a daily basis may be referred to in an associated document (HW-23517).

Graphs showing the results obtained from absorption and decay studies on particles collected during this period may also be referred to in HW-23517.

The activity density from alpha emitters in the atmosphere was determined by counting the filters obtained from monitoring locations listed in Tables IV and V. Standard alpha counters were employed and the techniques followed standard procedures used in the control Laboratory.(HW-20136). Table IX summarizes the results from these measurements for this period. (Please refer to Table IX on following page.)

Trace alpha emission was detected at all locations in the immediate environs

TABLE IX
AIR FILTER MONITORS
OCTOBER, NOVEMBER, DECEMBER
1951

Alpha Emitters - Activity Density x 10^{-15} μc/cc

Location	Number Samples	Maximum	Average
200 East Southeast	13	15	4
200 West, Tower #4	13	42	10
200 East Semi-Works	13	32	32
200 East, Tower #16	13	11	5
Gable Mountain	13	23	7
Richland	11	37	10
Pasco	13	15	6
300 Area	13	34	9
100-D Area	13	31	12
200 West Gate	11	142	43
Benton City	13	11	<4
Hanford 614 Building	13	5	<4
White Bluffs	13	13	4
North Richland North	13	6	4
200 West Redox Area	13	11	5
100-H Area	13	64	14
Hanford 101 Building	12	9	4
Riverland	13	6	<4
Kennewick	9	31	9
200 East Tower #15	12	17	7
Meteorology Tower Ground Level	13	74	24
Meteorology Tower 200' Level	13	9	4
Meteorology Tower 400' Level	13	41	5
Dual Monitoring Units:			
200 West East Center #1	13	62	28
200 West East Center #2	13	256	35
200 East Southeast #1	13	16	6
200 East Southeast #2	13	20	6
200 East 2707 E.A Bldg. #1	2	27	16
200 East 2707 E.A Bldg. #2	2	26	17
200 East East Center #1	13	18	5
200 East East Center #2	13	18	7
Richland #1	10	9	<4
Richland #2	10	14	<4

during some portion of the three-month period. The average activity density from this source barely exceeded the detection limit of the measurement at locations which were removed from the immediate vicinity of the separation areas. Maximum measurements on the order of 1.0 to 2.5 x 10^{-13} μc/cc at the 200 West Area Gatehouse were consistent with previous results. Average activity at this

same location ranged from 2 to 4 x 10^{-14} μc/cc. It is interesting to note that maximum measurements for this type of monitoring were found at the same location that showed maximum deposition from I-131 on vegetation and maximum concentrations from I-131 in the atmosphere.

SECTION III

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES

Radioactive contamination in Hanford wastes was determined by analyzing liquid and solid samples, taken daily or weekly, as conditions warrant, from the open waste areas in the 100, 200, and 300 Areas. These samples were analyzed for the activity density of gross beta and alpha particle emitters and were spot checked for uranium and plutonium. Analytical methods followed standard control laboratory procedures (HW-20136, HW-22682, and HW-23769). The measurements from these samples were supplemented by field surveys using portable instruments such as VGM's and CP meters. Summaries of the results obtained from this program in each of the Hanford Works Operating Areas follows.

100 Area Wastes: Three-hundred and eighty-six samples were obtained from the outlet side of the 107 retention basins in the 5 reactor areas during the quarter to determine the amount of alpha and beta particle emitters admitted to the Columbia River in the pile cooling water. A summary of these results is presented in Table I; the tabulation includes only those samples analyzed within 16 hours of sampling and which were obtained while the piles were operating at normal power levels.

TABLE I
RADIOACTIVE CONTAMINATION IN THE 107 BASINS
DURING PERIODS OF NORMAL PILE OPERATION
OCTOBER, NOVEMBER, DECEMBER
1951

Location	No. Samples	Alpha Emitters Average Activity Density 10^9 uc/cc	Beta Emitters Activity Density x 10^3 uc/cc	
			Maximum	Average
100-B Area	77	<5.	8.9	1.5
100-D Area	78	<5.	3.6	1.4
100-DR Area	81	<5.	2.6	1.9
100-F Area	65	<5.	2.3	1.3
100-H Area	85	<5.	4.3	1.4

In general, the mean activity density from beta emitters showed a slight increase at all pile areas. The operation of the piles at somewhat higher levels during short intervals throughout the quarter may have contributed to the apparent

increase in the activity from beta emitters in the effluent water.

Although the average activity density from alpha emitters averaged less than 5×10^{-9} μc/cc at all areas, several individual samples indicated trace activity on the order of 1.0 to 1.5×10^{-8} μc/cc. These positive measurements were randomly dispersed and were not confirmed by subsequent samples. Direct sampling of the Columbia River at downstream locations did not confirm the presence of alpha emitters in the effluent water.

Two-hundred fifty-one samples of effluent water were analyzed for uranium. The majority of these samples indicated less than 2 μg U/liter; the maximum result was 5.5 μg U/liter. The amount of Pu was less than the detectable limit of the analysis in checks of the majority of these samples.

Portable instrument surveys in the burning grounds of the 100 Areas indicated trace contamination in several instances. Counting rates as determined from a VGM were on the order of 1,000 to 6,000 c/m above background on material such as laboratory glass ware and masks. Except for these isolated cases, the contamination level in these areas was well within the range of natural background.

Composite samples were obtained daily from the sump in the Biology Farm waste discharge line at the 100-F Area. These samples were analyzed for I-131 according to standard laboratory techniques. The average amount of I-131 in this waste was 3.3×10^{-6} μc/cc with maximum measurements of 2.0×10^{-5} μc/cc. The samples obtained during the month of October were approximately 25% higher than those obtained during November and December. The amount of I-131 discharged to the river daily throughout the quarter averaged 0.2 mc as determined from the concentration and the metered volume of water. This value is comparable to values of the previous quarter.

Twenty-eight samples were collected near the Hanford Ferry to determine if the I-131 discharged at the Biology Farm could be detected in the Columbia River. The amount of I-131 in these samples averaged 1.2×10^{-7} μc/cc with maximum

measurements on the order of 9×10^{-7} μc/cc. Although these values appeared somewhat lower than those of the previous quarter, statistical comparison did not indicate a significant decrease.

200 Area Wastes: A summary of the results obtained from analyzing liquid and solid samples obtained at 200 area waste sources for contamination by gross alpha and beta particle emitters is presented in Table II.

TABLE II
RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS
OCTOBER, NOVEMBER, DECEMBER
1951

LIQUID SAMPLES

Location	No. Samples	Alpha Emitters Activity Density x 10^8 μc/cc		Beta Emitters Activity Density x 10^7 μc/cc	
		Maximum	Average	Maximum	Average
T Swamp	38	5.5	<0.5	9.6	3.8
U Swamp	26	2.8	0.8	2.8	1.0
Laundry Ditch	26	22.0	3.1	61.0	7.7
231 Ditch	26	220.0	10.0	5.8	2.4
200 E "B" Ditch	39	1.8	<0.5	51.0	12.0
200 E "B" Swamp	26	1.6	<0.5	35.0	10.0
234-35 Ditch	13	13.0	1.9	3.9	1.8
200 E Retention Pond	52	<0.5	<0.5	57.0	16.0
200 W Retention Pond	48	2.0	<0.5	15.0	5.2
234 Retention Pond	10	76.0	25.0	-	-
Redox Swamp	11	<0.5	<0.5	4.0	1.5

SOLID SAMPLES

		Activity Density x 10^6 μc/gm		Activity Density x 10^5 μc/gm	
T Swamp	26	26.0	2.1	130.0	15.0
Laundry Ditch	13	28.0	13.0	67.0	19.0
200 E "B" Ditch	36	7.1	<2.0	1500.0	200.0
200 E "B" Swamp	24	7.0	<2.0	280.0	80.0
234-35 Ditch	13	220.0	97.0	12.0	4.7
Redox Swamp	11	<2.0	<2.0	3.9	2.9

In general, the amount of activity found at sources summarized in Table II was well within the range of values expected at these locations and were not indicative of a significant trend when compared to similar measurements obtained during 1951.

Nearly all samples obtained from 200 Area waste sources were analyzed for uranium by a flourescence method. The only location consistently indicating uranium was the laundry ditch which showed an average of 9 μg U/liter of H_2O including maximum values of 64 μg U/liter. Mud samples obtained at the waters edge in the laundry ditch showed an average of 10 μg U/gram including a maximum of 23 μg U/gram. Five to 10 ug U/gm of uranium were found in isolated samples from the T and U Swamps and from the 234-35 and 231 ditches.

Samples of mud collected near the 234-35 pipe outlet showed small amounts of plutonium on the order of 10^{-6} μc/gm during the month of October; one sample collected during November contained 1.5×10^{-4} μc/gm. Samples from other waste sources in the 200 Areas showed negligible activity from plutonium.

Portable instrument surveys at the ditches and swamps in the 200 West Area showed maximum readings near the inlet of the T Swamp; readings ranged from 300 to 500 c/m above background during most of the period, however, during the middle of December, two surveys showed values approaching 1,000 c/m. Instrument readings at other locations showed the radiation level to be less than 300 c/m above background throughout the three-month period. Similiar surveys in the 200 East Area showed readings ranging from 4,000 to 6,000 c/m over mud along the waste ditch leading to the "B" Swamp.

Portable instrument surveys over the open terrain in the 200 Areas showed average readings in the range of 100 to 300 c/m above background. Isolated locations in the burning ground showed readings approaching 1,000 c/m above background in several instances.

The maximum radiation level detected near open waste at the 200 North Area was 19 mrep/hr including 12 mr/hr at the inlet of the "P" Ditch. Radiation levels were less than 6 mr/hr at the inlet of the "N" and "R" Ditches and at all other locations around the perimeter of the swamps into which the "N", "P", and "R" ditches flow.

300 AREA WASTES: Table III summarizes the results obtained from the analysis of samples from 300 Area waste sources during the period October, November, and December.

TABLE III
RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
OCTOBER, NOVEMBER, DECEMBER
1951

Location	No. Samples	Beta Emitters Activity Density x 10^7 μc/cc		Alpha Emitters Activity Density x 10^8 μc/cc		Fluorophotometer μg U/liter	
		Maximum	Average	Maximum	Average	Maximum	Average
Old Pond Inlet Liquid	6	4.5	2.1	87	50	1300	870
New Pond Inlet Liquid	10	8.0	3.2	150	66	2300	850
300 Area Waste Line	60	46	6.6	1800	104	3600	730
		Activity Density x 10^3 μc/gram		Activity Density x 10^6 μc/gram		μg U/gram	
Old Pond Inlet Solid	6	<1	<1	69	30	120	33
New Pond Inlet Solid	2	<1	<1	800	320	48	72

As in the past, significant quantities of uranium were found in all waste sources at the 300 Area. A wide variation in the amount of uranium in individual samples from the pond was associated with the locations around the pond from which the samples were taken (HW-21566). The day to day change in amount of uranium admitted to the pond was evaluated from samples taken directly from the 300 Area waste line; values ranged from negligible amounts up to 3600 μg U/liter with an overall average of 730 μg U/liter of water. Forty-seven of the samples obtained from the waste line were analyzed for plutonium by the La F_3 method. The average of these samples showed 4.5×10^{-9} μc/cc including a maximum measurement of 7.2×10^{-8} μc/cc.

SECTION IV

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

The amount and extent of radioactive contamination in the Columbia River was determined by analyzing nearly 400 samples of river water collected from representative locations during the period October, November, December, 1951. These samples were analyzed by radiochemical methods (HW-20136) for the activity density from alpha and beta particle emitters. The subsequent counting rates were corrected for decay, geometry and volume by applying standard corrections used for this type of measurement, (HW-22682). Samples were obtained on a weekly frequency from control locations and daily samples were obtained from the region of higher contamination along the south bank of the Columbia River near the Hanford Ferry. Background evaluations were determined from samples obtained from the Columbia River above the 100-B area, and the Yakima and Snake Rivers.

The flow rate of the river over the three-month interval was relatively constant, averaging 596,000 gallons per second. Maximum flow was 680,000 gallons per second measured on October 25 and minimum flow was 458,000 gallons per second measured on December 26. These flow rates are significantly lower than the peak flow of 2,655,000 gallons per second measured during the previous quarter. (Figure 6 shows the trend of the measured flow rate over the six month period). The resulting lower dilution ratio of river water to pile effluent water yielded an over-all increase in the specific activity density from gross beta emitters in the Columbia River.

Table I summarizes the results obtained from the radiochemical analysis for the activity density from gross beta emitters in the Columbia River during this period.

TABLE I
AVERAGE ACTIVITY DENSITY OF GROSS BETA EMITTERS
IN THE COLUMBIA RIVER
OCTOBER, NOVEMBER, DECEMBER
1951

Activity Density x 10^8
μc/cc

Location	October Average	November Average	December Average	Quarter Average	Last Quarter Average	Maximum Measurement This Quarter
Wills Ranch	<5	<5	<5	<5	<5	9
100-B 181 Bldg.	<5	<5	<5	<5	<5	12
Allard Pumping Station	100	130	97	110	6	310
100-D 181 Bldg.	120	220	170	170	30	280
100-H 181 Bldg.	230	280	250	250	89	440
Below 100-H	790	550	480	610	200	1500
100-F 181 Bldg.	500	410	780	540	270	1100
Below 100-F	430	470	730	520	210	890
Hanford South Bank	550	560	550	550	380	960
Hanford Middle	430	580	490	490	220	790
Hanford North Bank	360	210	270	280	120	640
300 Area	210	270	360	280	170	640
Richland	220	280	250	250	110	340
Higher Pumping Station	170	210	210	190	110	240
Pasco-Kennewick Bridge						
Kennewick Side	160	140	180	160	86	240
Pasco Side	160	150	230	180	69	260
Sacajawea Park	110	100	130	110	43	210
Snake River Mouth	<5	<5	<5	<5	<5	9
McNary Dam	61	60	40	52	33	100
Peterson	40	40	34	38	25	57
Yakima River Mouth	<5	<5	<5	<5	<5	<5

A review of the above data indicates that the increase in activity density from beta particle emitters was on the order of a factor of 2 to 3 in most portions of the river, however, results obtained from remote sample points at McNary Dam and the Patterson Ferry showed this increase to be slightly less than by a factor of 2. A comparison of the data on a month to month basis for a given location shows very little change or trend occurring during the period; negligible variation was expected during this period because the flow rate showed very little fluctuation. The values summarized above were generally higher than those measured during the same three-month period in 1950; this increase was associated

with an overall increase in the mean power level at which the 5 pile areas were operated at during the current period. The two maximum measurements obtained below the 100-H Area and at the 181-F Building (1.5 and 1.1 x 10^{-5} μc/cc) represent some of the highest values obtained from this type of monitoring during the year 1951.

Samples obtained from Wills Ranch which is located above the Hanford Works pile areas indicate that the background or naturally occurring activity from beta emitters in the Columbia River was below the detection limit of this type of measurement (less than 5 x 10^{-8} μc/cc). These results were not significantly different than those obtained from the analysis of samples which were collected at the mouth of the Yakima and Snake Rivers.

Radiochemical analysis of samples obtained from the locations summarized in Table I for the specific activity density of alpha particle emitters showed that the average from this source was less than 5 x 10^{-9} μc/cc at all locations. Trace activity from alpha particle emitters on the order of 5 x 10^{-9} μc/cc to 1.0 x 10^{-8} μc/cc was detected in several individual samples, however, the results were not confirmed by subsequent resample or by samples obtained from downstream locations.

The second of a series of three seasonal studies to determine the dispersion pattern of radioactive wastes in the Columbia River was completed during the quarter; this study represented a joint effort between the Regional Survey Group and the Environmental Hazards and General Studies Unit. A detailed presentation of the results obtained from the dispersion studies along with graphs showing the estimated velocity and activity distribution at representative locations along the Columbia River may be referred to in an associated publication (HW-22851).

Three large volume samples were obtained from Bonneville Dam during the quarter. Radiochemical analysis of these samples indicated that the activity density from gross beta emitters was less than 5 x 10^{-8} μc/cc and the activity

density from alpha emitters less than 5 x 10^{-9} μc/cc. All individual measurements were below the detection limit for this type of measurement.

Mud samples were collected weekly from 15 control stations along the river. Seven of these locations were inside the Hanford Works perimeter and 8 locations were downstream from the Hanford Works. Two samples were obtained at each project location; one sample was taken directly from the waters edge and the remaining sample was obtained from a location approximately 5 feet from the shore line. The results obtained from the alpha particle measurement showed negligible activity; Table II summarizes the results obtained from the measurement for the specific activity density from gross beta particle emitters.

TABLE II
RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES
OCTOBER, NOVEMBER, DECEMBER
1951

Location	Beta Emitters - Activity Density x 10^{-5} μc/gram					
	October Average	November Average	December Average	Quarter Average	Last Quarter Average	Maximum This Quarter
Wills Ranch, shore	3.0	3.7	3.7	3.4	3.5	5.6
5' out	3.1	3.0	3.5	3.7	2.9	4.1
Allard Pumping Sta., shore	2.0	6.3	6.0	5.5	3.2	15.6
5' out	1.5	4.7	3.1	3.7	3.2	9.2
100-H Area, shore	6.8	5.5	8.1	6.7	3.0	13.7
5' out	3.6	9.9	8.3	7.2	4.7	16.2
Below 100-F Area, shore	19.0	7.1	8.2	11.5	6.0	31.8
5' out	9.6	8.7	9.9	9.4	7.4	19.7
Richland Dock, shore	8.6	8.0	3.9	7.0	5.8	23.1
5' out	9.0	6.9	5.7	7.4	6.9	16.8
300 Area, shore	2.5	4.5	2.5	3.0	4.6	6.7
5' out	5.1	3.9	2.6	4.2	4.2	8.1
Pasco Bridge (Pasco side)	4.6	3.4	1.9	3.6	4.3	6.0
5' out	4.8	3.7	4.1	4.2	3.9	6.9
Pasco Bridge (Kenn. side)	2.5	4.9	4.0	3.8	3.7	11.8
5' out	8.5	3.3	4.6	5.6	3.5	20.4
Hanford Ferry, shore	12.0	5.8	7.0	8.8	5.4	26.8
5' out	6.9	4.9	5.7	6.0	9.0	14.1
Highland Pumping Sta., shore	7.7	4.6	4.2	5.4	3.5	17.8
5' out	7.0	5.7	6.1	6.4	4.5	10.6
Byers Landing	6.7	-	3.3	5.0	4.8	6.8
Sacajawea Park 5' out	6.0	20.1	8.7	10.8	8.6	23.1
McNary Dam, 5' out	4.6	2.4	3.9	3.6	3.0	7.1
Patterson, 5' out	2.8	2.7	3.3	2.9	4.3	4.0
Snake River Mouth 5' out	4.5	3.8	3.1	3.9	4.1	10.9

The values summarized in Table II are not significantly different from the results obtained during the previous quarter. Analysis of the data does not indicate any trend as the sampling progresses downstream and does not show any trend when comparing the results from any given location on a month to month basis. Average measurements which exceeded 1.0×10^{-4} μc/gm were generally weighted by one high result.

Spot samples from each of the locations indicated in Table II were analyzed for uranium. The activity from this source was below the detection limit of the analyses in all cases.

The specific activity density from gross beta particle emitters in mud samples obtained at the base of Bonneville Dam averaged 2.2×10^{-5} μc/gm with a maximum measurement of 3.3×10^{-5} μc/gm; the activity density from alpha particle emitters in these same samples was less than 5×10^{-6} μc/gm in each sample analyzed.

About 150 samples were obtained from the raw wtaer - river export line at the Hanford Works operating areas during the quarter. These samples represented water pumped from the Columbia River to the areas for drinking purposes which has not been purified and chlorinated at the consuming area. A summary of the results obtained from the measurement for the activity density from gross beta emitters in this water is presented in Table III. (Please refer to Table III on following page.)

The general increase in the activity density as indicated in Table III was expected during this period and was attributed to the significant increase in the activity density of the Columbia River. As in the past, the maximum activity was detected at the two operating areas located farthest downstream (100-H and 100-F), opposite that portion of the Columbia River in which the highest contamination is detected.

TABLE III

RADIOACTIVE CONTAMINATION IN RAW WATER - RIVER EXPORT LINE

OCTOBER, NOVEMBER, DECEMBER

1951

BETA EMITTERS - ACTIVITY DENSITY x 10^8 μc/cc

Location	October Average	November Average	December Average	Quarter Average	Last Quarter Average	Maximum This Quarter
183 Building, 100-B Area	<5	<5	<5	<5	<5	<5
183 Building, 100-D Area	21	39	32	30	6	79
183 Building, 100-DR Area	51	19	22	26	11	92
183 Building, 100-H Area	64	49	78	64	22	120
183 Building, 100-F Area	93	70	120	95	160	26
283 Building, 200 East Area	43	-	27	34	16	67
283 Building, 200 West Area	32	-	33	33	19	55

Radiochemical analysis for the activity density from gross alpha particle emitters in raw water supplies indicated negligible activity from this source (less than 5 x 10^{-9} μc/cc).

Weekly samples obtained directly from the raw water retention ponds in the 200 East and 200 West Areas showed that the average activity density from beta emitters at these locations was 3.5 and 3.3 x 10^{-7} μc/cc respectively. The maximum beta activity measured in the retention ponds was 6.5 x 10^{-7} μc/cc. The activity density from alpha emitters was below the detection limit of the analysis in all samples analyzed.

SECTION V

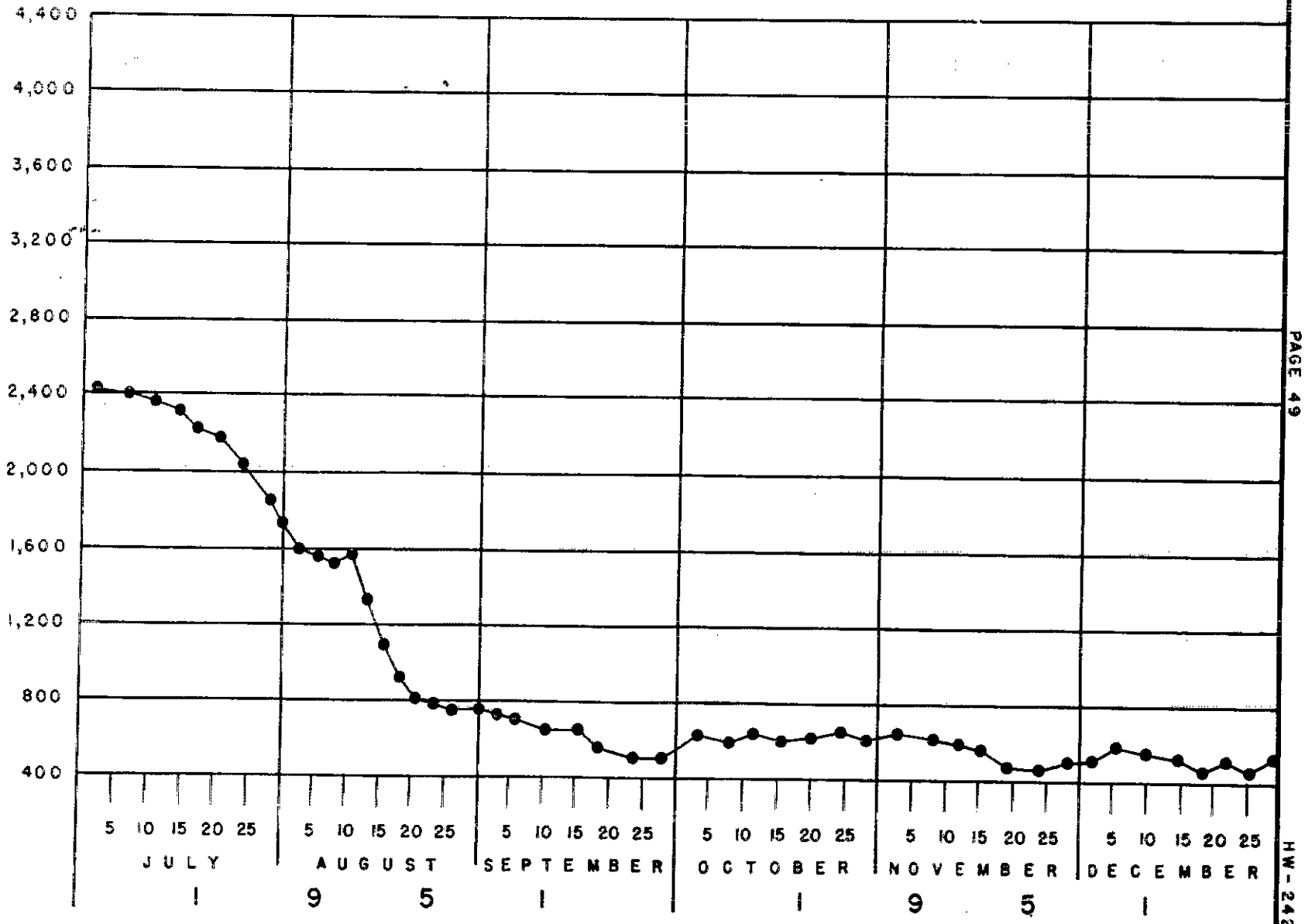
(Please refer to Figure 6)

COLUMBIA RIVER FLOW

OCTOBER - NOVEMBER - DECEMBER

1951

FIGURE — 6



SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN

Quantitative estimations of the activity density from gross beta emitters in rain-fall were determined by analyzing 228 samples collected from 27 locations on and adjacent to Hanford Works. Locations at which rain collectors were placed may be referred to in a map published in a previous document of this series, (HW-21214). Analytical procedures used for these analyses were identical to those used for all water samples at the control laboratory (HW-20136).

A summary of the rain-fall data for the period October, November, December for the years 1949 through 1951 as measured at the meteorology station near the 200 West Area is presented in Table I.

TABLE I
PRECIPITATION MEASURED AT HANFORD WORKS
OCTOBER, NOVEMBER, DECEMBER

units - inches

Year	October	November	December	Quarterly Total
1949	0.10	1.47	0.16	1.73
1950	2.46	0.55	0.97	3.98
1951	0.71	0.82	0.70	2.23

The total of 2.2 inches of rain during this period represented a significant increase over the amount of rain measured during the previous quarter (0.62 inches) and offered considerable opportunity to evaluate the magnitude of beta emitters brought to the earth during periods of precipitation. In general, the amount of rain-fall was consistent throughout the three months of the quarter and the number of activity measurements were, therefore, well distributed over the three-month period. Table II summarizes the results of these measurements during the quarter. (Please refer to Table II on the following page.)

A significant decrease in the activity density from beta emitters in rain occurred during this period. This decrease was on the order of a factor of 10 to 20 at stations within a 2 mile radius of the Separation Areas and in extreme

TABLE II

ACTIVITY DENSITY FROM GROSS BETA EMITTERS IN RAIN

OCTOBER, NOVEMBER, DECEMBER

1951

Location	No. Samples	Activity Density x 10^6 μc/cc Maximum	Average
In 200 East Area			
250' E of stack	11	22	5
2000' E of stack	10	28	5
750' SE of stack	10	30	9
3500' SE of stack	13	17	6
Summary	44	30	6
In 200 West Area			
1000' E of stack	7	22	7
7000' E of stack	7	39	14
8000' SE of stack	10	32	8
4900' SE of stack	6	17	5
Redox Area	9	3	1
Summary	39	39	7
100 Area Environs			
100-B SE	7	11	3
100-D SW	6	8	2
100-F SW	7	7	2
Hanford 614	8	4	1
Hanford 101	11	19	3
White Bluffs	9	7	2
100-H SE	7	3	1
Summary	55	19	2
Perimeter Locations			
Richland	10	7	2
Pasco H & R	7	3	1
Benton City	5	2	1
Riverland	7	2	1
North Richland	6	7	2
Summary	35	7	1
Intermediate Locations			
Route 4S, Mile 6	6	5	3
300 Area 614	7	3	1
200 North 614	8	16	3
Gable Mountain	8	6	3
Batch Plant	9	15	4
622 Building	17	42	4
Summary	55	42	3

cases approached a factor of 25 at monitoring locations in the nearby residential communities of Pasco, Richland, and Benton City. This decrease was associated

with the significant reduction in the amount of I-131 emitted from the Separation Area stacks (detailed tabulation in Section I). The maximum measurements summarized in Table II represented values obtained during the month of October when the amount of I-131 admitted to the atmosphere at the separation areas was about three times greater than that emitted during the months of November and December. A comparison of the average activity density from gross beta particle emitters in rain during this period in 1951, with similiar measurements obtained during the same three-month period in 1950, showed that current values for locations near the 200 Area were about 5 times lower than those measured during 1950. In residential areas, trace quantities of beta particle emitters were detected during the present period as compared with negligible activity (less than 1. x 10^{-6} $\mu c/cc$) measured at these locations during the year 1950.

Several periodic checks during the period to determine the activity density from alpha particle emitters in rain indicated negligible activity from this source. As the volume of the collected samples was generally below 100 ml., the sensitivity of the latter measurement was about 2 x 10^{-8} $\mu c/cc$.

SECTION VI

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

Over 1,000 samples of drinking water supplies and test wells were analyzed for the activity density from alpha and beta particle emitters during the period October, November, December, 1951. Sampling frequencies at the various sources varied from daily to monthly; the frequency at a given location was based on the possibility of contamination, the hazards involved, and the current trend of the results. All samples were analyzed at the control laboratory by standard procedures and techniques (HW-20136). The counting rates were corrected for counting efficiency, absorption, weight, and a process efficiency by factors normally used for this evaluation (HW-22682). Most drinking water supplies with detectable quantities of alpha emitters were also analyzed for uranium; all other water supplies were checked periodically for uranium.

A summary of the results obtained at locations were the activity density from alpha emitters averaged above the detectable limit of 5×10^{-9} μc/cc over the three month period is presented in Table I.

TABLE I
ACTIVITY DENSITY IN DRINKING WATER
OCTOBER, NOVEMBER, DECEMBER
1951
500 ml. samples

Location	No. Samples	Activity Density μc/cc x 10^8		No. Samples	Fluorophotometer μg U/cc x 10^3	
		Maximum	Average		Maximum	Average
Richland Well #13	13	5.7	0.8	13	7	3
Richland Well #15	11	2.8	0.6	11	14	6
Richland Well #18	12	3.5	0.7	12	6	4
Benton City Store	12	2.1	0.9	11	24	11
Benton City Water Co. Well	10	2.2	1.1	10	23	13
Cobb's Corner	13	3.8	0.7	12	5	2
Pasco Improvement Farm Well	2	0.9	0.6	-	-	-
Byers Landing	2	1.1	0.6	-	-	-

As in the past, the drinking water supplies in the Benton City and Richland region showed trace alpha activity throughout the period. All wells which

indicated this activity also showed trace quantities of uranium which presumably occurs naturally in the water table below the Benton City - Richland Area.

Nearly all drinking water supplies showed trace amounts of alpha particle emitters in one or more samples collected during the three-month period. Most of these individual measurements were in the range of from 5×10^{-9} μc/cc to 2.0×10^{-10} μc/cc. Except for one or two isolated cases, these positive measurements were not confirmed by resample and the mean activity over the three-month period was well below the detection limit for an individual measurement. Table II summarizes the results obtained from all wells which were sampled repetitively during the quarter.

TABLE II

SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES

500 ml. samples

OCTOBER, NOVEMBER, DECEMBER

1951

Location	Number Samples	Alpha Emitters Activity Density x 10^8 μc/cc		Beta Emitters Activity Density x 10^8 μc/cc	
		Maximum	Average	Maximum	Average
Richland Well #2	11	0.7	0.4	5	<1
Richland Well #4	58	1.1	0.4	4	<1
Richland Well #5	11	0.5	0.3	1	<1
Richland Well #12	13	0.7	0.4	<1	<1
Richland Well #13	13	5.7	0.8	2	<1
Richland Well #14	12	0.9	0.4	<1	<1
Richland Well #15	11	2.8	0.6	1	<1
Richland Well #18	12	3.5	0.7	1	<1
Tract House J-685	11	0.4	0.3	1	<1
3000 Area Well "A"	10	1.1	0.3	2	<1
3000 Area Well "B"	11	0.4	0.3	1	<1
3000 Area Well "C"	12	1.3	0.3	2	<1
3000 Area Well "D"	5	0.6	0.3	2	<1
3000 Area Well "E"	10	1.2	0.4	14	2
3000 Area Durand #5	11	0.7	0.4	2	<1
Columbia Field Well "A"	11	0.6	0.3	2	<1
Columbia Field Well "B"	8	0.6	0.3	1	<1
Columbia Field Well "C"	10	0.6	0.4	1	<1
Hanford Well #1	8	0.4	<0.2	3	<1
Hanford Well #4	8	0.2	<0.2	<1	<1
Hanford Well #7 (San.)	13	0.2	<0.2	<1	<1
Foster Well #2	5	<0.2	<0.2	2	<1
Headgate Well	10	0.9	0.3	<1	<1
1100 Area Well #8	13	0.3	<0.2	2	<1
Benton City Store	12	2.1	0.9	<1	<1
Benton City Water Co.	[illegible]	2.2	1.1	5	1

TABLE II (CON'T)

SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES

500 ml. samples

OCTOBER, NOVEMBER, DECEMBER

1951

Location	Number Samples	Alpha Emitters Activity Density x 10^8 μc/cc		Beta Emitters Activity Density x 10^8 μc/cc	
		Maximum	Average	Maximum	Average
Cobb's Corner	13	3.8	0.7	2	<1
Enterprise Well	12	0.9	0.2	5	<1
Kennewick Std. Station	13	0.8	<0.2	18	10
Riverland	13	0.4	<0.2	1	<1
Lower Knob	12	0.3	<0.2	1	<1
Wills Ranch	10	0.4	<0.2	3	<1
P-11 Well	12	1.1	0.3	1	<1
Pistol Range	12	0.6	0.2	1	<1
White Bluffs Ice House	11	0.6	0.3	24	7
300 Area Sanitary	23	0.5	0.2	1	<1
200 East Sanitary	7	0.4	0.3	26	13
200 West Sanitary	7	<0.2	<0.2	44	22
100-B Sanitary	13	0.3	<0.2	<1	<1
100-D Sanitary	12	0.3	<0.2	14	6
100-DR Sanitary	10	0.2	<0.2	18	8
100-F Sanitary	13	0.7	<0.2	61	30
100-H Sanitary	13	<0.2	<0.2	62	30
White Bluffs Tele. Exch.	6	0.6	0.3	7	4
Redox Administration Bldg.	10	1.9	0.2	8	3
291 Building Sanitary	11	0.5	0.2	28	5
Byers Landing	2	1.1	0.6	3	2
Pasco Sanitary	13	-	-	50	31
Pasco Improvement Farm	2	0.9	0.6	<1	<1
Sacajawea Park	12	0.6	0.4	1	<1
McNary Dam Sanitary	11	0.3	<0.2	9	4
Patterson Sanitary	12	0.7	0.3	<1	<1
Plymouth Sanitary	12	0.3	<0.2	<1	<1
Prosser Sanitary	12	0.3	<0.2	6	1

Nearly 200 large volume samples (11.7 L) were collected from water supplies containing questionable detectable amounts of alpha particle emitters. Analysis of the larger volume samples increased the sensitivity of the measurement to 2 x 10^{-10} μc/cc. Results obtained from these analyses are presented in Table III. (Please refer to Table III on the following page.)

In general, the average activity density from alpha particle emitters as measured by analyzing the large volume samples ranged from 1 to 3 x 10^{-9} μc/cc;

TABLE III

SUMMARY OF ALPHA EMITTERS MEASURED IN DRINKING WATER

12 liter samples

OCTOBER, NOVEMBER, DECEMBER

Activity Density x 10^{10}

$\mu c/cc$

1951

Location	Number Samples	Maximum	Average
Richland Well #2	7	46	32
Richland Well #4	6	40	30
Richland Well #5	3	22	13
Richland Well #12	4	60	25
Richland Well #13	6	29	10
Richland Well #14	4	44	35
Richland Well #15	7	64	33
Richland Well #18	8	30	13
Tract House J-685	4	13	5
3000 Area Well "A"	5	21	16
3000 Area Well "B"	5	16	14
3000 Area Well "C"	2	23	16
3000 Area Well "D"	3	14	12
3000 Area Well "E"	5	18	11
3000 Area Durand #5	5	19	9
Columbia Field Well "A"	5	13	8
Columbia Field Well "B"	5	19	8
Columbia Field Well "C"	5	19	10
Hanford Well #1	3	15	12
Hanford Well #4	3	18	12
Hanford Sanitary	4	4	2
Foster Well #1	1	7	7
3000 Area Pond Inlet	2	15	12
1100 Area #8	5	25	19
Benton City Store	5	46	15
Benton City Water Co. Well	5	144	113
Cobb's Corner	5	22	14
Enterprise Well	5	8	4
Kennewick Std. Station	5	13	9
Riverland	6	15	6
Midway	6	11	5
Wills Ranch	4	87	34
P-11 Well	5	18	13
Pistol Range	5	23	19
White Bluffs	4	47	22
251 Bldg. Sanitary	5	19	12

these values were consistent with those observed from similiar analyses during the year 1951. As in the past, the Richland Area (8 Richland Wells and 4 wells immediately adjacent to Richland) consistently showed trace alpha emission.

A check of the Benton City Water Company Well (1.1×10^{-8} uc/cc) gave results identical to those obtained from the 500 ml. samples.

Radiochemical analyses of all drinking water supply samples for the activity density from gross particle beta emitters showed the only contaminated supplies were those that obtained water directly from the Columbia River or were located immediately adjacent to the river. In general, these included the sanitary water supplies at each of the Hanford Works operating areas and the drinking water supplies at Pasco and Kennewick. Maximum activity was detected at the 100-F and 100-H Areas, and at Pasco; mean values at these locations were on the order of 3×10^{-7} μc/cc with maximum measurements in the range of 5 to 6×10^{-7} μc/cc. No detectable activity was found in the Richland Wells.

Weekly samples obtained from the various filtering media and backwash processes at the Pasco Filter Plant showed significant quantities of beta particle emitters in all samples collected. Maximum measurements were found in samples of backwash material which represented the first backwash step; the liquid portion of these samples showed an average of 3.3×10^{-6} μc/cc and the solid portion 3.6×10^{-2} μc/gm. General increases noted in the activity density in filter plant samples were associated with the increase in activity in the Columbia River. (See Section V.) The general efficiency of decontamination through the various treatment processes at the filter plant was reflected in the average activity density from beta emitters in water leaving the plant (3.1×10^{-7} μc/cc) which showed a two-fold increase during the quarter as compared with an average increase by about a factor of 4 in the activity in water entering the plant from the river.

Table IV summarizes the results obtained from analyzing samples obtained at the filter plant. (Please refer to Table IV on the following page.)

TABLE IV
PASCO FILTER PLANT MEASUREMENTS
OCTOBER, NOVEMBER, DECEMBER
1951

Type Sample	No. Samples	Activity Density Gross Beta Particle Emitters	
		Maximum	Average
Water Entering Plant From River	10	7.8×10^{-6} µc/cc	2.9×10^{-6} µc/cc
Sand (surface of sand filter	8	1.0×10^{-4} µc/gm	3.7×10^{-5} µc/gm
First Backwash Material (liquid)	11	8.3×10^{-6} µc/cc	3.3×10^{-6} µc/cc
First Backwash Material (solid)	12	5.6×10^{-2} µc/gm	3.6×10^{-2} µc/gm
Coal (surface of coal filter)	10	4.7×10^{-4} µc/gm	1.9×10^{-4} µc/gm
Water Leaving Plant	13	5.0×10^{-7} µc/cc	3.1×10^{-7} µc/cc

In addition to the wells used for drinking water, a large number of samples were obtained from various test wells located throughout the immediate environs of the Hanford Works. These samples were analyzed for the activity density from gross beta and alpha particle emitters according to standard laboratory procedures and techniques (HW-20136) and the subsequent counting rates were corrected by applying factors normally used for this calculation (HW-22682). Table V summarizes the results obtained from analyzing 500 ml. samples from test wells for all locations at which alpha or beta particle activity was detected during the period.

TABLE V
SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN TEST WELLS
500 ml. samples
OCTOBER, NOVEMBER, DECEMBER
1951

Location	Number Samples	Alpha Emitters Activity Density x 10^8 µc/cc		Activity Density x 10^8 µc/cc	
		Maximum	Average	Maximum	Average
300 Area Well #1	6	7.2	5.1	3	1
300 Area Well #2	7	12.9	8.6	2	<1
300 Area Well #3	18	4.3	2.5	5	<1
300 Area Well #4	9	37.1	20.9	13	4
300 Area North Well	10	440.8	348.7	42	16
By Well	13	0.7	0.2	3	<1
200 North Area Wells	7	0.3	<0.2	4	1
McGee Well	13	0.3	<0.2	2	<1
Meeker Well	13	0.3	<0.2	2	<1

The results summarized in Table V were not indicative of any significant trend or change compared to previous values for this period. In all cases, except locations inside the 300 Area, the measurements were not significantly positive. Large volume samples were obtained from some locations for increased sensitivity. Table VI summarizes the results obtained from these measurements for all locations at which positive values were obtained.

TABLE VI
ACTIVITY DENSITY IN TEST WELLS
OCTOBER, NOVEMBER, DECEMBER
1951
11.4 liter samples

Location	No. Samples	Activity Density x 10^{10} μc/cc Maximum	Average	No. Samples	Fluorophotometer μg U/liter Maximum	Average
BY Well	5	44	27	10	6	3
200 North Well #5	3	8	7	6	2	<2
Ford Ranch Well	6	7	2	11	<2	<2
Meeker Well	6	15	4	11	<2	<2

Forty-eight test wells, drilled by the Geology Group during the past several years, were incorporated into the Regional Survey monitoring program during the quarter. These wells are scattered throughout the Hanford Environs to determine activity dispersion patterns in the event that radioactive contamination from Hanford waste sources reaches the water table. Selected wells of this group are also used to determine the movement of the water table in this region. The latter measurement is performed by members of the Geology Group. The results obtained from preliminary measurements for the activity density from alpha and beta emitters in these wells indicate that this activity is below the detection limit of the measurement in all wells sampled during the period.

SECTION VII

H. J. Paas
Regional Survey-RADIOLOGICAL SCIENCES

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