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Radioactive Contamination in Liquid Wastes Discharged to Ground at Separation Facilities Thru June 1955

AUTHOR

H. J. Paas and K. R. Heid

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RADIOACTIVE CONTAMINATION IN LIQUID WASTES DISCHARGED TO GROUND AT SEPARATION FACILITIES THRU JUNE 1955

H. J. Paas and K. R. Heid
Radiological Administration and Communications Section
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* Alternate nomenclature 216 U #1 and 2 Cribs.



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ABSTRACT

Nearly 600,000 curies of fission products have been discharged to ground from separation facilities since the startup of the Hanford operation. Approximately 19 kilograms of plutonium were contained in this waste. Exclusive of open waste disposal sites, the estimated volume of waste admitted to ground was 4.6×10^9 liters.

Principally due to the TBP scavenging program (78,000 curies) and the large amounts of fission products in redistilled condensate from the redox process (250,000 curies), over 50% of the total fission product activity entered the ground during the fiscal year covered by this report.

Open waste disposal sites in the separation areas have received over 7×10^{10} liters since startup. Approximately 1500 curies of fission products and 22 grams of plutonium were contained in this waste. The redox and U swamps which contain 1050 curies of fission products and 16 grams of plutonium respectively, accounted for the bulk of contamination discharged to open waste sites.

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TABLE I

SUMMARY OF RADIOACTIVE WASTES DISCHARGED TO MAJOR
DISPOSAL SITES IN THE 200 EAST AREA THRU JUNE 1955

DISPOSAL SITE	VOLUME IN LITERS	PLUTONIUM GRAMS	BETA PARTICLE EMITTERS-CURIES
<u>"B" FACILITY</u>			
5-6 Crib and Tile Field*	3.60×10^7	174.	7,800.
216 ER #1,2,&3 Cribs	2.54×10^8	226.	453.
241 B #1 & 2 Cribs	4.38×10^7	4240.	5,180.
241 B #3 Crib	2.72×10^7	29.	710.
241 B - 361 Reverse Well	3.06×10^7	4280.	3,800.
241 BX Trenches #1,2,4, 5,6, & 7	8.99×10^6	4.75	7,800.
241 BX Trench #3	4.29×10^6	0.91	3,190.
241 BX Trench #8	1.51×10^6	**	4,800.
241 BY #1,2,&3 Cribs	1.26×10^7	22.0	77,700.
242 B #1 & 2 Cribs	2.96×10^7	3.73	38.9
B Swamp	1.70×10^{10}	1.44	10.5
<u>"C" FACILITY</u>			
216 C #1 Crib	1.85×10^7	2.52	733.
216 C #5 Crib	3.89×10^4	0.00	93.9

* Alternate nomenclature 241-B-361 Crib and Tile Field.

** Plutonium measurements were not made for this waste.

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TABLE II

SUMMARY OF RADIOACTIVE WASTES DISCHARGED TO MAJOR
DISPOSAL SITES IN THE 200 WEST AREA THRU JUNE 1955

DISPOSAL SITE	VOLUME IN LITERS	PLUTONIUM GRAMS	BETA PARTICLE EMITTERS-CURIES
<u>"S" FACILITY</u>			
216 S #1 & 2 Cribs	1.25 x 10 ⁸	657.	417,000.
216 S #3 Crib	3.98 x 10 ⁶	0.26	208.
216 S #5 Crib	2.60 x 10 ⁹	248.	657.
216 S #6 Crib	5.53 x 10 ⁸	76.7	228.
216 SL #1 & 2 Cribs	2.22 x 10 ⁸	51.1	189.
216 SX #1 Crib	1.43 x 10 ⁶	0.05	9.77
Redox Swamp	6.35 x 10 ⁹	3.27	1,050.
<u>"T" FACILITY</u>			
241 T #1 & 2 Cribs	2.90 x 10 ⁷	3720.	1,500.
241 T #3 Crib & TF	9.17 x 10 ⁷	120.	3,060.
241 T #1,2,3&4 Trenches	3.85 x 10 ⁶	2.66	3,300.
241 T #5 Trench	2.65 x 10 ⁶	175.	125.
241 T #17 Crib	9.68 x 10 ⁵	1.43	840.
241 T - 361A Reverse Well	1.13 x 10 ⁷	3350.	2,800.
241 TX #1,2,3&4 Trenches	5.03 x 10 ⁶	6.50	19,300.
241 TX #5 Trench	2.99 x 10 ⁶	0.60	14,200.
241 TX-153 Crib & Tile Field	3.50 x 10 ⁷	4.37	5.59
361 T #1 & 2 Cribs	4.50 x 10 ⁷	275.	15,000.
T Swamp	2.73 x 10 ¹⁰	2.05	83.3
<u>"U" FACILITY</u>			
216 U #3 Crib	7.50 x 10 ⁵	0.038	0.412
216 WR #1, 2 & 3 Cribs	2.16 x 10 ⁸	224.	379.
361 WR #1 & 2 Cribs	9.26 x 10 ⁶	37.6	947.
U Swamp	2.02 x 10 ¹⁰	16.1	377.
<u>"Z" FACILITY</u>			
231 #1 & 2 Cribs	3.08 x 10 ⁷	340.	
231 W Trench	4.12 x 10 ⁷	438.	
231 W-150 Reverse Well	1.00 x 10 ⁶	50.	
234-5 #1,2,3&4 Cribs	7.72 x 10 ⁷	573.	

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TABLE III

DISPOSAL SITE: 216 ER #1, #2 AND #3 CRIBS

WASTE STREAM: 221-224 U CONCENTRATOR CONDENSATE,
SEPTEMBER 1952 TO DATE

SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of kg.	Units of Grams	Units of Curies
July 1954	94.1	245.	1.16	10.9
August	115.	56.9	0.72	8.54
September	95.3	91.5	1.01	20.9
October	43.5	27.3	0.43	8.70
November	32.1	8.65	0.29	10.8
December	14.0	150.	2.17	0.79
January 1955	53.3	1,210.	40.3	4.10
February	54.8	1,660.	22.2	15.3
March	76.4	862.	1.09	56.3
April	93.0	161.	1.61	146.
May	56.7	318.	4.64	42.9
June	87.3	521.	6.80	35.8
TOTAL 7/54-6/55	816.	5,310.	82.4	361.
PREVIOUS TOTAL (2)	1,720.	10,300.	144.	92.0
TOTAL TO DATE	2,540.	15,600.	226.	453.

Isotopic analysis for ruthenium performed on weekly composite samples collected during April, May, and June showed values of 18.8, 2.68, and 13.4 curies, respectively.

TABLE IV

DISPOSAL SITE: 241 B #1 AND #2 CRIBS

WASTE STREAM: 224 B OCTOBER 2, 1946 TO MARCH 1953;
221 B 5-6 WASTE FROM OCTOBER 3, 1947 TO
AUGUST 12, 1948 AND DECEMBER 1954 TO
DATE

SETTLING FACILITY: 201 TANK OCTOBER 1946 TO OCTOBER 1948;
204-203-202 CASCADE FROM OCTOBER 1948
THRU MARCH 1953

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
October 1954**	1.77	0.06	0.26
December (3)	0.57	0.02	0.09
January 1955	0.00		
February	0.36	0.16	4.75
March	1.52	4.27	45.6
April	2.74	0.486	8.20
May	1.26	0.648	10.3
June	1.05	0.28	9.46
TOTAL 7/54-6/55	9.27	5.96	78.7
PREVIOUS TOTAL	429.(2)	4,230.(1)*	5,100.(1)*
TOTAL TO DATE	438.	4,240.	5,180.

* This value was partially calculated on the basis of amounts sent to the settling tank and may be an overestimate of the actual amount to ground; a review of previous disposal data by H. V. Clukey indicated that about 10% of the settling tank activity actually goes to cribs.

** Represents disposal of 224-B waste on October 21 - 25 via 202-B tank. (3)

TABLE V

DISPOSAL SITE: 241 BX TRENCHES 1, 2, 4, 5, 6, AND 7

WASTE STREAM: FIRST CYCLE SUPERNATANT TRENCHING FROM THE
110 BX, 111 BX, 112 BX, 106 BY AND 110 BY
TANKS

SETTLING FACILITY: TANKS AS INDICATED ABOVE

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TRENCH	VOLUME Units of 10 ⁵ L	UNITS OF GRAMS		UNITS OF CURIES				TANK NUMBER	DATE	
		Plutonium	Uranium	Gross Beta	Cesium	Strontium	Antimony		Filled	Emptied
BX 1	9.62	0.48	1,330.	500.	558.	1.8	26.	110 BX	1/26/50	2/18/54
BX 2	17.7	0.32	1,270.	1,030.	1,010.	6.2		111 BX	5/31/50	4/27/54
BX 4	15.0	1.20	45,000.	3,000.	6.3	1,850.		110 BY	7/52	7/17/54
BX 5	7.80	1.38	2,220.	905.	430.	11.7	21.	112 BX	12/6/51	12/1/53
BX 5	7.60	0.13	3,990.	350.	450.	0.38	44.	106 BY	3/29/51	11/1/54
BX 6	11.3	0.90	34,000.	1,040.	2.4	280.		110 BY	7/52	8/54
BX 6	5.86	0.10	3,080.	270.	350.	0.29	34.	106 BY	8/29/51	4/1/54
BX 7	15.1	0.24	7,940.	700.	890.	0.76	88.	106 BY	8/29/51	11/1/54
TOTAL	89.9	4.75	98,800.	7,800.	3,700.	2,150.	213.			

Although radiochemical analysis of samples from BX 1 showed no detectable quantities of ruthenium, samples from BX 5 (112 BX) indicated 210 curies of Ru were discharged in this waste. Cerium was not detected in waste sent to BX 1 but 94 curies were discharged to BX 5 (112 BX).

Discrepancies in the balance between gross beta particle emitters and the total of the activity contributed by individual isotopes in the above table were recognized in the analytical data and were associated with differences in sampling and analytical techniques.

TABLE VI

DISPOSAL SITE: 241 BX TRENCH #3

WASTE STREAM: FIRST CYCLE EVAPORATOR BOTTOMS
FROM TANKS 107 B, 108 B, AND 109 B

SETTLING FACILITY: TANKS AS INDICATED

VOLUME Units of 10 ⁵ L	UNITS OF GRAMS		UNITS OF CURIES			TANK NUMBER	DATE EMPTIED
	Plutonium	Uranium	Gross Beta	Cesium	Strontium		
12.1	0.05	1780.	992.	992.	9.0	107B	8/31/54
17.0	0.33	690.	1000.	952.	1.7	108B	9/54
13.8	0.53	1280.	1200.	1130.	5.1	109B	8/8/54
TOTAL 42.9	0.91	3750.	3190.	3070.	15.8		

TABLE VII

DISPOSAL SITE: 241 BX TRENCH #8

WASTE STREAM: TBP PRODUCTION SCAVENGED WASTE

SETTLING FACILITY: 110 BY TANK

The fourth tank of TBP scavenged waste sent to ground was directed to the 241 BX Trench #8 from the 110-BY tank. On February 18, 1955 pumping was completed; 1.51 x 10⁶ liters were disposed. A tank sample collected from 110 BY on January 18 and 23, 1955 showed that approximately 4800 curies of beta particle emitters were contained in the waste; isotopic analysis showed 96 curies of cesium and 1040 curies of strontium. Although no samples were collected directly from the trench, a review of the results obtained from analyzing other scavenged waste samples indicates that significant quantities of Ru, Sb, Ce, RE, and Zr-Nb were present.*

* Five tanks of TBP scavenged waste were sent to the BY Cries (See Table VIII).

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TABLE VIII

DISPOSAL SITE: 241 BY CRIBS #1, #2, AND #3

WASTE STREAM: TBP SCAVENGED WASTE

SETTLING FACILITY: TANKS AS INDICATED

TANK NUMBER	DATE EMPTIED	DISPOSAL SITE	VOLUME N ⁵ LITERS	Pu GRAMS	URANIUM kg.	UNITS OF CURIES								pH
						TOTAL B	Cs	Sr	Ru	Sb	Ce	RE	Zr-Nb	
1-110-BY	11-10-54	BY 1	21.1	0.40	12.5	3,140.	45.9	1,340.	48.2	15.0	314.	1,570.		9.7
2-107-BY	12-11-54	BY 2	15.7	0.48	1.64	5,880.	13.9	1,810.	407.	370.	798	2,350.	524.	8.9
3-108-BY	12-24-54	BY 2	15.2	0.11	0.41	3,560.	192.	332	440.	480.	1,400.	340.	356	9.0
5-107-BY	3-11-55	BY 2	25.3	10.5	0.32	12,100.	446.	670	4,560.	174.	1,010.	637.	1,140.	10.0
7-106-BY	4-11-55	BY 3	26.7	9.07	0.64	22,100.	410.	2,210.	5,510.	850.	4,450.	4,210.	3,560.	9.4
10-108-BY*	6-20-55	BY 3	22.4	1.44	4.71	30,900.	1,080.	582	11,200.	2,020.	6,500.	1,120.	4,480.	9.2
TOTAL			126.	22.0	20.2	77,700.	2,190.	6,940.	22,200.	3,910.	13,800.	10,200.	10,100.	

* Tabulated values were based on results of tank samples; the stream was not sampled at time of discharge.

Tank 4-110-BY was discharged to the 241 BX 8 trench.
Tanks having prefix 6, 8, and 9 were not sent to ground.

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TABLE IX

DISPOSAL SITE: 242 B #1 AND #2 CRIBS
 WASTE STREAM: 242-B WASTE EVAPORATOR CONDENSATE,
 DECEMBER 1951 TO NOVEMBER 1, 1954 (4)
 SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
1954	Units of 10 ⁵	Units of Grams	Units of Curies
July	10.2	0.077	0.63
August	7.86	0.060	2.58
September	8.96	0.090	0.48
October	8.12	0.047	0.29 ⁽⁴⁾
TOTAL 7, 54-6/55	35.1	0.27	3.98
PREVIOUS TOTAL (2)	261.	3.46	34.9
TOTAL TO DATE	296.	3.73	38.9

(4) This facility was shut down after run number B-10-E-36 during October 1954.

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TABLE X

DISPOSAL SITE: 216 C-1 CRIB

WASTE STREAM: CONDENSATE FROM 201-C FROM DECEMBER 1952
THRU APRIL 1954 AND FROM FEBRUARY 1955
TO DATE. COIL AND CONDENSER COOLING
WATER FROM 201-C FROM JUNE 1953 TO APRIL
1955 AND FROM FEBRUARY 1955 TO DATE.

SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	PLUTONIUM	BETA PARTICLE EMITTERS
1955	Units of 10 ⁵	Units of kg.	Units of Grams	Units of Curies
February	7.69	10.0		0.18
March	9.98	63.9		1.28*
April	9.05	162.		0.68
May	9.95	35.6		111.0
June	9.48	0.45	1.	292.
TOTAL 7/54-6/55	46.2	272.	1.	405.
PREVIOUS TOTAL **	139.0	16.5	1.52	328.
TOTAL TO DATE	185.	289.	2.52	733.

* No analyses for beta activity were performed during this period; results were estimated from samples representing adjacent months.

** Previous totals were obtained from letter G. C. Oberg to H. J. Paas June 14, 1955.

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TABLE XI

DISPOSAL SITE: 216 C-5 CRIB
WASTE STREAM: HIGH-SALT COLD-RUN WASTES FROM
201-C FROM MARCH 1955 TO DATE
SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	NaNO ₃	BETA PARTICLE EMITTERS
1955	Units of 10 ⁵	Units of kg.	Pounds	Units of Curies
March	.227	40.5	13,000.	54.8*
April	.043	11.9	6,130.	.032
May	.050	None	4,130.	12.1*
June	.069	0.45	745.	27.0
TOTAL 7/54-6/55	.389	52.9	24,000.	93.9
TOTAL TO DATE	.389	52.9	24,000.	93.9

* No analyses for beta activity were performed during this period; results were estimated from samples representing adjacent months.

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TABLE XII*

DISPOSAL SITE: 216 3 CRIBS #1 AND #2
 WASTE STREAM: 202-S BUILDING CELL DRAINAGE
 (D-1 WASTE) FROM JANUARY 1952
 TO DATE
 SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	0.46	0.3	32.
August	0.20	6.3	14.
September	0.40	17.8	42.
October	1.25	25.5	578.
November	1.55	9.7	284.
December	2.29	6.9	305.
January 1955	2.55	3.5	130.
February	1.07	1.8	55.
March	0.69	3.5	31.
April	0.24	0.17	22.6
May	0.17	0.59	18.8
June	0.04	0.01	0.06
TOTAL 7/54-6/55	10.9	76.1	1,510.
PREVIOUS TOTAL (2)	9.93	112.	18,500.
TOTAL TO DATE	20.8	188.	20,000.

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* Data for D-2 waste to same location is summarized in Table XIII.

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TABLE XIII*

DISPOSAL SITE: 216 S CRIBS #1 AND #2

WASTE STREAM: 202-S BUILDING REDISTILLED
CONDENSATE (D-2 WASTE) FROM
JANUARY 1952 TO DATE

SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	26.0	44.5	46,900.
August	38.8	47.7	50,500.
September	42.2	47.6	36,200.
October	41.3	19.0	4,400.
November	47.1	16.5	4,100.
December	53.1	28.1	46,700.
January 1955	14.7	71.9	30,300.
February	39.7	31.3	12,300.
March	48.6	6.20	2,500.
April	4.23	1.16	1,160.
May	49.8	5.46	7,730.
June	35.1	38.6	7,420.
TOTAL 7/54-6/55	441.	358.	250,000.
PREVIOUS TOTAL (2)	788.	111.	147,000.
TOTAL TO DATE	1,230.	469.	397,000.

188,800 ✓

62,000 ✓

* Data for D-1 waste to same location is summarized in Table XII.

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TABLE XIV

DISPOSAL SITE: 216 S-3 CRIB

WASTE STREAM: CONDENSATE FROM 101-S AND 104-S TANK
CASCADES FROM AUGUST 1953 TO DATE

SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Grams	Units of Curies
July 1954	2.61	29.7	0.02	38.9
August	1.78	20.3	0.007	16.9
September	1.17	19.4	0.005	15.2
October	1.97	23.7	0.111	18.3
November	1.06	12.1	0.016	3.07
December	1.02	49.2**	0.016**	5.71
January 1955	0.91	43.8**	0.014**	3.09
February	0.42	20.0	0.006	0.76
March	0.23	10.9**	0.004**	1.68
April	0.22	10.8**	0.003**	5.02
May	0.53	70.2	0.01	8.67
June*	0.65	5.75	0.003	1.84
TOTAL 7/54-6/55	12.6	316.	0.215	119.
PREVIOUS TOTAL	27.2	87.8***	0.046***	89.2***
TOTAL TO DATE	39.8	404.	0.261	208.

98 ✓
✓
221 ✓

* Volume data through June 30; activity data through June 14.

** Samples were not analyzed for Pu during these periods. Values were estimated from analytical data prior and subsequent to the subject month.

*** Represents only May and June of 1954. No samples were analyzed between August 1953 and May 1954.

SPECIAL ANALYSES

Selected samples which were analyzed for specific isotopes showed that to date 18.7 curies of Cs were discharged in 7.72×10^5 liters of this waste. Sr in 1.24×10^6 liters totaled 44.7 curies. The percentage of salts was measured during seven months since the facility was used; values ranged from <0.01% to 0.03%. pH values measured over a five month period ranged from 6.8 to 9.8.

TABLE XV

DISPOSAL SITE: 216 S-5 CRIB

WASTE STREAM: 202-S PROCESS VESSEL COOLING
WATER AND HEATING CONDENSATE
FROM MARCH 1954 TO DATE

SETTLING FACILITY: RETENTION IN 207-S BASIN

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	1,670.	14.4	63.1
August	3,160.	21.1	27.1
September	3,060.	16.3	31.4
October	2,150.	31.5	293.
November	1,210.	29.2	16.4
December	700.	3.76	18.0
January 1955	399.	4.13	6.55
February	477.	3.84	2.41
March	585.	3.82	64.5
April	580.	13.9	7.90
May	645.	6.45	13.5
June	221.	1.11	0.99
TOTAL 7/54-6/55	14,900.	150.	545.
PREVIOUS TOTAL	11,100.	98.2	112.
TOTAL TO DATE	26,000.	248.	657.

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TABLE XVI

DISPOSAL SITE: 216 S-6 CRIB

WASTE STREAM: 202-S PROCESS VESSEL COOLING WATER AND HEATING CONDENSATE FROM OCTOBER 1954 TO DATE

SETTLING FACILITY: RETENTION IN 207-S BASIN

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
October 1954	715.	10.5	97.5
November	1,210.	29.2	16.4
December	700.	3.76	18.0
January 1955	399.	4.13	6.55
February	477.	3.84	2.41
March	585.	3.82	64.5
April	580.	13.9	7.90
May	645.	6.45	13.5
June	221.	1.11	0.99
TOTAL TO DATE	5,530.	76.7	228.

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TABLE XVII*

DISPOSAL SITE: 216 SL CRIBS #1 AND #2
 WASTE STREAM: WORKS LABORATORY WASTE IN 300 AREA FROM JULY 1953 TO DATE.
 SETTLING FACILITY: STORED IN 340 WASTE TANKS PRIOR TO DISPOSAL

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	1.89	0.079	2.27
August	1.89	0.078	5.33
September	2.27	0.161	25.7
October	1.89	0.063	6.05
November	3.21	0.215	8.58
December	3.59	0.538	27.6
January 1955	1.89	0.475	3.97
February	2.65	0.145	1.35
March	2.65	0.852	5.56
April	3.40	0.657	30.6
May	1.70	1.37	11.9
June	2.27	1.39	18.8
TOTAL 7/54-6/55	29.3	6.02	148.
PREVIOUS TOTAL (2)	6.72	1.06	10.9
TOTAL TO DATE	36.0	7.08	159.

* Refer to Table XX for summary.

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TABLE XVIII*

DISPOSAL SITE: 216 SL CRIBS #1 AND #2

WASTE STREAM: 222-S CRIB WASTES FROM JANUARY 1952 TO DATE

SETTLING FACILITY: 102-S TANK

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	0.171	0.177	1.80
August	0.282	0.446	1.04
September	0.281	0.620	0.301
October	0.208	0.352	1.40
November	0.00		
December	0.174	0.071	0.072
January 1955	0.347	0.306	0.118
February	0.356	0.347	0.075
March	0.328	0.877	0.229
April	0.321	1.88	0.183
May	0.450	0.993	0.527
June	0.335	0.398	0.173
TOTAL 7/54-6/55	3.25	6.47	5.92
PREVIOUS TOTAL (2)	11.3	13.2	6.90
TOTAL TO DATE	14.6	19.7	12.8

* Refer to Table XX for summary.

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TABLE XIX*

DISPOSAL SITE: 216 SL CRIBS #1 AND #2
 WASTE STREAM: 207-SL RETENTION BASIN WATER
 SETTLING FACILITY: 207-SL BASIN

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	82.0	0.849	0.351
August	82.0	0.628	0.455
September	79.4	0.608	0.453
October	82.0	1.00	0.533
November	79.4	0.882	0.667
December	82.0	1.10	0.624
January 1955	68.1	1.25	0.216
February	82.0	0.628	1.25
March	82.0	1.26	2.47
April	79.4	1.74	1.60
May	40.7	0.643	0.357
June**	20.4	.00390	.00475
TOTAL 7/54-6/55	859.	10.6	8.98
PREVIOUS TOTAL (2)	1,310.	13.8	8.08
TOTAL TO DATE	2,170.	24.4	17.1

* Refer to Table XX for summary.

** Changes in analytical procedures starting June 1955 account for general decrease by factor of $\sim 10^2$. Ref. letter R. P. Knight to H. J. Peas 7/17/55.

TABLE XX

DISPOSAL SITE: 216 SL CRIBS #1 AND #2

WASTE STREAM: SUMMARY OF INDIVIDUAL SOURCES
ITEMIZED IN TABLES XVII, XVIII,
AND XIX.

SETTLING FACILITY: REFER TO TABLES XVII THRU XIX.

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	84.1	1.11	4.42
August	84.2	1.15	6.83
September	82.0	1.39	26.5
October	84.1	1.42	7.98
November	82.6	1.10	9.25
December	85.8	1.71	28.3
January 1955	70.3	2.03	4.30
February	85.0	1.12	2.68
March	85.0	2.99	8.26
April	83.1	4.28	32.4
May	42.9	3.01	12.8
June	23.0	1.79	19.0
TOTAL 7/54-6/55	892.	23.1	163.
PREVIOUS TOTAL (2)	1,330.	28.0	25.9
TOTAL TO DATE	2,220.	51.1	189.

TABLE XXI

DISPOSAL SITE: 216 SX-1 CRIB

WASTE STREAM: CONDENSATE FROM SX TANK FARM
(101 SX AND 104 SX CASCADE)
FROM NOVEMBER 1954 TO DATE

SETTLING FACILITY: 106 SX TANK

(The near complete absence of analytical data for this waste stream prompts presentation of summary in discussion rather than tabular form.)

Volume measurements reviewed by the Exposure Illustrator show that 1.43×10^6 liters have been discharged to the crib; 4.44×10^5 liters represented one pumping of the 106 SX tank during March 1955.

Uranium was only measured in June during which period 4.38 grams were sent to the crib.

Gross beta particle emitters measured during March, May, and June showed curie values of 9.7, 0.01, and 0.005, respectively.

Plutonium analyses confined to June showed 0.007 grams sent to ground in that month.

Estimations of the total activity discharged to the 216 SX-1 crib during the period November 1954 thru June 1955 were made by the authors by applying the June analytical results to the measured volume data for all other periods in which there were no analytical results. In summary the total discharge to this facility, calculated on the above basis, was:

Total Volume:	1.43×10^6 liters
Beta Particle Emitters:	9.77 curies
Plutonium:	0.05 grams
Uranium:	34.7 grams



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TABLE XXII*

VOLUMES DISCHARGED TO THE 241 T-3 CRIB

PERIOD	UNITS OF 10 ⁵ LITERS			
	224 Wastes	Second Cycle Wastes	"5-6 Wastes"	Total
July 1954	7.4	5.7	10.3	23.4
August	6.9	5.8	11.5	24.2
September	7.6	6.3	10.9	24.8
October	8.3	5.5	8.0	21.8
November	8.5	6.9	7.3	22.7
December	9.2	6.5	11.0	26.7
January 1955	9.9	8.2	13.7	31.8
February	9.2	7.7	9.5	26.4
March	7.1	5.4	14.6	27.1
April	4.7	3.6	13.8	22.1
May	7.8	7.9	14.1	29.8
June	9.1	9.1	14.4	32.6
TOTAL 7/54-6/55	95.7	78.6	139.	313.
PREVIOUS TOTAL (2)	125.	313.	214.	652.
TOTAL TO DATE	221.	391.	353.	965.

*Refer to Table XXIII for contamination data.

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TABLE XXIII

DISPOSAL SITE: 241 T-3 CRIB

WASTE STREAM: SECOND CYCLE FROM APRIL 1948 TO DATE; 224-T WASTES FROM JUNE 1952 TO DATE; AND "5-6" WASTE FROM JUNE 1951 TO DATE

SETTLING FACILITY: THROUGH THE 110-111-112-T TANK CASCADE PRIOR TO DISCHARGE

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	23.4	0.37	0.56
August	24.2	0.30	0.62
September	24.8	0.47	2.98
October	21.8	0.23	1.08
November	22.7	1.64	16.0
December	26.7	0.45	1.24
January 1955	31.8	1.06	2.72
February	26.4	0.20	0.63
March	27.1	0.41	106.
April	22.1	0.45	1.09
May	29.8	6.62	76.8
June	32.6	0.44	1.17
TOTAL 7/54-6/55	313.	12.6	211.
PREVIOUS TOTAL (2)	604.	108.	2,850.
TOTAL TO DATE	917.	120.	3,060.

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TABLE XXIV

DISPOSAL SITE: 241 T TRENCHES #1, #2, #3, AND #4

WASTE STREAM: FIRST CYCLE SUPERNATANT TRENCHING FROM THE
104-T, 105-T, AND 106-T TANKS

SETTLING FACILITY: TANKS AS INDICATED

TRENCH	VOLUME Units of 10 ³ L	UNITS OF GRAMS		UNITS OF CURIES			TANK NUMBER	DATE	
		Plutonium	Uranium	Gross Beta	Cesium	Strontium		Filled	Emptied
T 1	4.60	0.36	14,500.	547.	230.	1.01	104T	8/51	1/15/54
T 1	5.46	0.42	14,700.	437.	229.	4.75	105T	10/26/51	1/22/54
T 2	9.15	0.75	23,300.	686.	403.	20.1	105T	10/26/51	1/29/54
T 2	1.27	0.08	2,850.	108.	610.	1.00	106T	12/22/51	2/4/54
T 3	10.2	0.58	21,400.	878.	510.	8.67	106T	12/22/51	2/10/54
T 4	3.48	0.21	9,400.	278.	157.	0.42	106T	12/22/51	2/13/54
T 4	4.37	0.26	10,100.	367.	208.	2.54	106T	12/22/51	6/10/54
TOTAL	38.5	2.66	96,300.	3,300.	2,350.	38.5			

TABLE XXV

DISPOSAL SITE: 241 T TRENCH #5

WASTE STREAM: SECOND CYCLE SUPERNATANT*

SETTLING FACILITY: 112-T TANK

TRENCH	VOLUME Units of 10 ³ L	UNITS OF GRAMS	UNITS OF CURIES	TANK NUMBER	DATE
		Plutonium	Gross Beta		EMPTIED
T 5	26.5	175.	125.	112T	5/5/55

* 750,000 liters represented current waste discharged during supernatant removal.

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TABLE XXVI

DISPOSAL SITE: 241 TX TRENCHES #1, #2, #3, AND #4

WASTE STREAM: FIRST CYCLE SUPERNATANT TRENCHING FROM THE 109-TX, 110-TX, AND 111-TX TANKS

SETTLING FACILITY: TANKS AS INDICATED

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TRENCH	VOLUME Units of 10 ⁵ L	UNITS OF GRAMS		UNITS OF CURIES			TANK NUMBER	DATE	
		Plutonium	Uranium	Gross Beta	Cesium	Strontium		Filled	Emptied
TX 1	4.63	1.25	521.	7,920.	389.	7.87	109 TX	7/25/52	6/24/54
TX 2	15.4	1.90	2,170.	3,800.	1,850.	49.3	110 TX	6/14/53	7/23/54
TX 3	7.48	0.21	842.	935.	591.	16.5	110 TX	6/14/53	7/30/54
TX 3	7.38	0.66	244.	2,440.	738.	23.6	111 TX	2/23/54	8/6/54
TX 4	15.4	2.48	8,320.	4,200.	1,420.	38.5	111 TX	2/23/54	8/13/54
TOTAL	50.3	6.50	12,100.	19,300.	4,990.	136.			

TABLE XXVII

DISPOSAL SITE: 241 TX TRENCH #5

WASTE STREAM: FIRST CYCLE EVAPORATOR BOTTOMS FROM TANKS 101-TY AND 102-TY

SETTLING FACILITY: TANKS AS INDICATED

TRENCH	VOLUME Units of 10 ⁵ L	UNITS OF GRAMS		UNITS OF CURIES			TANK NUMBER	DATE EMPTIED
		Plutonium	Uranium	Gross Beta	Cesium	Strontium		
TX 5	24.8	0.58	855.	11,000.	7,190.	3.97	101 TY	9/19/54
TX 5	5.07	0.02	258.	3,240.	1,700.	0.14	102 TY	9/22/54
TOTAL	29.9	0.60	1,110.	14,200.	8,890.	4.11		

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TABLE XXVIII

DISPOSAL SITE: 241 TX-153 CRIB AND TILE FIELD
 WASTE STREAM: 242-T WASTE EVAPORATOR CONDENSATE
 SEPTEMBER 1951 TO DATE
 SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Curies
July 1954	6.80	0.026	0.302
August	6.16	0.047	0.027
September	3.97	0.031	0.118
December*	6.88	0.040	0.020
January 1955	8.99	0.718	0.233
February	8.12	0.062	0.096
March	8.46	0.049	0.130
April	7.93	0.074	0.216
May	5.53	0.248	0.920
June	3.77	0.252	0.069
TOTAL 7/54-6/55	66.6	1.55	2.13
PREVIOUS TOTAL (2)	283.3	2.82	3.46
TOTAL TO DATE	350.	4.37	5.59

* The waste evaporator was not operating during October and November. Information via phone contact from M. L. Short 7/12/55.

TABLE XXIX

DISPOSAL SITE: 216.U-3 CRIB
 WASTE STREAM: CONDENSATE FROM 110-U TANK CASCADE
 MAY 1954 TO DATE
 SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of Grams	Units of Grams	Units of Curies
July 1954	1.02	116.	0.006	0.002
August	0.79	9.53	0.003	0.007
September	0.87	18.3	0.007	0.339
October	0.38	4.53	0.003	0.002
November	0.53	17,700.	0.002	0.012
December	0.32	3.86	0.001	0.002
January 1955	0.34	3.26	0.001	0.002
February	0.23	2.76	0.001	0.002
March	0.22	3.56	0.001	0.002
April	0.21	2.51	0.001	0.022
May	0.04	0.44	< 0.001	< 0.001
June	< 0.01	0.01	< 0.001	< 0.001
TOTAL 7/54-6/55	4.96	17,900.	0.028	0.394
PREVIOUS TOTAL	2.54	49.4	0.010	0.018
TOTAL TO DATE	7.50	17,900.	0.038	0.412

SPECIAL MEASUREMENTS:

Cs measured in 3.5×10^5 liters of this waste totaled 0.33 curies. Sr measured in 6.2×10^5 liters was 1.8 curies. pH values ranged from 9.8 to 11.7 over an eight month period. Salt content varied from 0.006% to 0.017% with the majority of values below 0.01%.

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TABLE XXX

DISPOSAL SITE: 216 WR #1, #2, AND #3 CRIBS

WASTE STREAM: 221-U CONCENTRATOR CONDENSATES,
JULY 1952 TO DATE

SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of kg.	Units of Grams	Units of Curies
July 1954	62.4	152.	0.72	5.89
August	82.0	42.8	0.87	7.41
September	62.4	41.4	0.58	13.9
October	25.3	18.2	0.29	6.18
November	15.5	5.0	0.15	4.72
December	4.2	50.5	0.72	0.28
January 1955	7.6	201.	0.81	0.62
February	46.9	1,570.	20.6	11.6
March	76.4	862.	1.09	26.3
April	93.0	161.	1.61	146.
May	56.7	318.	4.64	42.9
June	87.3	521.	6.80	35.8
TOTAL 7/54-6/55	620.	3,940.	38.9	302.
PREVIOUS TOTAL (2)	1,540.	14,500.	185.	77.2
TOTAL TO DATE	2,160.	18,400.	224.	379.

Isotopic analysis for ruthenium performed on weekly composite samples collected during April, May, and June showed values of 18.8, 2.68, and 13.4 curies, respectively.

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TABLE XXXI

DISPOSAL SITE: 361 WR CRIBS (SOMETIMES CALLED
216 U-1. AND 2 CRIBS)

WASTE STREAM: 224-U, 276-U, 221-U, AND 5-6 FROM
NOVEMBER 1951 TO DATE

SETTLING FACILITY: NONE

PERIOD	VOLUME IN LITERS	URANIUM	PLUTONIUM	BETA PARTICLE EMITTERS
	Units of 10 ⁵	Units of kg.	Units of Grams	Units of Curies
July 1954	0.38	4.60	0.15	10.4
August	0.38	7.70	0.00	0.79
September	0.38	15.0	0.29	3.31
October	1.51	30.5	0.29	53.1
November	1.51	42.8	0.72	4.57
December	1.89	107.	0.87	96.7
January 1955	1.51	42.8	0.72	45.7
February	0.38	0.46	0.15	0.06
March	0.76	6.80	0.29	94.0
April	0.45	0.46	0.15	0.56
May	0.87	7.26	1.01	3.60
June	0.38	5.44	0.14	12.2
TOTAL 7/54-6/55	10.4	270.	4.78	325.
PREVIOUS TOTAL (2)	82.2	2,850.	32.8	622.
TOTAL TO DATE	92.6	3,120.	37.6	947.

TABLE XXXII

DISPOSAL SITE: 231 W TRENCH
 WASTE STREAM: STANDARDS LABORATORY WASTE AND
 PROCESS WASTE, FEBRUARY 1947
 TO DATE
 SETTLING FACILITY: SUMPS #1 AND #2

PERIOD	VOLUME IN LITERS	PLUTONIUM
	Units of 10 ⁵	Units of Grams
July 1954	.070	0.26
August	.003	0.06
September	.054	0.13
October	.088	1.03
November	.099	0.54
December	.099	0.27
January 1955	.185	9.77
February	.193	22.4
March	.216	1.03
April	.407	7.27
May	.259	8.24
June	.304	4.30
TOTAL 7/54-6/55	1.98	55.3
PREVIOUS TOTAL (2)	410.	383.
TOTAL TO DATE	412.	438.

TABLE XXXIII

DISPOSAL SITE: 234-5 #1, #2, #3, AND #4 CRIBS AND
TILE FIELD

WASTE STREAM: ANALYTICAL LABORATORY WASTE,
DEVELOPMENT LABORATORY WASTE AND
PROCESS WASTE FROM JUNE 1949 TO
DATE

SETTLING FACILITY: SUMP TANKS D4, D5, D6, D7, AND D8

PERIOD	VOLUME IN LITERS	PLUTONIUM
	Units of 10 ⁵	Units of Grams
July 1954	5.71	11.8
August	9.21	6.72
September	9.48	4.86
October	10.5	7.47
November	12.1	12.6
December	14.0	9.20
January 1955	4.49	22.3
February	1.95	15.4
March	3.54	23.2
April	16.3	30.2
May	22.5	37.1
June	64.9	17.9
TOTAL 7/54-6/55	175.	199.
PREVIOUS TOTAL (2)	597.	374.
TOTAL TO DATE	772.	573.

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LARGE VOLUME WASTES TO OPEN DISPOSAL SITES

In addition to the radioactive wastes discharged to ground, large quantities of relatively uncontaminated water from the separations process were discharged to open storage areas in and near the separation facilities. Periodic process difficulties allowed trace quantities of radioactive material to enter these streams and thus cause these locations to be another disposal site for radioactive waste.

Prior to this publication, volume data for these locations was estimated by J. W. Healy⁽¹⁾ for the period 1945-1953. Subsequent volume data was obtained from the Earth Sciences Unit in the Radiological Sciences Department and from the Separations Unit of the Manufacturing Department. Weekly liquid samples were collected from the inlet to these disposal areas by Regional Monitoring and analyzed for the activity density of gross alpha and gross beta particle emitters. Estimates of the total activity discharged to these sites were calculated from the above information by the Radiation Measurements Evaluation group⁽⁶⁾. Tables XXXIV thru XXXVII summarize these data for individual sites by periods in which the flow rates were relatively constant. Large fluctuations in volume and low sampling frequency necessitate re-emphasizing that the curie and gram values should be regarded as estimates only; tabulated values may be in error by as much as a factor of two.

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TABLE XXXIV

DISCHARGE TO THE 200 EAST AREA B SWAMP

PERIOD		VOLUME	BETA PARTICLE EMITTERS	PLUTONIUM
From	To	N ⁸ Liters	Units of Curies	Units of Grams
4-45	12-49	65.0	2.2	1.0
1-50	3-52	77.5	7.1	0.18
4-52	7-54	25.8	1.1	0.25
8-54	6-55	1.82	0.056	0.012
TOTAL		170.	10.5	1.44

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TABLE XXXV

DISCHARGE TO THE 200 WEST AREA S SWAMP

PERIOD		VOLUME	BETA PARTICLE EMITTERS	PLUTONIUM
From	To	Units of 10 ⁶ Liters	Units of Curies	Units of Grams
11-51	2-52	1.29	0.031	0.0073
3-52	7-52	5.78	0.042	0.051
8-52	1-53	20.9	330.	1.6
	2-53	2.12	5.5	0.017
3-53	4-53	6.92	510.	0.78
	5-53	4.69	8.9	0.064
6-53	3-54	21.8	200.	0.75
TOTAL		63.5	1,050.	3.27

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TABLE XXXVI

DISCHARGE TO THE 200 WEST AREA T SWAMP

PERIOD		VOLUME	BETA PARTICLE EMITTERS	PLUTONIUM
From	To	Units of 10^8 Liters	Units of Curies	Units of Grams
11-44	12-49	105.	0.47	1.2
1-50	12-51	69.2	2.6	0.28
1-52	5-53	29.3	3.2	0.19
6-53	7-54	32.2	48.	0.26
8-54	10-54	10.4	2.1	0.036
11-54	1-55	12.2	3.8	0.030
	2-55	3.18	2.6	0.0093
	3-55	2.95	12.	0.030
	4-55	1.70	1.0	0.0050
	5-55	2.95	2.7	0.0072
	6-55	3.97	4.8	0.0071
TOTAL		273.	83.3	2.05

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TABLE XXXVII

DISCHARGE TO THE 200 WEST AREA U SWAMP

PERIOD		VOLUME	BETA PARTICLE EMITTERS	PLUTONIUM
From	To	Units of 10^8 Liters	Units of Curies	Units of Grams
11-44	12-48	19.8	0.040	0.42
1-49	11-52	27.0	0.19	1.2
12-52	3-53	15.2	0.41	0.91
4-53	5-53	15.0	0.47	0.34
6-53	6-54	62.7	6.3	5.3
7-54	6-55	62.0	370.	7.9
TOTAL		202.	377.	16.1

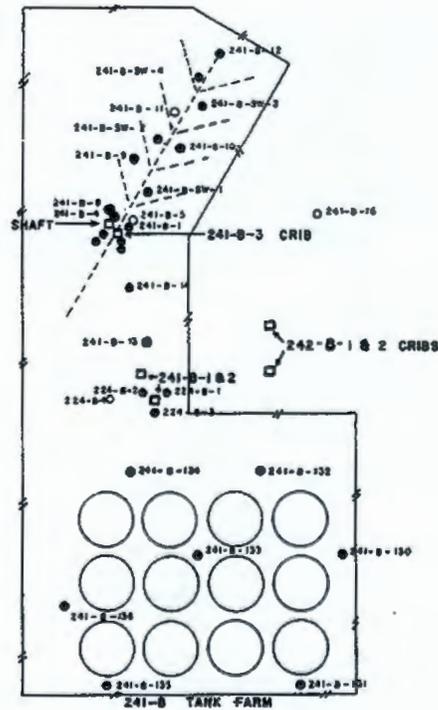
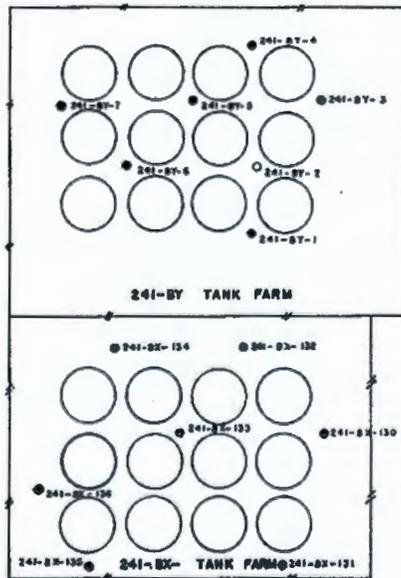
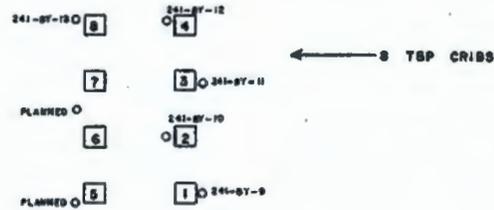
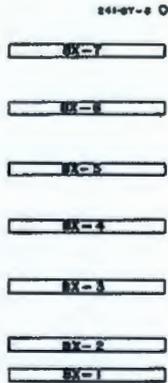
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TEST WELLS

"B" FACILITY

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WASTE TRENCHES



LEGEND

- TEST WELL DRILLED TO WATER
- ◻ DRY TEST WELL

15 APRIL 1955
K.R.H.G.

N - 46,800

N - 46,400

N - 46,000

N - 45,600

N - 45,200

W - 53,800

W - 53,400

W - 53,000

W - 52,600

W - 52,200

W - 51,800

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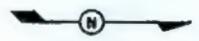
HW-38562

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REFERENCE DRAWINGS

- N-2-2000 — 300-ON WASTE DISPOSAL FACILITIES
- N-2-2020 — 300-WEST PROCESS WASTE SYSTEM
- N-2-1774 — TEST WELL LOCATION, 241-S TANK FARM
- W-3200 — RADIOACTIVE LIQUID WASTE DISPOSAL FACILITIES

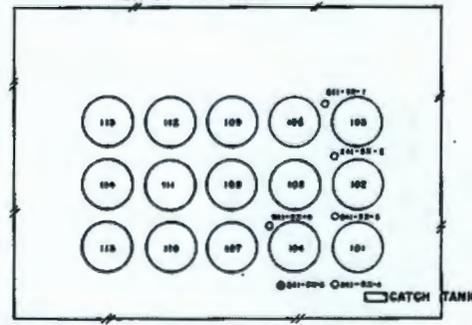


216-S-4 CRIB

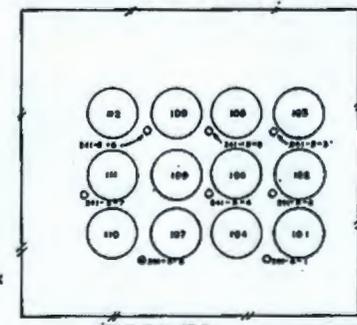
216-SX-1 CRIB

300 - WEST PERIMETER FENCE

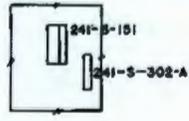
241-SX TANK FARM



241-S TANK FARM



216-S-3 CRIB



- LEGEND
- Test well to water
 - Dry test well

TEST WELLS
 241-S, SX TANK FARM
 and
 216-S, SX CRIB AREAS

OFFICIAL USE ONLY

5 MAY 1955 KRM

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- (2) HW-33591 Ruppert, H. G. and Heid, K. R., Summary of Liquid Radioactive Wastes Discharged to the Ground - 200 Areas, July 1952 through June 1954.
- (3) Letter H. V. Clukey to H. J. Paas et al, Routing of B-Plant 5-6 Waste Through December 1954, dated Jan. 17, 1955.
- (4) Letter M. L. Short to H. J. Paas, Summary of Condensate Cribbed - 1st Cycle Evaporator - East Area, June 6, 1955.
- (5) Letter J. R. Raymond to H. J. Paas, June 10, 1955.
- (6) Letter H. T. Norton to H. J. Paas, June 25, 1955.

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