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REACTOR EFFLUENT ANALYTICAL DATA
OCTOBER, NOVEMBER, DECEMBER, 1964

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REACTOR EFFLUENT ANALYTICAL DATA
OCTOBER, NOVEMBER, DECEMBER, 1964

W. N. Koop
Process and Reactor Development
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

January 20, 1965

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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January 20, 1965

REACTOR EFFLUENT ANALYTICAL DATA
OCTOBER, NOVEMBER, DECEMBER, 1964

This report continues the tabulation of reactor effluent data for record purposes and follows document RL-REA-43 in the series. Although no changes were made during the subject period, different sampling methods are anticipated early in 1965. The analytical procedures were unchanged except for zinc-65. The new method, adopted in November, 1964, consists of precipitating zinc sulfide, filtering onto a millipore plate, dissolving in hydrochloric acid, and counting gamma activity with a 400-channel analyzer. This procedure provides earlier and more consistent results than the method followed previously.

Data tabulated on pages 4 through 10 are radionuclide concentrations in the rear riser effluent samples as determined by the Purex Analytical Laboratory. The

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data on page 11 are the monthly average curies of individual nuclides released per day, calculated by the author from average analytical results and reactor flow rates. Data on page 12 are the total curies of the same five nuclides released during diatomaceous earth purges, calculated by Purex Laboratory personnel from the water volume during each purge and the nuclide content found in purge effluent samples. There were also 14 purges of very brief duration (less than five minutes each) conducted at 105-C during November and December, 1964 that were not sampled. The important radionuclides released during these purges could be estimated from results of previous purge samples. The data on page 13 summarize reactor river releases during 1962, 1963, and 1964 for nuclides of greatest radiological interest.

During this report period, all reactor coolant had sodium dichromate added to a concentration of 1.0 ppm. Coolant for both of the K Reactors was treated with liquid alum at a rate of about 12 ppm. Bauxite was used at all other reactors to provide a nominal alum concentration of 18 ppm during treatment.

The coolant pH at DR, F, KE, and KW was reduced from 7.0 to 6.6 on October 23, October 29, December 5, and December 6, 1964, respectively. By the end of the report period, pH 6.6 coolant was in use at all reactors.

W. N. Koop

Radiological Engineering Unit
Process and Reactor Development
Research and Engineering Section

WN Koop:nmd

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DAILY EFFLUENT RISER ANALYSES - OCTOBER, 1964
(Units of pc/ml Corrected to Sampling Time)

Arsenic-76

Date	B	C	D	DR	F	H	KE	KV
1	135/140	159	96	55/63	58	---	52	---
2	171/156	147	98	82/67	79	47	60	---
5	151/153	116	83	---	49	53	65	---
6	168/198	147	99	65/56	61	80	76	---
7	139/99	148	81	---	55	63	---	---
8	166/182	146	---	---	74	83	---	---
9	138/141	90	---	47/40	55	61	---	---
12	---	---	106	---	57	83	50	---
13	---	---	77	---	55	49	46	---
14	---	---	---	51/70	61	---	56	---
15	---	76	---	59/58	61	---	(174)	---
16	---	97	---	69/63	---	66	54	---
19	97/123	100	---	56/66	38	87	---	---
20	102/115	98	---	---	35	62	33	23
21	123/157	---	---	---	63	109	68	40
22	149/167	---	---	---	69	116	54	51
23	165/169	---	---	68/60	75	141	57	58
26	115/115	---	---	91/85	89	---	86	---
27	---	---	---	---	83	148	60	58
28	---	---	---	---	59	115	97	37
29	86/105	---	---	26/23	45	34	70	44
30	176/169	196	---	93/83	79	149	103	68
Ave.	140	130	91	63	62	86	64	47

Phosphorus-32

1	1.4/1.7	7.5	5.4	2.4/2.5	4.7	---	5.9	---
2	1.7/1.0	7.4	4.7	3.9/1.4	4.6	3.3	6.8	---
5	2.2/3.5	11.6	8.0	---	2.5	7.1	7.9	---
6	2.9/3.6	9.3	5.7	(9.5/26.6)	4.5	7.9	8.0	---
7	2.0/6.0	8.8	6.0	---	4.5	6.5	---	---
8	1.9/6.1	8.8	---	---	4.8	8.6	---	---
9	1.9/4.6	7.5	---	5.5/5.0	5.0	6.4	---	---
12	---	---	7.7	---	3.4	6.9	5.9	---
13	---	---	6.7	2.1/2.3	4.9	6.0	5.0	---
14	---	---	---	5.6/4.4	4.8	---	5.9	---
15	---	5.7	---	3.1/2.4	4.4	---	(9.1)	---
16	---	5.8	---	3.7/3.4	---	6.6	6.6	---
19	6.2/4.7	5.8	---	3.6/6.0	3.7	7.8	---	---
20	3.8/3.4	7.6	---	---	4.1	9.2	5.5	2.0
21	4.4/3.5	---	---	---	4.9	9.3	6.9	4.0
22	5.7/4.4	---	---	---	4.5	9.3	6.2	4.1
23	4.0/3.7	---	---	6.1/6.5	4.8	8.3	3.8	3.8
26	2.9/4.3	---	---	5.6/6.1	4.6	---	5.8	---
27	---	---	---	---	4.2	9.5	5.9	5.1
28	---	---	---	---	4.7	8.9	3.6	3.3
29	3.6/4.4	---	---	5.9/6.0	3.3	6.5	9.4	4.4
30	3.7/3.9	9.9	---	7.2/9.1	2.9	7.0	8.4	5.3
Ave.	3.6	8.0	6.3	4.6	4.3	7.5	6.3	4.0

() - Omitted from monthly average.

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DAILY EFFLUENT RISER ANALYSES - OCTOBER, 1964 (Cont'd)

Chromium-51

<u>Date</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>
1	466	824	423	352	297	---	115	---
2	393	743	447	456	300	(142)	112	---
5	405	788	404	---	203	293	170	---
6	423	425	(101)	296	158	484	94	---
7	492	388	(163)	---	231	(32)	---	---
8	392	763	---	---	291	285	---	---
9	379	455	---	203	162	264	---	---
12	---	---	429	---	298	371	115	---
13	---	---	470	450	348	(1170)	116	---
14	---	---	---	430	300	---	107	---
15	---	443	---	1040	299	---	(1200)	---
16	---	604	---	750	---	326	118	---
19	421	790	---	447	318	426	---	---
20	400	857	---	---	279	350	94	35
21	377	---	---	---	216	387	130	88
22	410	---	---	---	310	400	114	87
23	287	---	---	392	245	469	124	79
26	225	---	---	463	297	---	121	---
27	---	---	---	---	293	390	123	81
28	---	---	---	---	265	480	120	91
29	299	---	---	352	313	415	142	109
30	353	(91)	---	549	336	---	142	116
Avg.	380	640	430	480	270	380	120	90

Neptunium-239

1	188	161	83	87	86	---	56	---
2	177	166	112	142	89	51	55	---
5	173	149	(33)	---	(23)	79	58	---
6	(29)	(2)	---	---	---	(15)	---	---
7	(45)	(5)	---	---	(21)	(4)	---	---
8	(28)	(22)	---	---	(14)	(21)	---	---
9	(28)	(11)	---	(4)	(6)	(19)	---	---
12	---	---	74	---	84	116	59	---
13	---	---	92	93	93	(1910)	58	---
14	---	---	---	106	82	---	55	---
15	---	99	---	139	80	---	91	---
16	---	120	---	126	---	86	65	---
19	168	147	---	119	66	114	---	---
20	178	156	---	---	73	96	55	13
21	176	---	---	---	50	104	70	33
22	194	---	---	---	83	107	59	37
23	181	---	---	96	69	120	75	37
26	122	---	---	108	79	---	71	---
27	---	---	---	---	80	115	77	37
28	---	---	---	---	77	127	72	41
29	119	---	---	78	63	87	68	37
30	150	84	---	60	58	---	52	31
Avg.	170	140	90	110	80	100	60	30

() - Omitted from monthly average.

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DAILY EFFLUENT RISER ANALYSES - NOVEMBER, 1964
(Units of pc/ml Corrected to Sampling Time)

Arsenic-76

<u>Date</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>
2	138	154	---	89/95	83	158	99	---
3	---	82	---	52/45	71	120	81	---
4	77	76	40	35/39	41	---	47	---
5	---	178	116	103/98	69	---	71	36
6	---	91	62	57/54	---	---	59	34
9	176	125	88	70/69	30	86	76	81
10	93	---	75	58/68	44	82	56	40
11	114	---	80	62/61	96	90	58	47
12	129	120	90	82/60	48	98	62	53
13	121	---	---	72/73	39	72	61	50
16	---	79	45	---	36	54	---	45
17	---	96	52	75/55	45	75/49	---	30
18	---	181	70	94/59	60	83/76	---	59
19	---	113	---	81/67	---	90/65	---	58
20	77	142	---	---	---	64/87	---	58
23	144	203	133	---	---	125/99	74	90
24	186	---	---	---	56	130/91	61	---
25	134	---	---	---	61	(226/226)	50	72
30	124	138	---	142/77	57	91/53	37	---
Avg.	126	127	77	70	56	84	64	54

Phosphorus-32

2	4.8	8.7	---	3.9/8.4	7.2	10.6	7.9	---
3	---	6.6	---	4.2/8.5	4.6	10.3	4.8	---
4	3.6	6.5	4.3	6.5/9.2	5.4	---	7.4	---
5	---	7.6	5.6	8.1/8.7	7.5	---	7.8	4.5
6	---	8.1	6.2	5.1/7.7	---	---	6.3	4.6
9	6.3	7.6	8.5	7.7/9.7	5.7	9.8	10.6	6.7
10	7.5	---	7.7	8.1/8.6	6.6	13.7	7.0	5.8
11	6.7	---	7.5	9.2/6.4	4.6	14.1	6.6	7.7
12	4.1	8.6	7.6	6.5/6.8	5.6	13.9	10.4	6.8
13	5.2	---	---	7.1/8.4	6.1	17.1	6.2	5.0
16	---	11.0	13.7	---	6.0	12.0	---	6.8
17	---	11.6	11.2	9.6/7.5	5.5	11.6/17.1	---	7.5
18	---	9.0	9.0	8.7/6.7	(20.8)	10.9/22.4	---	(15.3)
19	---	10.2	---	8.2/7.8	---	9.3/9.9	---	6.4
20	4.0	12.9	---	---	---	11.2/12.3	---	8.2
23	4.9	14.3	8.4	---	---	7.3/12.4	---	8.5
24	5.1	---	---	---	7.0	8.3/(37.1)	---	---
25	6.0	---	---	10.3/10.3	11.0	8.9/14.3	---	8.2
30	(15.0)	(3.0)	---	9.3/9.6	12.6	8.0/10.7	8.4	---
Avg.	5.3	9.4	8.2	7.9	6.8	12.3	7.6	6.5

() - Omitted from monthly average.

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DAILY EFFLUENT RISER ANALYSES - NOVEMBER, 1964 (Cont'd)

Chromium-51

<u>Date</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>
2	326	(261)	---	543/(106)	262	334	284	---
3	---	829	---	480	356	470	141	---
4	397	868	304	490/459	381	---	108	---
5	---	794	344	(9790)/380	---	---	125	---
6	---	694	415	523	---	---	141	100
9	450	850	416	576/522	326	390	(499)	108
10	416	---	429	548	290	456	148	106
11	441	---	449	540	309	356	151	122
12	426	962	473	550/559	341	473	(499)	126
13	485	---	---	594/557	346	464	120	123
16	---	1130	---	532	360	454	---	118
17	---	1090	468	631/240	368	402	---	132
18	---	---	481	315/551	(533)	437/434	---	122
19	---	892	---	579	---	387	---	117
20	285	972	---	---	---	412/331	---	123
23	337	1060	463	---	---	449	142	169
24	361	---	---	531	301	388	121	---
25	357	---	---	---	307	(805)	129	125
30	409	996	---	(789)	353	407	128	---
Avg.	390	930	420	520	330	420	140	120

Neptunium-239

2	(76)	(95)	---	117/65	107	96	75	---
3	---	166	---	99	206	133	87	---
4	169	159	53	127/99	(264)	---	93	---
5	---	167	56	(589/306)	---	---	65	---
6	---	159	77	99	---	---	89	50
9	186	167	92	129/103	78	105	94	66
10	171	---	90	126	88	117	103	62
11	179	---	96	121	81	98	109	69
12	174	193	99	132/103	88	123	96	73
13	196	---	---	133/109	86	119	89	70
16	---	183	---	105	84	115	---	71
17	---	199	113	121/61	90	116	---	80
18	---	198	111	72/103	117	135/112	---	78
19	---	174	---	134	---	116	---	79
20	125	197	---	---	---	128/98	---	78
23	147	231	91	---	---	127	61	96
24	183	---	---	123	57	111	57	---
25	162	---	---	---	70	(1510)	55	68
30	170	196	---	142	81	114	54	---
Avg.	170	180	88	110	95	115	81	72

() - Omitted from monthly average.

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DAILY EFFLUENT RISER ANALYSES - DECEMBER, 1964
(Units of pc/ml Corrected to Sampling Time)

Arsenic-76

Date	B	C	D	DR	F	H	KE	KW
1	120	175	62	---	53	92/55	58	---
2	150	117	61	55/62	73	117/55	37	---
3	(241)	222	115	156/120	70	108/70	47	---
4	183	208	(209)	---	---	(161)/88	63	---
7	---	---	---	---	---	---	---	---
8	184	210	153	121/137	96	---	54	39
9	196	231	116	123/134	---	---	57	31
10	160	129	---	81/75	---	47/36	36	23
11	203	211	---	130/128	---	86/62	37	33
14	---	(52)	---	(23/32)	(26)	(24/16)	(12)	(13)
15	---	152	58	97/88	57	78/44	37	45
16	---	---	59	93/75	58	69/58	---	29
17	111	165	70	98/119	75	120/50	---	44
18	119	180	64	105/85	69	91/57	---	50
21	---	---	---	---	---	---	---	---
22	138	---	88	---	82	95/71	---	45
23	113	---	68	---	51	87/49	24	30
28	---	97	88	86	---	76	25	42
29	74	111	88	---	---	90/52	28	39
30	88	101	73	84/100	---	86/50	26	46
31	86	92	70	---	(32)	76/43	26	33
AVE.	138	160	82	103	68	72	38	38

Phosphorus-32

1	7.2	10.7	7.6	---	7.5	10.1/9.4	8.0	---
2	5.5	12.4	10.6	9.9/10.0	7.5	8.4/7.0	8.3	---
3	6.6	13.0	10.8	12.8/11.7	8.9	12.9/9.8	9.0	---
4	(1.5)	(1.5)	(6.7)	---	---	(4.5/8.6)	(1.8)	---
7	(2.1)	(5.1)	(3.0)	(3.6/4.2)	(2.0)	---	(2.5)	(1.5)
8	5.0	12.5	11.1	11.6/8.5	(3.4)	---	8.1	5.1
9	6.2	12.5	7.6	9.6/9.0	---	---	8.7	(13.5)
10	7.3	15.4	---	10.1/(3.7)	---	6.8/14.1	7.8	5.2
11	6.2	16.0	---	13.7/13.4	---	9.9/10.2	7.3	6.3
14	---	13.0	---	(5.5)/9.7	6.0	9.0/7.5	8.0	4.0
15	---	16.7	8.2	14.9/13.9	5.0	8.5/8.8	8.9	5.9
16	---	10.6	9.8	13.3/11.9	8.2	9.3/5.5	---	4.3
17	3.9	14.7	(3.6)	12.2/11.7	7.2	7.8/6.4	---	7.3
18	3.2	17.0	7.4	9.1/14.1	6.6	6.2/4.2	---	4.9
21	5.1	---	8.4	11.0/(33.4)	8.1	10.0/10.2	5.0	---
22	7.5	---	6.2	---	7.0	8.2/9.1	---	5.9
23	7.4	---	5.1	---	8.7	8.4/10.6	4.3	5.5
28	---	8.1	5.0	(27.3)	---	13.3	4.4	5.9
29	4.3	(3.3)	10.3	---	---	15.9/12.3	3.1	7.2
30	(15.2)	15.4	9.6	10.2/14.1	---	15.2/10.2	5.6	6.9
31	5.7	11.3	7.6	---	(17.1)	16.8/10.5	---	5.8
AVE.	5.8	13.3	8.3	11.5	7.3	10.0	6.8	5.7

() - Omitted from monthly average.

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DAILY EFFLUENT RISER ANALYSES - DECEMBER, 1964 (Cont'd)

Chromium-51

<u>Date</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>
1	442	978	238	---	---	377	140	---
2	441	1080	435	682	373	298	114	---
3	391	880	449	707	333	392	108	---
4	438	1090	370	(499)	---	396	161	---
7	477	1240	440	880	409	---	122	---
8	431	851	455	729	373	---	137	65
9	464	1150	457	767	---	---	81	77
10	469	1100	---	821	---	209	148	123
11	885	1180	---	(147)	---	286	(41)	99
14	---	1040	---	718/641	---	242/256	161	(7)
15	---	(570)	384	688	364	330	152	114
16	---	(125)	399	666	345	334	---	125
17	211	1300	330	683	407	327	---	(1620)
18	447	1000	379	696	371	(122)	---	120
21	405	---	355	950	377	329	120	(297)
22	447	---	(135)	---	423	407	---	---
23	415	---	409	---	369	407	---	(384)
28	293	757	418	649	362	375	108	135
29	287	791	417	---	---	383	128	138
30	344	905	426	779	---	358	127	141
31	412	846	451	---	284	(1190)	144	145
Avg.	430	1000	400	740	370	409	130	120

Neptunium-239

1	181	200	78	---	---	118	59	---
2	(99)	212	99	120	84	88	45	---
3	158	189	104	126	81	117	42	---
4	179	199	107	(72)	---	117	84	---
7	173	205	112	160	90	---	43	---
8	156	161	108	158	82	---	49	---
9	177	196	108	175	---	---	42	---
10	172	199	---	171	---	60	50	---
11	191	202	---	(50)	---	83	(225)	(79)
14	---	179	---	133/105	75	81/60	50	41
15	---	221	---	156	77	97	44	46
16	---	(45)	63	130	81	99	---	(175)
17	103	208	83	123	83	97	---	42
18	286	197	88	135	77	(43)	---	(98)
21	177	---	87	161	92	104	35	---
22	187	---	(46)	---	112	98	---	(83)
23	176	---	95	---	77	114	30	46
28	249	153	113	138	---	123	37	45
29	127	180	110	---	---	136	35	48
30	147	219	125	160	---	(289)	55	37
31	85	199	119	---	84	124	31	50
Avg.	170	200	100	150	84	100	45	43

() - Omitted from monthly average.

RTG 153-171

ZINC-65 ANALYSES - OCTOBER, NOVEMBER, DECEMBER, 1964
(Units of pc/ml)

	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>
October, 1964								
1st Period	5	9	3	16	11	5	(1)	*
2nd Period	4	9	*	20	9	5	5	6
Average	5	9	3	18	8	5	5	6
November, 1964								
1st Period	4	8	14	13	8	5	6	4
2nd Period	6	12	14	13	14	4	9	7
Average	5	10	14	13	11	5	8	6
December, 1964								
1st Period	3	14	4	19	10	4	10	8
2nd Period	4	13	5	15	10	4	6	7
Average	4	14	5	17	10	4	8	8

* No sample.

() - Not included in monthly average.

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AVERAGE EFFLUENT RELEASE RATE
OCTOBER, NOVEMBER, DECEMBER, 1964
(In Curies Per Day)

<u>Operating Period</u>	<u>Nuclide</u>	<u>Reactor</u>								<u>IPD Total</u>
		<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>	<u>KE</u>	<u>KW</u>	
October, 1964	P ³²	1.5	3.6	2.0	1.8	1.9	3.3	6.4	1.6	22
	Cr ⁵¹	160	290	140	190	120	170	120	40	1200
	Zn ⁶⁵	2	4	1	7	3	2	5	2	26
	As ⁷⁶	57	58	30	24	27	37	65	19	320
	Np ²³⁹	68	60	29	40	33	44	65	13	350
November, 1964	P ³²	2.0	4.3	2.7	3.5	2.8	5.6	7.6	6.7	35
	Cr ⁵¹	150	430	140	230	140	190	140	120	1500
	Zn ⁶⁵	2	5	5	6	5	2	8	6	39
	As ⁷⁶	47	58	25	31	23	38	63	55	340
	Np ²³⁹	64	83	29	49	40	53	81	74	470
December, 1964	P ³²	2.5	6.0	3.4	5.2	3.3	4.3	6.7	5.2	37
	Cr ⁵¹	190	450	160	330	170	150	130	110	1700
	Zn ⁶⁵	2	6	2	8	5	2	8	7	40
	As ⁷⁶	60	72	34	46	31	31	38	34	350
	Np ²³⁹	74	90	45	68	38	43	45	39	440

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DIATOMACEOUS EARTH PURGES
OCTOBER, NOVEMBER, DECEMBER, 1964

<u>Date</u>	<u>Reactor</u>	<u>Volume 10⁶ Gal</u>	<u>Total Curies</u>				
			<u>As⁷⁶</u>	<u>P³²</u>	<u>Np²³⁹</u>	<u>Cr⁵¹</u>	<u>Zn⁶⁵</u>
10-8	C	0.4	0.2	<0.1	<0.1	<1	<0.1
10-20	B	1.3	0.6	0.3	2.0	15	0.4
10-30	C	1.5	*	<0.1	2.4	5	7.2
11-4	C	2.0	*	0.1	2.0	64	4.1
11-6	C	4.0	*	0.1	0.3	3	4.6
12-30	DR	1.7	1.1	0.3	11.6	61	7.5

* Sample arrived too late.

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MONTHLY AVERAGE CURIES/DAY
RELEASED FROM ALL REACTORS DURING 1962, 1963, AND 1964

	<u>P³²</u>			<u>As⁷⁶</u>			<u>Np²³⁹</u>			<u>Cr⁵¹</u>			<u>Zn⁶⁵</u>		
	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1962*</u>	<u>1963</u>	<u>1964</u>	<u>1962*</u>	<u>1963</u>	<u>1964</u>
January	35	29	40	230	170	380	440	210	620	3500	1000	1800	120	63	33
February	43	25	44	310	190	360	640	330	600	3000	1400	1800	110	65	46
March	53	43	50	470	510	360	800	540	590	2800	1600	1600	110	36	46
April	53	48	46	470	450	360	750	620	660	4500	1600	1300	270	79	71
May	50	34	49	310	310	420	990	490	870	5200	1300	1600	260	57	66
June	39	32	34	240	300	400	1100	480	760	9200	1400	1700	190	34	58
July	30	30	23	190	270	260	450	450	420	3700	1600	1000	220	40	30
August	35	25	17	210	320	260	490	530	400	2900	2200	1300	110	26	30
September	32	25	20	180	290	330	520	490	400	3000	1800	1400	140	23	37
October	27	31	22	180	310	320	370	490	350	1800	2000	1200	97	31	26
November	20	30	35	160	290	340	375	440	470	2900	1800	1500	74	22	39
December	28	40	37	185	370	350	360	560	440	1700	1900	1700	88	23	40

* Note the higher release rates of chromium-51 and zinc-65 listed in 1962 relative to subsequent years. These reductions are probably not real but actually the result of several sampling technique improvements made during the late months of 1962.

**DATE
FILMED**

8/29/94

END