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MONTHLY REPORT

CONTAMINATION CONTROL - COLUMBIA RIVER

JANUARY, 1966

R. G. Geier

Research and Engineering Section

January 31, 1966

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MONTHLY REPORT
CONTAMINATION CONTROL - COLUMBIA RIVER
JANUARY 1966

I. INTRODUCTION

It is the purpose of this report to present data obtained from the routine reactor effluent radioactivity monitoring program as well as the results obtained from the research and development program directed toward the reduction of effluent radioactivity.

II. PERTINENT ASPECTS OF REACTOR OPERATIONS

A. General

Samples of the effluent from each reactor are obtained each weekday during operation and analyzed for P^{32} , As^{76} , Np^{239} , and Cr^{51} . The Zn^{65} concentration in the effluent from each reactor is obtained semi-monthly from a composite of the daily samples. The above isotopes are monitored because:

1. Phosphorus-32 and Zn^{65} are the nuclides of Hanford origin which are of significance in fish, shellfish, and foodstuffs.
2. Arsenic-76 and Np^{239} are responsible for most of the dose received by drinking water derived from the Columbia River.
3. Chromium-51 is the nuclide released in the greatest quantity downstream of the Hanford plant, but its contribution to dose is relatively small.

B. Phosphorus-32 and Arsenic-76

1. Concentration in Reactor Effluent

a. B and C Reactors

The alum feed rate at B and C Reactors averaged 17 and 18 ppm, respectively, during December. The coolant pH at both reactors was maintained at 6.6, and the sodium dichromate feed rate was held at 1.0 ppm. The average concentration of P-32 and As-76 in the reactor effluent during December, along with some historical data, are shown in the following table:

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	<u>Phosphorus-32</u> <u>pCi/ml</u>		<u>Arsenic-76</u> <u>pCi/ml</u>	
	<u>B</u>	<u>C</u>	<u>B</u>	<u>C</u>
December, 1965	17.7	11.6	205	124
November, 1965	16.0	9.8	274	140
December, 1964	5.8	13.3	140	160
December, 1963	9.8	14.3	105	160

Both the P-32 and As-76 results from C Reactor are about the same as last month and in prior years. Although there has been improvement in the As-76 concentration from B Reactor, both the P-32 and As-76 concentrations are substantially higher than in previous years. At about month end, adjustments were made such that all of the acid for pH adjustment was added through the bauxite conversion box. This is a continuation of the steps initiated in November to improve the B Reactor performance.

b. D Reactor

Laboratory and single-tube in-reactor tests have indicated that the addition of sodium silicate to process water at a concentration of 20 ppm SiO₂ would reduce the amount of radioactivity in the reactor effluent. In order to determine the magnitude of the effluent activity reduction as well as the filming and corrosion effects of using sodium silicate, a half-plant test was initiated at D Reactor on January 15, 1965. The silicate concentration was increased gradually, and test conditions were established on January 25. Other water treatment variables such as 18 ppm alum, 1.0 ppm sodium dichromate, and a coolant pH of 6.6 remained constant since the start of the test. The P-32 and As-76 concentrations from the control and test sides of the reactor have been:

	<u>Phosphorus-32</u> <u>pCi/ml</u>		<u>Arsenic-76</u> <u>pCi/ml</u>	
	<u>Control</u>	<u>Test</u>	<u>Control</u>	<u>Test</u>
December, 1965	8.7	5.4	170	21
November, 1965	6.8	3.8	130	26
October, 1965	6.9	3.5	115	21
September, 1965	4.5	1.7	83	18
August, 1965	2.7	1.7	80	20

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The P-32 concentrations from both sides of the reactor and the As-76 concentration from the control side are higher than last month. The factors of radioactivity reduction for P-32, As-76, Np-239, and Cr-51 were 1.6, 8.1, 5.2, and 5.0. With the exception of P-32, these are higher than observed during November. By the end of November, Panellit pressure increase due to filming in the fringe tubes had exceeded the maximum reached during February and March of 1965.

c. Small Reactor Averages

The average concentrations of P-32 and As-76 in the small reactor effluent are shown below. Long term trends are shown in Figures 1 and 2.

	Phosphorus-32 <u>pCi/ml</u>	Arsenic-76 <u>pCi/ml</u>
December 1965	12.1	140
November 1965	10.4	164
December 1964	9.0	104
December 1963	11.1	114

The P-32 concentration is about the same as last month and in recent years. The As-76 concentration although lower than last month is higher than in prior years.

d. K Plants

The pH of the K Plant coolant remained at 6.6 during December, and the sodium dichromate feed rate was maintained at 1.0 ppm. The alum feed rate was 16.5 ppm at KE Reactor and 7.9 ppm at KW Reactor.

The P-32 and As-76 concentrations in the K Plant effluent during December are shown in the following table, and long-term trends are shown in Figures 1 and 2.

	Phosphorus-32 <u>pCi/ml</u>			Arsenic-76 <u>pCi/ml</u>		
	<u>KE</u>	<u>KW</u>	<u>Avg.</u>	<u>KE</u>	<u>KW</u>	<u>Avg.</u>
December 1965	7.0	9.6	7.9	50	235	142
November 1965	7.7	12.3	10.0	60	275	167
December 1964	6.8	5.7	6.2	38	38	38
December 1963	5.5	5.8	5.7	36	50	43

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The P-32 and As-76 concentrations from KE Reactor are about the same as last month and in prior years. Both the P-32 and As-76 concentrations from KW Reactor showed some reduction from last month and reflect the approach to equilibrium at a nominal alum feed of 6 ppm alum. Early in January the alum feed rate was increased to 9 ppm.

2. Reactor Output

The release rate of P-32 from the five reactors averaged 31 curies per day during December. This compared to 30 curies per day during November and 37 curies per day during December 1965. Thus the 12-month average release rate decreased to 35 curies per day. The release rate of As-76 averaged 440 curies per day during December, and the 12-month average increased from 360 to 370 curies per day.

C. Neptunium-239

1. Concentration in Reactor Effluent

The monthly average Np-239 concentrations in the small and K Reactor effluent are shown in Figure 3. There was a slight decrease at the K Plants and no change at the small reactors.

2. Reactor Output

The release rate of Np-239 from the five reactors averaged 270 curies per day during December, and the 12-month average declined from 380 to 360 curies per day.

D. Chromium-51

1. Concentration in Reactor Effluent

The monthly average concentrations of Cr-51 in the small and K Reactor effluent are shown in Figure 4. There was a small increase at the small reactors and no change at the K Plants.

2. The release rate of Cr-51 averaged 1000 curies per day during December, and the 12-month average decreased from 1200 to 1130 curies per day.

E. Water Plant Operating Conditions

The changes in coolant treatment since mid-1961 are shown in Table I. There were no changes made during December.

III. RESEARCH AND DEVELOPMENT

A. Water Analysis

The analytical data obtained on raw water from 183-B are given in Table II.

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There was no change in sulfate concentration, an increase in phosphate and silica, and a decrease in iron.

B. Zeta Potential

The results of routine measurements of zeta potential of the floc in the water plant settling basins are shown in Table III. The data appear more variable than in the past few months. The difference in alum feed between KE and KW Reactors is quite apparent from the negative zeta potential at KW Reactor.

C. Deionized Water

In-reactor single-tube testing with deionized water has been delayed due to equipment difficulties.

R. G. Geier
Specialist, Effluent Studies
Process and Reactor Development

RGG:vs

TABLE I

WATER PLANT OPERATING CONDITIONS

Alum Feed Rate Changes, ppm

Initially all reactors variable from 3 to 14.

5-1-61	F to 18	1-17-63	1/2 F to 6
7-1-61	B and C to 16	2-15-63	KE, KW Variable 6 to 18
7-6-61	KE and KW to 18	4-1-63	KE, KW to 12
7-15-61	D, DR, and H to 18	5-1-63	KE, KW Variable 12 to 18
9-6-61	KW to 8	10-30-63	1/2 B to 11
10-6-61	KW to 12	1-23-64	1/2 B to 7
12-6-61	KW to 18	5-7-64	1/2 B to 18
3-9-62	KE and KW to 10	5-19-64	1/2 F to 18
4-12-62	KE to 13	2-1-65	KW to 8
4-30-62	KW to 18	3-10-65	1/2 F to 0
5-21-62	KW to 20, KE to 18	5-3-65	1/2 F to 18
9-1-62	KW to 18	8-20-65	KW to 3
		10-15-65	KW to 6

pH Changes

Initially all reactors 7.0.

6-23-61	KW to 6.6	10-18-63	1/2 D to 6.6
9-26-61	KE to 6.6	12-20-63	1/2 D to 6.2
3-1-63	C to 6.6	5-19-64	DR and F to 7.0
3-19-63	1/2 D to 6.6	6-24-64	1/2 D to 6.6
6-12-63	H to 6.6	9-25-64	KE, KW to 7.0
6-20-63	B to 6.6	10-23-64	DR to 6.6
6-23-63	F to 6.6	10-29-64	F to 6.6
7-1-63	DR to 6.8	12-5-64	KW to 6.6
7-14-63	DR to 6.6	12-6-64	KE to 6.6

Dichromate Changes, ppm

Initially all reactors 1.8.

9-20-60	1/2 C to 1.0	6-20-63	B to 1.8
7-1-61	B, F, H, KE to 1.0	6-23-63	F to 1.8
9-26-61	KE to 1.8	7-1-63	DR to 1.8
12-61	D, DR to 1.0	9-5-63	B, D, DR, F, H, KE, KW to 1.4
3-19-63	D to 1.8	4-14-64	B, 1/2 C, D, DR, F, H, KE, KW to 1.0

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TABLE II

WATER ANALYSIS
183-B Raw Water

	<u>SO₄ ppm</u>	<u>SiO₂ ppm</u>	<u>PO₄ ppb</u>	<u>Fe ppb</u>
12-2	15.5	5.8	159	24
3	15.8	6.7	148	23
7	15.5	6.7	159	32
8	14.7	6.0	148	54
9	14.8	6.5	154	58
10	14.7	6.0	151	43
11	14.3	6.3	137	44
16	12.9	6.3	140	37
17	13.0	6.2	154	32
18	13.0	6.2	145	34
19	12.9	6.0	154	70
20	12.8	6.0	151	46
22	14.6	6.0	152	111
23	14.6	5.8	163	65
27	14.8	6.0	160	52
29	22.8	5.8	145	50
31	21.0	6.2	160	60

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TABLE III

ZETA POTENTIAL MEASUREMENTS
(Values in Millivolts)

	<u>B</u>	<u>C</u>	<u>KE</u>	<u>KW</u>
12-20	---	---	+9.7	-10.0
21	+9.5	-11.8	---	---
22	---	---	+4.8	---
27	---	---	0.0	-10.0
28	+7.0	---	---	---
29	---	---	0.0	---
30	0.0	---	---	---
1-5	---	---	+2.8	---
7	---	---	+8.0	---
10	---	---	+6.3	---
12	---	---	+3.7	---
14	---	---	---	+ 4.7

FIGURE 1

P^{32} CONCENTRATION IN REACTOR EFFLUENT

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FIGURE 2

FIGURE 3 - NEPTUNIUM-239 CONCENTRATION IN REACTOR EFFLUENT

FIGURE 4 - CHROMIUM-51 CONCENTRATION IN REACTOR EFFLUENT

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