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series

MONTHLY REPORT

CONTAMINATION CONTROL - COLUMBIA RIVER

MAY, 1966

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By Authority of RL0-C6-4

RE Dydean 11-27-89

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by

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Process and Reactor Development
Research and Engineering Section

June 3, 1966

DOUGLAS UNITED NUCLEAR, INC.

RICHLAND, WASHINGTON

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MONTHLY REPORT
CONTAMINATION CONTROL - COLUMBIA RIVER
MAY, 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 semimonthly 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 April. 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 April, along with some historical data, are shown in the following table:

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	Phosphorus-32		Arsenic-76	
	pCi/ml		pCi/ml	
	<u>B</u>	<u>C</u>	<u>B</u>	<u>C</u>
April, 1966	13.4	12.3	110	110
March, 1966	12.1	10.6	100	110
April, 1965	14.1	17.3	140	130
April, 1964	6.0	19.5	120	150

The As-76 concentration in the effluent from both reactors is about the same as last month and lower than in previous years. The P-32 concentration in B Reactor effluent is about the same as last month and in April, 1965, but higher than in April, 1964. The P-32 concentration in C Reactor effluent although slightly higher than last month is lower than in previous years.

b. D Reactor

The half-plant test using coolant containing 20 ppm SiO_2 was terminated after about 13 months on March 11, 1966. During the test a coolant pH of 6.6, 18 ppm alum and 1.0 ppm sodium dichromate had been maintained constant. The behavior of As-76 and Np-239 during the test indicated that perhaps the silicate provided an environment in which the concentration of parent material in the influent had little to do with the concentration of radioisotope in the effluent. Thus, on March 12, the following conditions were established at D Reactor:

	<u>Test Side</u>	<u>Control Side</u>
SiO_2 , ppm	20	20
Dichromate, ppm	1.0	1.0
pH	6.6	6.6
Alum, ppm	6	18

The reduced alum feed will permit a greater amount of parent material to enter the reactor. In this way, the effect of parent material concentration on silicate effectiveness could be determined.

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The P-32 and As-76 concentrations from the test and control sides of the reactor during recent months have been:

	Phosphorus-32 pCi/ml		Arsenic-76 pCi/ml	
	Control	Test	Control	Test
April, 1966	7.3	6.7	175	60
March 12-31, 1966	14.1	6.8	250	64
March 1-11, 1966	13.6	4.9	240	32
February, 1966	9.8	5.4	185	26
January, 1966	8.9	5.1	120	17

The control side P-32 and As-76 results for April are lower than they have been in recent months. This could be attributed to an unusually early spring peak. The deterioration in the effectiveness of the silicate is also quite apparent. During April, the factors of radioactivity reduction for P-32, As-76, Np-239, and Cr-51 were 1.1, 2.9, 2.7, and 4.6, respectively. These can be compared to the factors of reduction of 2, 6, 4.5, and 5.5 for the same isotope which were obtained during the last nine months of the parent production test.

About mid-May it is planned to increase the alum feed on the test side and reduce the SiO_2 concentration to 15 ppm.

c. Small Reactor Averages

The average concentration 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 pCi/ml	Arsenic-76 pCi/ml
April, 1966	10.9	115
March, 1966	10.8	120
April, 1965	13.8	110
April, 1964	10.7	115

Both the P-32 and As-76 concentrations are virtually identical with last month and in previous years.

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d. K Plants

The pH of the K-Plant coolant remained at 6.6 during April, and the sodium dichromate was maintained at 1.0 ppm. The alum feed rate was 14.3 ppm at KE Reactor and 11.4 ppm at KW Reactor.

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

	Phosphorus-32			Arsenic-76		
	pCi/ml			pCi/ml		
	<u>KE</u>	<u>KW</u>	<u>Avg.</u>	<u>KE</u>	<u>KW</u>	<u>Avg.</u>
April, 1966	7.8	8.3	8.0	65	110	88
March, 1966	7.9	9.5	8.7	60	130	95
April, 1965	9.7	11.6	10.6	55	105	80
April, 1964	10.0	10.4	10.2	50	65	58

The P-32 concentrations are lower than last months and in previous years. The As-76 concentration in the KE-Reactor effluent is higher than last month while in the KW-Reactor effluent the As-76 is lower than last month. The improvement is probably due to the increase from 9 to 12 ppm alum which took place March 27, 1966.

2. Reactor Output

The release rate of P-32 from the five reactors averaged 29 curies per day in April. This compares to 33 curies per day in March and 56 curies per day in April, 1965. The 12-month average release rate decreased from 31 to 29 curies per day. The release rate of As-76 averaged 300 curies per day during April, and the 12-month average remained at 380 curies per day.

C. Neptunium-239

1. Concentration in Reactor Effluent

The monthly average concentrations in the small and K-Reactor effluent are shown in Figure 3. There was a small increase at both the small and K Reactors.

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2. Reactor Output

The release rate of Np-239 from the five reactors averaged 310 curies per day during April, and the 12-month average decreased from 320 to 300 curies per day.

D. Chromium-51

1. Concentration in Reactor Effluent

The monthly average concentrations of Cr-51 are shown in Figure 4. There was a small increase at both the small and the K Reactors.

2. Reactor Output

The release rate of Cr-51 from the five reactors averaged 920 curies per day during April, and the 12-month average declined from 1020 curies per day to 990 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 in April.

Beginning the last week in April a half-plant test was initiated to evaluate the use of bauxite obtained from Alabama in contrast to normal bauxite which is obtained from South America. Both cost advantage and the development of a United States source are factors prompting the test. To date the Alabama bauxite appears to be operating satisfactorily.

III. RESEARCH AND DEVELOPMENT

A. Water Analysis

The analytical data on the phosphate, iron, sulfate, and silica content of raw water are given in Table II. Comparing the April averages of 129 ppb PO_4 , 105 ppb Fe, 20.5 ppm SO_4 , and 6.7 ppm SiO_2 with the March averages of 216, 69, 17.5, and 6.5 shows a marked decrease in phosphate and an increase 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 average values for May were

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<u>Reactor</u>	<u>Zeta Potential</u>
B	-5.4
C	-6.0
KE	-5.3
KW	-8.7

The effect of the lower alum feed at KW Reactor is still apparent.

In preparation for a test using zeta potential as a basis for alum feed control, an operator training program in the use of the zeta potential instrumentation was initiated at C Reactor.

C. Arsenic Addition

The addition of 2.5 ppb arsenic to two tubes was started. The determination of inert and radioarsenic in the influent and effluent will assist in determining the adsorption-release kinetics.

D. Film Studies

Sections from two process tubes were obtained during the month for film studies. The inventory of both parent and radio material will be determined.

E. Lithium Silicate

The results of the test using lithium silicate coated fuel have been documented in:

BNWL-CC-642, "Effect of Lithium Silicate Coating on Effluent Activities," W. B. Silker, April 8, 1966.

F. Water Treatment Pilot Plant

Tests are continuing to study the influence of pH and zeta potential on effluent activity.

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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	2/15/63	KE, KW Variable 6 to 18
7/1/61	B and C to 18	4/1/63	KE, KW to 12
7/6/61	KE and KW to 18	5/1/63	KE, KW Variable 12 to 18
7/15/61	D, DR, and H to 18	10/30/63	1/2 B to 11
9/6/61	KW to 8	1/23/64	1/2 B to 7
10/6/61	KW to 12	5/7/64	1/2 B to 18
12/6/61	KW to 18	5/19/64	1/2 F to 18
3/9/62	KE and KW to 10	2/1/65	KW to 8
4/12/62	KE to 13	3/10/65	1/2 F to 0
4/30/62	KW to 18	5/3/65	1/2 F to 18
5/21/62	KW to 20, KE to 18	8/20/65	KW to 3
9/1/62	KW to 18	10/15/65	KW to 6
1/17/63	1/2 F to 6	1/12/66	KW to 9
		3/11/66	1/2 D to 6
		3/27/66	KW to 12

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

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TABLE I (Cont.)Dichromate Changes, ppm

Initially all reactors 1.8

9/20/60	1/2 C to 1.0	6/20/63	D 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>
4-1	19.7	7.3	148	88
2	19.8	7.4	146	104
3	18.9	7.4	126	88
4	27.6	7.4	148	66
5	22.7	6.2	157	80
6	21.9	6.5	146	92
7	22.4	6.2	140	84
8	22.4	6.6	137	70
9	22.4	6.8	128	68
10	22.8	7.0	131	86
11	22.4	6.1	120	74
12	20.1	5.8	123	68
13	18.9	5.8	157	107
14	19.9	5.6	126	62
15	19.9	5.8	117	71
16	19.7	5.6	102	72
17	18.6	5.6	143	148
18	19.3	5.6	91	72
25	20.4	5.9	105	94
26	20.2	8.2	126	151
27	20.0	7.7	105	192
28	19.5	8.2	143	194
29	19.3	8.2	134	189
30	20.0	7.4	108	200

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TABLE III

ZETA POTENTIAL MEASUREMENTS

Values in Millivolts

	<u>B</u>	<u>C</u>	<u>KE</u>	<u>KW</u>
4-18	--	--	-2.5	--
19	+3.2	0.0	--	--
20	--	--	0.0	--
21	--	0.0	--	--
22	--	--	-.34	--
25	--	--	0.0	--
26	0.0	0.0	--	--
27	--	--	-3.4	--
28	-3.5	02.6	--	--
29	--	--	0.0	--
5-3	-4.5	-4.4	--	--
4	--	--	--	-9.7
5	-7.0	-7.0	--	--
6	--	--	-5.2	--
9	--	--	-5.0	-6.2
10	-9.5	-5.5	--	--
11	--	--	-4.5	-10.0
12	-6.2	-10.1	--	--
13	--	--	-5.2	-13.0
16	--	--	-9.5	-12.8
17	-3.0	-5.0	--	--
18	--	--	-7.0	-10.0

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TABLE III (Cont.)

	<u>B</u>	<u>C</u>	<u>KE</u>	<u>KW</u>
5-19	-4.0	-4.6	--	--
20	--	--	-3.8	-6.2
23	--	--	-3.5	-3.5
24	--	-5.5	--	--
25	--	--	--	-9.3
26	-4.0	--	--	--
27	--	--	-4.2	-7.0

P³² CONCENTRATION IN REACTOR EFFLUENT

FIGURE 1

[REDACTED]
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As⁷⁶ CONCENTRATION IN REACTOR EFFLUENT

FIGURE 2

[REDACTED]

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Np²³⁹ CONCENTRATION IN REACTOR EFFLUENT

FIGURE 3

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Cr⁵¹ CONCENTRATION IN REACTOR EFFLUENT

FIGURE 4

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