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T I T L E

INTERIM REPORT II - PRODUCTION TEST IP 581-A
HALF-PLANT HIGH FLOCCULATION pH
TEST AT B REACTOR

AUTHOR

ISSUING FILE

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INTERIM REPORT II - PRODUCTION TEST IP-581-A

HALF-PLANT HIGH FLOCCULATION pH TEST AT B REACTOR

R. G. Geier
Process and Reactor Development
Research and Engineering
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INTRODUCTION

A half-plant high flocculation pH test⁽¹⁾ began at B Reactor on September 24, 1963. The purpose of the test was to determine whether operation of the water plant flocculation basins and filters at a pH higher than 7.0 with subsequent coolant pH adjustment to 6.6 is beneficial as far as radioactivity in the effluent is concerned. It is planned to increase the flocculation basin pH in steps to a maximum of 7.6. Although primarily an effluent activity test, fuel discharged after a metal cycle at each water plant condition will be monitored by visual examination. Thus, it will be possible to determine whether the incidence of localized corrosion is influenced by the various modes of operation. One 20 column fuel discharge, ten columns from each side of the reactor, was obtained prior to the start of the test.⁽²⁾ This report discusses the results obtained from the first discharge of fuel under test conditions.

SUMMARY

Fuel representative of 20 columns which had been charged on December 9, 1963, was discharged from B Reactor on January 21, 1964. Visual examination data from the 440 fuel elements, 240 from the far side and 200 from the near side, gave the following results:

1. There was no significant difference in the incidence of localized corrosion between the two sides of the reactor.
2. Although the incidence of ledge corrosion was higher than in the previous 20 column discharge it remained low.
3. The incidence of groove corrosion was nil.

The concentrations of P-32, As-76, Np-239, and Cr-51 in the effluent from the two sides of the reactor indicated that the higher flocculation pH might have compensated for the reduced alum feed to some extent but not completely.

DISCUSSION

Water Treatment

In order to determine whether or not operating the water plant flocculation basins and filters at a higher pH would be beneficial as far as the concentration of radioisotopes in the reactor effluent is concerned, a half-plant test was started at B Reactor. Prior to the start of the test both sides of the water plant operated at the following conditions:

Dichromate, ppm	1.5
Alum, ppm	18
Flocculation pH	7.0
Reactor pH	6.6

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After the outage of September 20, 1963, conditions were changed to:

	Control Side (Far)	Test Side (Near)
Dichromate, ppm	1.5	1.5
Alum, ppm	18	10-12
Flocculation pH	7.0	7.3
Reactor pH	6.6	6.6

Test conditions were maintained until October 8, 1963, when a filming situation which manifested itself particularly on the near side forced a return to pre-test conditions. A second attempt made on October 30, 1963, to establish test conditions was successful, and the conditions were maintained until the outage which began on January 21, 1964. Thus, almost three months of sustained operation was achieved.

Following the outage of January 21, 1964, water plant operating conditions were changed to:

	Control Side (Far)	Test Side (Near)
Dichromate, ppm	1.5	1.5
Alum, ppm	18	6-8
Flocculation pH	7.0	7.6
Reactor pH	6.6	6.6

Fuel Element Characteristics

Twenty columns of fuel elements, ten from each side of B Reactor, which had been charged during the outage of December 9, 1963, were discharged during the outage of January 21, 1964. The average irradiation conditions are shown in the following table.

	<u>Far Side</u>	<u>Near Side</u>
Exposure, MWD/T	360	365
Tube Power, kw	1210	1220
Tube Inlet Temp., °C	6.5	6.5
Tube Outlet Temp., °C	105.5	105.5
Tube Flow, gpm	46.5	47.0
Calendar Days in Reactor	44	44
Operating Days	36	36
Tube Age, Month	20	18
Fuel Charge	31 OIIIN+WM	31 OIIIN+WM

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In contrast to the pre-test fuel discharge in which the tubes had been selected to provide a difference in irradiation conditions between the two sides, the tubes for the present discharge were selected to provide similar irradiation conditions on the two sides. Inspection of the above table indicates that the irradiation conditions are essentially the same.

For comparative purposes the average irradiation conditions for both discharges are compared below.

	<u>Pre-test Fuel</u>	<u>Present</u>
Exposure, MWD/T	670	360
Tube Power, kw	1000	1215
Tube Outlet Temp., °C	19.0	6.5
Tube Inlet Temp., °C	95.5	105.5
Tube Flow, gpm	49.2	46.8
Tube Age, Month	22	19

Although the exposure of the present fuel is lower than that of the previous fuel, both outlet temperature and tube power are higher.

Visual Examination

1. Definitions

Visual fuel element examination identifies the serious type of corrosion attack as well as recognizing the presence of secondary effects. A fuel element may exhibit pitting, uniform, ledge or groove corrosion. Both primary and secondary are reported according to the following definitions:

Primary -- Type of corrosion considered most detrimental to fuel survival.

Secondary - Type of corrosion, although less important than primary, which may be a potential cause of future corrosion problems.

The severity of corrosion is categorized as follows:

Code 2 -- Corrosion judged to be 10 mils deep.

Code 3 -- Penetration to the Al-Si.

2. Results

The fuel from 20 B Reactor columns was discharged on January 22, 1964. An inadvertent mixing of some of the fuel at the time of discharge resulted in the recovery of 200 and 240 pieces which could be identified as near and far side pieces, respectively. An analysis of the visual examination data from the 440 fuel elements produced the following results.

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	<u>Localized Corrosion Incidence</u>			
	<u>Per Cent of Pieces</u>			
	<u>Present</u>			<u>Pre-test</u>
	<u>Near</u>	<u>Far</u>	<u>Over-all</u>	<u>Over-all</u>
Primary Ledge	4.0	6.2	5.2	1.0
Secondary Ledge	0.0	0.0	0.0	0.0
Primary Groove	0.5	0.4	0.7	1.3
Secondary Groove	0.0	0.4	0.2	0.0
Severity - Code 2	2.5	0.4	1.4	2.0
Severity - Code 3	0.0	0.4	0.2	0.0

The data indicate no significant difference in the incidence of localized corrosion between the near and far side fuel.

Although the incidence of ledge corrosion has increased over that found in the previous fuel discharge, it is still quite low. The incidence of groove corrosion remains essentially nil.

Effluent Activity

The primary purpose of the test was to determine whether the operation of the water plant flocculating basins and filters at a pH higher than 7.0 would be beneficial as far as effluent activity is concerned. During the period that the test side water plant pH was 7.2, the effluent from both sides of the reactor was sampled each weekday that the reactor was operating. The samples were analyzed for phosphorus-32, arsenic-76, neptunium-239, and chromium-51. Monthly average analytical results are given in Table I.

The data show that both P-32 and As-76 concentrations are from 15 to 20 per cent higher in the test side effluent. This is a smaller difference than might be expected from the reduction in alum feed required to increase the flocculating basin pH. The 50 per cent higher Np-239 concentration in the test side effluent is about that which would have been anticipated as would the similarity in Cr-51 concentration. Thus, it would appear that while the higher water plant pH might have compensated to some extent for the reduced alum feed it does not completely do so.

REFERENCES

- (1) HW-76996, "Production Test IP-581-A - Half-Plant High Flocculation pH Test at B Reactor," R. G. Geier, May 1, 1963.
- (2) HW-76996-A, "Interim Report I - Production Test IP-581-A - Half-Plant High Flocculation pH Test at B Reactor," R. G. Geier, October 31, 1963.

R. G. Geier

TABLE I
HIGH FLOCCULATION pH TEST
REACTOR EFFLUENT RADIOISOTOPE CONCENTRATIONS

	Phosphorus-32		Arsenic-76		Neptunium-239		Chromium-51	
	pc/ml		pc/ml		pc/ml		pc/ml	
	<u>Test</u>	<u>Control</u>	<u>Test</u>	<u>Control</u>	<u>Test</u>	<u>Control</u>	<u>Test</u>	<u>Control</u>
January 1964 ⁽¹⁾	11.6	9.7	103	89	295	185	340	330
December 1963	10.2	9.4	111	95	260	175	335	330
November 1963	7.8	8.8	100	122	270	180	350	350

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