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HALF-PLANT LOW ALUM FEED WATER TREATMENT
AT F REACTOR

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INTERIM REPORT VI. PRODUCTION TEST IP-549-A
HALF-PLANT LOW ALUM FEED WATER TREATMENT
AT F REACTOR

By

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INTERIM REPORT VI, PRODUCTION TEST IP-549-A
HALF-PLANT LOW ALUM FEED WATER TREATMENT
AT F REACTOR

INTRODUCTION

A half-plant low alum water treatment test^[1] began at F Reactor on January 16, 1963. The test, which had been prompted by the analysis of ledge corrosion attack on fuel elements,^[2] will demonstrate whether or not high alum feed is responsible for increasing the frequency of ledge and groove corrosion^[3] attack on fuel element surfaces. The effect will be evaluated by comparing visual examination results obtained from the normal production fuel irradiated in process water treated with two different alum feed rates. Five 20-column fuel discharges, ten columns from each side of the reactor, have been taken during the test as follows:

1. One discharge prior to the start of the test.^[4]
2. One discharge such that the test side was exposed to coolant treated with both high and low alum feed.^[5]
3. Three discharges under test conditions.^[6,7,8]

This report discusses the results obtained from the fourth discharge under test conditions.

SUMMARY

The visual examination data from 619 F-Reactor fuel elements which had been charged on September 9, 1963, and discharged on December 5, 1963, gave the following results:

1. Primary ledge corrosion occurred on 8 per cent of the near side pieces and 7 per cent of the far side pieces.
2. Groove corrosion was evident on less than 1 per cent of the pieces.

The incidence of ledge corrosion is lower than it has been since May 1963, and indicates a moderation of the combination of variables responsible for ledge corrosion. The absence of groove corrosion continues a trend which began at F Reactor early in 1963.

DISCUSSION

A. Water Treatment

In order to determine whether high alum feed water treatment was responsible for an increased frequency of occurrence in the types of localized corrosion described as groove and ledge, the following half-plant test conditions were established at F Reactor on January 16, 1963.

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	<u>Control Side</u> <u>(Near)</u>	<u>Test Side</u> <u>(Far)</u>
pH	7.0	7.0
Dichromate, ppm	1.0	1.0
Alum, ppm	18.0	6.0

Test conditions were changed following startup from June 19, 1963, outage to:

	<u>Control Side</u> <u>(Near)</u>	<u>Test Side</u> <u>(Far)</u>
pH	6.6	6.6
Dichromate, ppm	1.8	1.8
Alum, ppm	18.0	6.0

The change was in conformance with the reduction in pH made at the smaller reactors to prolong process tube life.

During the irradiation period of the fuel discussed in this report (September 9 - December 5), the alum feed to the test side was maintained at 6 ppm.

B. Fuel Element Characteristics

Twenty columns of fuel elements, ten from each side of the reactor, which had been charged during the outage of September 9, 1963, were discharged during the outage of December 5, 1963. The average irradiation conditions are shown in the following table.

	<u>Control Side</u> <u>(Near)</u>	<u>Test Side</u> <u>(Far)</u>
Exposure, Mwd/t	621	618
Tube Power, kw	1121	1117
Tube Inlet Temperature, °C	15.5	15.5
Tube Outlet Temperature, °C	105.0	106.0
Tube Flow, gpm	47.0	46.5
Calendar Days in Reactor	87	87
Operating Days	69	69
Tube Age, Months	21	19
Fuel Charge	31 pc OIIIN + WM	31 pc OIIIN + WM

As has been the case with previous fuel discharges made during the production test, conditions on each side of the reactor were essentially identical.

For comparative purposes, the average irradiation conditions for all the fuel discharges made during the test are given in Table I. With very few exceptions, the irradiation variables have been held quite constant.

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C. Visual Fuel Element Examination

1. Definitions

Visual fuel element examination identifies the serious type of corrosion attack as well as recognizing the presence of secondary effects. While a fuel element may exhibit several types of corrosion (pitting, uniform, ledge, or groove), only 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 analysis of the visual examination data from 619 fuel elements, 309 from the near side and 310 from the far side of F Reactor, produced the results shown below.

	<u>Localized Corrosion Frequency</u>		
	<u>Per Cent of Pieces</u>		
	<u>Near</u>	<u>Far</u>	<u>Over-all</u>
Primary Ledge	7.8	7.1	7.5
Secondary Ledge	0.0	0.0	0.0
Primary Groove	1.3	0.0	0.6
Secondary Groove	0.0	0.0	0.0
Severity - Code 2	0.7	0.3	0.5
Severity - Code 3	0.0	0.3	0.2

The results from previous fuel discharges made prior to and under the production test are shown in Table II.

The following items are of interest in connection with the results from the present fuel.

- a. The incidence of ledge and groove corrosion was the same on both sides of the reactor. This confirms the conclusion reached previously that if there is an alum effect it is of secondary importance.

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- b. The over-all incidence of ledge corrosion was lower than it has been at F Reactor since May 1963.
- c. The negligible incidence of groove corrosion observed at F Reactor throughout 1963 continued.
- d. As in the past, on 90 per cent of the pieces showing ledge corrosion, the ledging occurred on the bottom of the fuel element. On the other hand 80 per cent of hot spots occurred on the top of the fuel element.

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TABLE I
AVERAGE IRRADIATION CONDITIONS
OF LOW ALUM HALF-PLANT TEST
FUEL DISCHARGES

	<u>Pre-Test</u>	<u>First Test</u>	<u>Second Test</u>	<u>Third Test</u>	<u>Fourth Test</u>	<u>Fifth Test</u>
Discharge Date	1/3/63	3/29/63	5/6/63	6/19/63	9/9/63	12/5/63
Exposure, Mwd/t	565	940	645	650	685	620
Tube Power, kw	1125	1140	1160	1125	1065	1120
Tube Inlet Temperature, °C	102.5	98.0	98.5	100.0	104.0	105.5
Tube Outlet Temperature, °C	14.0	7.0	7.0	10.0	17.5	15.5
Tube Flow, gpm	48.2	47.6	47.8	47.6	46.7	46.7
Tube Age, Months	9.0	11.5	12.5	14.0	17.0	20.0
Fuel Charge	32	31 + WM	31 + WM	31 + WM	31 + WM	31 + WM

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TABLE II

THE INCIDENCE OF LOCALIZED
CORROSION ON THE LOW ALUM
HALF-PLANT FUEL ELEMENTS

	<u>PT-216 Data</u>	<u>Pre-Test</u>	<u>First Test</u>	<u>Second Test</u>	<u>Third Test</u>	<u>Fourth Test</u>	<u>Fifth Test</u>
Charge Date	-----	10/1-11/3/62	11/22/62	2/19/63	3/29/63	6/19/63	9/9/63
Discharge Date	7/61-12/62	1/3/63	3/29/63	5/6/63	6/19/63	9/9/63	12/5/63
Primary Ledge	10.5	15.7	8.0	1.4	11.5	22.1	7.5
Secondary Ledge	4.5	4.3	1.2	0.0	0.6	0.2	0.0
Primary Groove	6.2	8.4	0.5	0.2	0.7	0.0	0.6
Secondary Groove	3.6	8.4	1.9	0.2	0.3	0.0	0.0

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