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HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

Base

November 14, 1958

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TITLE

PRODUCTION TEST IP-207-A-3 FP
EVALUATION OF EFFLUENT CONTAMINATION PROBLEMS
ASSOCIATED WITH NICKEL-COATED FUEL ELEMENTS

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November 14, 1958

PRODUCTION TEST IP-207-A-3 FP
EVALUATION OF EFFLUENT CONTAMINATION PROBLEMS
ASSOCIATED WITH NICKEL-COATED FUEL ELEMENTS

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OBJECTIVE

The objective of this test is to evaluate the effluent water contamination problems associated with the use of nickel plate corrosion barriers on X-8001 and C-64 clad I & E fuel elements.

TEST SUMMARY

This test authorizes irradiation of two charges of control material, and two charges each of the two methods of plating an aluminum jacketed slug as summarized below:

- 1) Electroplating - Electrolytic deposition of a nickel plate on all surfaces of an I & E fuel element.
- 2) Electroless Plating - Chemical deposition of a nickel plate on all surfaces of an I & E fuel element using the "Kanigan" process of chemical reduction of the Nickel Ion.

Irradiation will be to goal exposures of 400 and 800 MWD/T in the charge-discharge test facility at C Reactor, which will permit periodic effluent water samples to be drawn from each tube.

TEST DETAILS

Nickel plating of I & E fuel elements provides a means of increasing the corrosion resistance of aluminum clad elements without excessive reactivity losses. Previous work has indicated that plates as thin as 0.04 mils may be accurately applied to aluminum jacketed fuel elements and in fact, does reduce corrosion attack on these elements. Some difficulties were experienced due to fractures and penetrations of the very thin plates; however, these problems presumably could be solved with further investigations.

Two methods of obtaining the nickel plate have been used successfully for fabrication of corrosion samples:

- a) Electroplating - Electrolytic deposition of nickel from a nickel salt solution, and
- b) Electroless - Chemical deposition of nickel from a chemical bath using aqueous sodium Hypophosphite as a reducing agent.

The former method produces a less uniform plate, requires extensive equipment modification and may require a heat-pressing after plating to assure an integral plate. The latter method eliminates many of the above problems but does produce a plate with up to 15% contained phosphorous.

The activation products of nickel and its contaminants are the subjects of study in this test.

The possible significant reactions are:

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It is not known which activation products will be significant or even detectable as a result of nickel plated slug usage; especially since a previous study on M-388 (~ 1% Ni in Al) slug jackets indicated no detectable change in effluent water composition or discharge area dose rates. Of the possible activation products probably Ni⁶³, Co⁵⁸ and Co⁶⁰ are the most significant potential river contaminants.

The activation of Phosphorus to form Phosphorus-32 is also important. Phosphorus-32 released to the river in reactor effluent water is concentrated by aquatic life and ultimately made available to humans in the flesh of food fish (principally whitefish). The concentration of P³² in the flesh of whitefish reaches levels that approach limiting amounts for human consumption during August, September and October. Studies are in progress to determine ways to reduce the P³² output in reactor effluent water and anything that would increase the amount of P³² in the river during these three months is discouraged.

Even though the technology of nickel plating has not been advanced to the point where fuel elements would be acceptable for large scale, high temperature and exposure irradiation; elements can now be fabricated which will provide an insight into one major problem; i.e., effluent contamination. Since information regarding effluent contamination is a necessity before excessive funds are expended on development work, and since these data may be obtained with fuel elements without perfect plate, it is proposed to perform this preliminary irradiation at current operating conditions. Since effluent water samples may be readily obtained during irradiation in the charge-discharge facility at C Reactor, this location was chosen for the test.

TEST DETAILS

1. Fuel Elements

All fuel elements used for this test shall be normal production CIIN fuel elements canned in C-64 alloy by the F Process. All test elements shall meet normal quality control requirements. After plating they shall be visually inspected and autoclave tested to insure jacket integrity and to eliminate slugs damaged in the process.

- a) The fuel elements clad by the electroplating method will be clad at HAPO with approximately 0.8-1.0 mils of nickel plate.
- b) The electroless clad elements will be clad off-site by the "Kanigan" process with approximately 0.5-1.0 mils of plate.
- c) Control material shall be normal production C-64 alloy clad CIIN fuel elements from the same HAPO lot as the clad elements.

2. Pre-irradiation Measurements

All fuel elements shall be weighed and individually numbered; and pre-irradiated measurements of length, diameter and warp shall be recorded.

3. Charging

Up to four columns of test and two columns of control material may be irradiated under this test in the charge-discharge pattern at C Reactor. All columns shall be charged normally in numerical order with piece number one downstream.

4. Irradiation

During irradiation daily temperature and weekly flow data shall be recorded for all tubes in this test. (Data sheets will be provided). In addition, periodic effluent water samples shall be obtained.

5. Discharge

All columns shall be discharged, picked up special and held for post-irradiation examination.

6. Post-Irradiation Examination

a) Post-irradiation measurements of length, diameter, warp and weight will be made on all elements.

b) All fuel elements will be visually examined and weaseled.

7. Hazards

Even though fuel elements with imperfect nickel plate may be utilized in this test, no hazards peculiar to this test are expected; however, one column of each plating process and one control column will be discharged at 400 MWD/T to evaluate any unforeseen difficulties.

8. Exposure

The columns shall be irradiated to the exposures indicated below:

<u>Column</u>	<u>Material</u>	<u>Goal</u>
1	Electroplated Elements	400
2	Electroplated Elements	800
3	Chemically Plated CIIN Elements	400
4	Chemically plated CIIN Elements	800
5	Control Elements	400
6	Control Elements	800

9. Tube Condition

This test shall be charged into process tubes in the approximate corrosion index range of 10-15 to prevent a limiting condition and to maintain sufficiently high top-of-annulus conditions.

COSTS

All incremental costs incurred in relation to this test may be charged to XXXX-5320XXX.04. Approximate outage time requirements for this test are listed below for scheduling purposes:

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<u>Job</u>	<u>Manhours Processing</u>	<u>Elevator Time</u>
Charge Columns	2/3 mh/tube	1/6 hr/tube
Discharge and Special Pickup of Test Columns	1 mh/tube	1/4 hr/tube

RESPONSIBILITIES

Hanford Laboratories Operation

Reactor and Fuels Research and Development Operation

The fuels Development Operation shall be responsible for plating of the electroplated fuel elements, and for coordination of the HLO portion of this test.

Fuels Preparation Department

Manufacturing Operation

The Manufacturing Operation shall be responsible for canning all pieces by the F Process, for normal quality control, and for pre-irradiation measurements and marking. They shall also arrange to provide the chemically plated elements which will be plated off-site.

Engineering Operation

The Engineering Operation shall be responsible for liaison in the 300 Area portion of this test, and for providing technical assistance.

Irradiation Processing Department

Research and Engineering Operation

Process Technology Operation shall be responsible for assistance in scheduling, choice of test channels, assistance in charging of the test, and for forwarding of operating data to the author.

Process and Reactor Development Operation shall be responsible for coordination of the test, data analysis and reporting of irradiation experience.

Component Testing Operation shall be responsible for obtaining post-irradiation examination data.

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B-C Reactor Operation

C Processing Operation will be responsible for planning, scheduling, the operational safety and production continuity of the reactor, and for collection of routine operating data for the test.

Reactor Fuels Operation
Process & Reactor Development
IRRADIATION PROCESSING DEPARTMENT

Radiological Engineering Operation
Process & Reactor Development
IRRADIATION PROCESSING DEPARTMENT

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7/18/94

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