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PRODUCTION TEST IP-455-A
COMPARISON OF N REACTOR INNER FUEL TUBES
WITH DIFFERENT PRE-IRRADIATION WARP CONDITIONS

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November 2, 1961

PRODUCTION TEST IP-455-A
COMPARISON OF N REACTOR INNER FUEL TUBES
WITH DIFFERENT PRE-IRRADIATION WARP CONDITIONS

IRRADIATION PROCESSING DEPARTMENT

by

W. K. Kratzer

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CG-PR-2, 3-3-94

By J E Savely 3-25-94

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PRODUCTION TEST IP-455-A
COMPARISON OF N REACTOR INNER FUEL TUBES
WITH DIFFERENT PRE-IRRADIATION WARP CONDITIONS

OBJECTIVE

The objective of this production test is to compare the irradiation behavior of N Reactor inner fuel tubes (NIEl elements) having negligible warp after beta heat treatment to the behavior of NIEl elements with extensive warp after beta heat treatment which were straightened and beta heat treated a second time. The information from this test will be used in the development of a program to evaluate the irradiation behavior of NIEl elements in various conditions of pre-irradiation warp and straightening.

SUMMARY

Five twenty-three inch NIEl elements, two with negligible warp after beta heat treatment and three with excessive warp after beta heat treatment which were subsequently straightened and heat treated a second time, will be irradiated in either KER-1 or KER-2 to exposures not greater than 1000 MWD/T. Modified sleeves of a design verified by preliminary KER-1 process tube probing will be required for the twenty-three inch elements irradiated in KER-1.

BASIS AND JUSTIFICATION

The present Coextrusion Process Specifications⁽¹⁾ for N Reactor inner fuel tubes sets up three categories of fuel warp after beta heat treatment:

- a. Elements warped less than .030 inch, which are acceptable.
- b. Elements warped more than .030 inch, but less than .075 inch. These are cold straightened and beta heat treated a second time. The elements are acceptable if the warp after the second heat treatment is less than .030 inch.
- c. Elements warped more than .075 inch, which are rejected.

A program is being developed to assess the effect of fuel element pre-irradiation warp condition on fuel distortion during irradiation. To obtain preliminary information to be used in preparing such a program, this test authorizes the irradiation of two NIEl elements with initial warp less than .030 inch and three NIEl elements with initial warp greater than .075 inch that have been cold straightened and beta heat treated a second time to give a residual warp less than a .030 inch. Irradiation of the five elements planned for this test will give an indication of the difference, if any, to be expected from the two types of material, and also provide confidence for the irradiation of such material to even higher exposures if no abnormal behavior is observed at 1000 MWD/T.

TEST DETAILS

1. Fuel Elements

The fuel elements shall consist of five twenty-three inch N Reactor inner fuel tubes that meet all the process, inspection, and dimensional requirements

(1) HW-69941, Coextrusion Process Specifications, August, 1961. (CONFIDENTIAL)

given in the Coextrusion Process Specifications except:

- a. Three of the elements shall have greater than .075 in. warp after beta heat treatment. These elements shall then be straightened and beta heat treated a second time producing a final warp less than .030 inch.
- b. The fuel element supports shall be sized to fit in a 1.500 inch ID sleeve.

Zr-2 sleeves, the same length as the fuel elements, will be used on all elements. The sleeves for use in KER-2 are 1.500 inch ID and 1.900 inch OD with N Reactor outer fuel tube supports at each end.

The sleeves for KER-1 are similar except that the ends and midpoint have been reduced to 1.810 inch OD as shown in H-1-33196 to permit easier passage through the KER-1 process tube.

2. Loading

The tube loading will be given in a document approved by Process Technology Operation and Process and Reactor Development Operation prior to charging. Coupon holders of a design approved by Coolant Testing Operation and Process and Reactor Development Operation may be included in the charge in positions not affecting the fuel element test.

3. Irradiation Facility

The fuel elements may be irradiated in KER high temperature recirculating loops 1 or 2.

4. Operating Conditions

The coolant will be pressurized water with the pH adjusted to 10.0 ± 0.5 by the addition of LiOH. The low pressure trip will be set at 1500 psig. For a charge in loop 2, the desired operating flow is 60 gpm with a low flow trip of 48 gpm. For a charge in loop 1, the desired operating flow is 50 gpm with a low flow trip of 40 gpm. The high outlet temperature trip, maximum operating outlet temperature, desired operating outlet temperature (which can be varied at the discretion of the test author as long as it does not exceed the maximum operating outlet temperature), and boiling point suppression trip will be given for each loading in a document approved by Process Technology Operation and Process and Reactor Development Operation prior to charging.

If recirculation with system pressures less than 1500 psig is required, the outlet temperature will be reduced and maintained at a temperature such that fuel surface temperatures will be less than the coolant saturation temperature and local channeled coolant temperatures are sufficiently below the coolant saturation temperature to preclude sub-cooled burnout.

5. Power and Temperature Limits

The operating conditions will be chosen so that surface boiling will not occur on the fuel elements during normal operation, burnout will not occur at the limiting trip conditions, and the maximum uranium temperature will not exceed 600 C.

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6. Exposure

The maximum exposure authorized by this production test is 1000 MWD/T.

7. Special Procedures

KER-1 will be probed with one of the KER-1 sleeves prior to charging to verify that the sleeve will pass through the process tube. The fuel elements from this production test will be discharged into a special tray according to procedures developed by the KE Maintenance Operation.

8. Priority

Additional down-time is authorized if charging or discharging cannot be accomplished during a normal outage.

9. Costs

a. Cost Code: XXX-5R24-XXX.73.

b. Time for each loading:

	<u>Elevator Time, Hours</u>		<u>Manhours</u>
	<u>Front</u>	<u>Rear</u>	
Charge	<u>1</u>	<u>1</u>	4
Discharge	<u>2</u>	<u>4</u>	10
	<u>3</u>	<u>5</u>	14

c. Reactivity Change: The test loading will have a reactivity intermediate between that of a dummy charge and a standard charge of normal fuel elements.

10. Data Desired

Routine operating data, including coolant flow, inlet and outlet temperature and pressure, system pressure, and operating time at temperature, will be taken during irradiation.

11. Hazards

The principal hazard involved in this test is the potential for failure of one of the elements resulting from excessive warp causing contact of the element with its sleeve. Such a failure would result in an unscheduled reactor outage, but would cause no damage to the process tube because of the protecting sleeve.

RESPONSIBILITIES

Fuels Preparation Department

Engineering Section

Coextruded Product Engineering is responsible for procuring the fuel elements and for routine inspections and measurements.

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Hanford Laboratories Operation

Reactor and Fuels Research and Development Operation

Fuels Development Operation

Fuel Element Design Operation is responsible for fuel evaluation, nonroutine fuel characterization, analysis of data, and issuance of technical reports.

Irradiation Processing Department

Research and Engineering Operation

Component Testing Operation is responsible for post-irradiation examination and testing of components in the test charge.

Coolant Testing Operation is responsible for:

- a. Operation of the KER Loops.
- b. Taking basic operating data.
- c. Scheduling the loop charge with the concurrence of KE Processing Operation.
- d. Reactor safety and production continuity as they are affected by loop operation.

Process and Reactor Development Operation is responsible for:

- a. Technical aspects of the fuel element irradiation, including effect of fuel elements on reactor safety.
- b. Termination of the production test and issuance of the final report.

KE-KW Reactor Operation

KE Processing Operation is responsible for:

- a. Operational safety.
- b. Production continuity, except where inconsistent with provisions of this test.
- c. Special discharges.

W. K. Kratzer
Process and Reactor Development
Research and Engineering
IRRADIATION PROCESSING DEPARTMENT

WKK:mm

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Dec 11, 1961

**DATE
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9/23/94

END