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IRRADIATION PROCESSING DEPARTMENT

May 11, 1960

SUPPLEMENT A

PRODUCTION TEST IP-314-A, MEASUREMENT OF FUEL ELEMENT TEMPERATURE
CHANGES AS THE RESULT OF FILM DEPOSITION

Classified by [redacted] To

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by

N. R. Miller

By Authority of CG-PR-2,
WA Snyder, 1-24-94.

W. K. Kratzer

By Quinn Mally, 4-20-94.

Verified By DK Hanson, 4-20-94.

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OBJECTIVE

The objective of this supplement is to determine the effects of operation with neutral pH water on crud deposition on fuel surfaces.

SUMMARY

This supplement authorizes testing designed to show the effects of coolant pH on the thickness of the crud layer deposited on fuel elements. The supplement will not require additional reactor down time nor will it introduce any hazards to the reactor.

BASIS AND JUSTIFICATION

The original test⁽¹⁾ authorizes measurement of the temperature gradients across the crud film deposited on fuel surfaces from high pH water. The data obtained from the original test will be quite important in showing the magnitude of temperature gradients to be expected during normal reactor operation. It also will be important to determine the additional effects, if any, which will result from non-normal reactor operation. Data of this type will be particularly useful in forming the bases for NPR Process Standards delineating acceptable deviations from the desired water quality.

One of the non-normal types of operation requiring study is operation with the coolant below the normal pH range (9.5 - 10.5). This supplement should supply quantitative information about the severity of fuel element temperature changes resulting from a reduction in coolant pH.

TEST DETAILS

1. Test Initiation

Testing authorized by this supplement will be initiated during a period of equilibrium reactor operation after the temperature gradients resulting from operation with normal pH (9.5 - 10.5) water have reached constant or near constant values.

2. Method of pH Control

The KER-1 Loop has a clean-up facility consisting of two parallel ion-exchange units. A side stream of water is diverted downstream of the main circulating pumps, routed through one or both units and returned to the main recirculating stream. During the testing authorized by this supplement, one of the units will be charged with a lithium base resin, the second unit will be charged with a mixed bed resin. The lithium base

1. HW-64800, Production Test, IP-314-A, Measurement of Fuel Element Temperature Changes as the Result of Film Deposition, by W. K. Kratzer, April 15, 1960.

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resin exchanges impurities in the coolant with LiOH, a base which will drive the coolant pH up. The mixed-bed resin exchanges impurities in the coolant (including LiOH) with water, and hence tends to drive the pH towards 7.0.

During the testing authorized by this supplement, the pH ordinarily will be controlled by an appropriate proportioning of the side stream through the two units. In some cases, it may be desirable to increase the coolant pH quite rapidly. This will be done by injection of LiOH solution into the coolant.

3. Procedure

When the conditions required for initiation of the test have been met, the pH will be lowered from 10.0 to 8.5 by routing flow through the mixed-bed unit. The pH will be held at 8.5 until the trend of the temperature increase is apparent. If the change in fuel temperature is such that temperature limits are not approached, the pH will be further reduced to about 7.0.

The fuel temperature will be observed during the period of pH reduction. If it becomes apparent at any time that filming is apt to increase the uranium temperature over 660°C or the jacket temperature over 350°C, the coolant temperature will be reduced or the coolant pH increased to prevent exceeding these limits.

If excessive filming is encountered and a return to pH 10.0 is required, a repeated reduction of pH can later be studied provided that core temperatures are below 630°C and cladding temperatures are below 350°C. In such a case, the pH will be reduced by small increments in an effort to determine the critical conditions which lead to rapid filming.

4. Other Operating Conditions

Coolant flows and temperatures will be the same as that specified by the original test.

5. Other Test Details

Other test details (fuel element description, loading, irradiation facility, deviations from process standards, exposures, costs and data required) are unchanged from those specified in the original test.

6. Hazards

This supplement introduces no hazards additional to those discussed in the original test. Operation at neutral pH will increase carbon steel corrosion rates from about 0.2 mils/year to about 1.0 mils/year - a negligible increase. If rapid film deposition is experienced, the supplement will be terminated before fuel element overheating occurs.

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RESPONSIBILITIESHanford Laboratories OperationReactor and Fuels Research and Development OperationFuels Development Operation

Fuel Element Design Operation is responsible for fabrication of the thermocouple element assembly and the tubular elements, analysis of data, and issuance of technical reports.

Materials Development Operation

Coolant System Development Operation is responsible for assembly of the thermocouple train, providing and maintaining the thermocouple leads, junctions, and temperature recorders, analysis of data, and issuance of technical reports.

Irradiation Processing DepartmentResearch 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.
- b. Termination of the production test and issuance of the final report.

Manufacturing Operation

KE Processing Operation is responsible for:

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

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