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GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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HW-55261

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TITLE

PRODUCTION TEST NO. IP-149-D
IRRADIATION SERVICE REQUEST NO. HAPD-215
THE IRRADIATION OF URANIUM DIOXIDE

AUTHOR

R. K. MARSHALL

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**HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON**

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PRODUCTION TEST NO. IP-149-D
IRRADIATION SERVICE REQUEST NO. HAPO-215
THE IRRADIATION OF URANIUM DIOXIDE

BASIS AND JUSTIFICATION

Fuel elements of uranium dioxide (UO_2) are being investigated for use in high temperature water cooled reactors. The principal advantages of uranium dioxide are its high melting point (2750 C) and its chemical inertness to high temperature water. To date, no determinations of the thermal conductivity of irradiated UO_2 have been reported. Knowledge of this physical property of UO_2 is required in order to intelligently evaluate this material as a fuel element for high temperature operation.

OBJECTIVE

The objective of this test is to authorize the irradiation of specimens of uranium dioxide upon which thermal conductivity measurements can be made.

REACTOR AND FACILITIES REQUIRED

A maximum of eight fringe process tubes in DR.

DETAILS OF ASSEMBLIES

The specimens to be irradiated are cylindrical rods of UO_2 each three inches long by one-fourth inch in diameter. The rods are fabricated by extruding, hydrostatically pressing, and sintering UO_2 powder. The density of the specimens is approximately 10 gm/cm^3 . Eight specimens are canned in an eight inch Hanford fuel element can as illustrated in Figure 1. The void spaces in the can are filled with helium after which the can is sealed by welding. All welds are x-rayed and the cans are helium leak tested and autoclaved. The UO_2 rods are brittle and thus subject to breakage so springs are located at each end of each specimen rod to absorb some of the shock which results from normal handling.

DETAILS OF IRRADIATION

Reactivity Loss: None

Procedure: Eight cans each containing eight specimens are to be irradiated in a region of low neutron flux ($1 \text{ or } 2 \times 10^{13} \text{ n/cm}^2\text{-sec}$) according to the following schedule:

Length of Irradiations (Months)	1	3	6	9	12
No. of Cans Discharged	1	1	2	2	2

The cans are to be charged into any of the central twenty tubes in Row 46. For the one month irradiation, one can is to be charged into one of the presently loaded central tubes in the top row and seated against the existing mint column.

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DS Jensen 12-15-92

By PM Eick 12-14-93

Verified By J.N. Wolfe 12-15-93

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This column is to be discharged after the can has been exposed for approximately one month. The same procedure is to be followed for the three months' irradiation. For the remaining irradiations of two cans each for 6, 9, and 12 months, the same procedure or an alternate one may be followed. The alternate procedure requires discharging existing mint columns. The new columns are made up as follows:

1. A standard downstream dummy pattern is charged except the farthest upstream piece is replaced with one sample can.
2. A standard mint column is charged.
3. One sample can is charged upstream of and seated against the mint column.

The entire column is discharged after the desired exposure. Because of the brittle nature of the specimens, the charging and discharging of the mint metal and the sample cans must be done by hand. The charging machine cannot be used. A special pickup of the sample cans is requested immediately after each column is discharged.

Reactor Down Time Required

The time which would be required to charge and discharge by hand the number of process tubes required to complete the irradiations.

HEAT GENERATION

The heat generation of UO_2 having a density of 10 gm/cm^3 and exposed to a flux of $3 \times 10^{13} \text{ n/cm}^2\text{-sec}$ is approximately 7 watts per gram. Calculations predict that the surface temperature of the UO_2 samples will be less than 150°C .

HAZARDS

No hazards other than those normally associated with the charge and discharge of a mint column by hand.

RESPONSIBILITY

DR Processing Operation will be responsible for scheduling the tests and for the operational safety and production continuity of the reactor. R. K. Marshall and A. G. Blasewitz, Irradiation Testing Operation, have responsibility for the interests of the Research and Engineering Operation.

R. K. Marshall

R. K. Marshall
Irradiation Testing Operation
IRRADIATION PROCESSING DEPARTMENT

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ALL PARTS (UNLESS OTHERWISE NOTED) SHALL CONFORM TO THE FOLLOWING:

1. TOLERANCES: FRACTIONAL $\pm$, DECIMAL $\pm$ ANGULAR $\pm$
2. PARTS TO SHOW GOOD WORKMANSHIP. FREE FROM BURTS.
3. UNHARRD AND CLEAN.
4. BREAK ALL CORNERS.
5. ALL MACHINED SURFACES $\sqrt{}$ (ASA B46.1-1935)
6. ALL MATERIAL TO BE AS SPECIFIED, OR EQUAL QUALITY.

MATL:
CAN & CAP - M388 AL
SAMPLE HOLDER - 2S AL
SPRING - SST

Figure 1

SECTION A-A

GENERAL NOTES

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DWC NO.		DRAWING TITLE	
		THERMAL CONDUCTIVITY OF UO ₂ TEST SLUG	
REFERENCE DRAWINGS			
U. S. ATOMIC ENERGY COMMISSION			
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