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October 10, 1959

PT-IP-280-A-FP, IRRADIATION OF ALLOYED DINGOT URANIUM FUEL ELEMENTS

OBJECTIVE

The objective of this test is to authorize irradiation of pilot quantities of alloyed dingot uranium and to provide for monitoring of its performance.

TEST SUMMARY

This test will authorize:

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By Authority of CG PR2

DS Lewis, 1-10-94.

By Jerri Maley, 4-21-94.

Verified By DK Hanson, 4-21-94

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- a) Charging of up to 50 tons of alloyed dingot fuel elements in two groups of 25 tons each, including 12 monitor charges which will accompany the first group, into D Reactor as a pilot loading.

BASIS AND JUSTIFICATION

Although purer and more dense than standard ingot uranium, the dingot uranium produced in the past by MCW has demonstrated poorer dimensional stability during irradiation. The instability has been manifest as warp, nearly double that of ingot which was irradiated in the same charge and by surface bumping up to 5 mils in height. Both the bumping and the warp are normally associated with large grain size, non-uniform orientation and/or residual stresses.

To improve the stability, primarily by grain size reduction, additions in the range of 150 ppm iron and 100 ppm silicon are being made to the green salt prior to reduction. The hydrogen content of the metal has been reduced by pre-heating the green salt at high temperature prior to triggering the metal reduction. Further refinements to the process include heat treatment in chloride salt bath to suppress hydrogen build-up, followed by delayed, hot-quench to improve grain structure.

The cause of extrusion defects seen in dingot metal received earlier this year has been located and eliminated by reducing the diameter of the follower block to prevent the billet surface from extruding on the surface of the bar. The alloyed low hydrogen dingot cores are expected to demonstrate equivalent or better dimensional stability than the standard ingot cores. Receipt of up to 25 tons/month has been scheduled for the initial two months of this evaluation. After a two-month lead time, provided the dingot metal meets all specifications as recorded herein, receipts will be increased to 60 tons/month for six months and further as previously scheduled⁽¹⁾. The scope of this program is to extend the irradiation of alloyed, low hydrogen dingot I & E elements up to 150 tons/month. Receipts in excess of 60 tons/month will depend on satisfactory performance of metal irradiated in this test. Charging beyond the initial 50 tons will be authorized separately.

It is understood that this schedule is not that normally followed in evaluating a new process change and that some risk is involved; however, in light of the forecasted metal requirements, the Mallinckrodt Chemical Plant must be brought "on-stream" as rapidly as possible. It is felt that this schedule involves the minimum risk potential of any which will meet the required metal delivery schedule. A group of twelve monitor columns will be charged with the first alloyed dingot material, four of which will be discharged at sufficiently low goals to permit examination before the first group of 60 tons is available. The remaining eight columns will be irradiated to normal goal as a check on the performance to provide assurance that fuel stability is at least equivalent to normal material.

TEST DETAILS

A. Fuel Elements

- a) Cores for this program shall be dingot uranium with approximately 100 ppm of silicon and 150 ppm of iron added as grain refiners; heat treated in solid blank form in chloride salt, and finish machined at Fernald to OIIN dimensions.

(1) J. W. Talbott, "Utilization of Dingot Uranium", Undocumented letter to A. T. Gifford, 3/4/59, Unclassified.

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Fuel Elements (cont'd)

- b) Cladding shall be that normally utilized in D-DR Reactors during the period this test is in effect.
- c) All normal quality control and standards will be applied during fabrication of this material as outlined in this test design. (2)

B. Lot Charging

All fuel charged under this test (50 tons) with the exception of the twelve monitor columns shall be utilized as normal production fuel, and will have one monitor charge per lot included as outlined in the Quality Certification Program. (3)

C. Monitor Charges

- a) Twelve monitor charges of alternated test and control elements will be required. The control material shall be normal production OIIN fuel elements.
- b) All fuel elements in the monitor columns shall have warp and diameter measurements for all pieces and weights for pieces 1-17 recorded; shall be assembled into twelve alternated charges; and shall be marked with column and location identification.
- c) The monitor columns are to be charged in order into central flow zone process tubes chosen by the assigned process engineer and approved by the test author, under the direction of a Research and Engineering representative. Series and tube relationship are to be obtained and forwarded to the test author.
- d) During irradiation daily temperature and weekly flow data shall be required. Irradiation shall continue until four of the columns have accrued approximately 400 MWD/T exposure, the remaining eight shall be exposed to 800 MWD/T.
- e) All monitor columns, including those charged under PT-IP-216-A, (3) require special pickup and shall be shipped to the 105-C Metal Examination Facility for evaluation of surface conditions, warp, diameter change, weight loss, and shall be weasled to determine the flux profile of the charge.

HAZARDS

Destructive examination of grain structure and apparent core quality has indicated that this material is equivalent or superior to normal ingot material, and as a result, charging schedules have been expedited to ease the core shortage problems. There still exists however, the possibility that unforeseen quality defects will result in poor performance of this material. The four columns scheduled for

(2) HW-61619 A, "Design of PT-IP-280-A-FP, Irradiation of Alloyed Dingo Uranium Fuel Elements", W. H. Hodgson, R. E. Hall, 8/28/59.

(3) HW-58271, "Production Test IP-216-A, Evaluation of Performance of Normal Production I and E Fuel Elements", R. E. Hall, R. R. Bloomstrand, 1/6/59.

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discharge at 400 MWD/T will indicate a gross difference before the semi-production quantities are charged. Since this schedule would permit semi-production quantities of metal to be charged before complete performance data on the pilot group are available, low goal discharging would be required to alleviate a problem should it become apparent. The "severity" of any such problem and its effect on IPD production should therefore be controllable.

COSTS

All incremental costs incurred as a direct result of this test may be charged to XXXX-5320-XXX.54. Outage time requirements for this test are listed below for scheduling purposes.

<u>Job</u>	<u>Manpower</u>	<u>Outage Time</u>
1. Charge 12 tubes specially	6 manhours	2 hours
2. Discharge and specially pickup 12 columns.	15 manhours	3 hours

RESPONSIBILITIES

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.

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.

D-DR Reactor Operation

D and DR Processing Operations will be responsible for planning, scheduling, the operational safety and production continuity of the reactors, and for collection of routine operating data for the test.

[Signature]
Reactor Fuels Unit
Process & Reactor Development Sub-Section
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

RE Hall:gtb

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