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TRANSITION TO NORMAL DISCHARGE PLAN
USING STRIPED TARGET COLUMNS

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PRODUCTION TEST IP-659-AC, SUPPLEMENT A

TRANSITION TO NORMAL DISCHARGE PLAN USING STRIPED TARGET COLUMNS

By

G. C. Masche

April 8, 1964

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April 8, 1964

PRODUCTION TEST IP-659-AC, SUPPLEMENT A
TRANSITION TO NORMAL DISCHARGE PLAN USING STRIPED TARGET COLUMNS

INTRODUCTION

The scheduled termination of PT IP-659-AC¹, presently being irradiated in F Reactor, will result in discharge of 105 columns of enriched uranium (0.947 w/o U-235) at less than 50 per cent of the goal exposure. The test block is currently scheduled to be replaced with natural uranium columns. Since F Reactor is on a semiblock discharge plan (alternate rows), subsequent operating plans would require that 64 of these replacement columns of natural uranium be likewise discharged during the scheduled outage in May of 1964 at less than 50 per cent of goal. It appears desirable to minimize the economic costs of the production test by an alternative discharge scheme (e.g., interim poison irradiation).

OBJECTIVES

The objective of this supplement is to soften the economic impact of low exposure fuel discharge scheduled by IP-659-AC and simultaneously to obtain a useful alternate product by irradiating nine columns of Li-Al and Bismuth in a "striped" charge.

TEST SUMMARY

At the semiblock discharge scheduled at F Reactor on 4-19-64, only those enrichment columns in odd rows in the E-Q block will be discharged, as per standard block practice; all thorium-oxide (Q) columns will be discharged. The nine vacated columns in the even rows will be charged with a striped charge of Li-Al and Bismuth. Each striped charge will consist of 40 target elements, 16 Li-Al and 24 B-Metal, arranged in a simple 2:3 alternating sequence with Li-Al pieces at the downstream end and B-Metal pieces at the upstream end. These nine poison columns will be irradiated until the scheduled outage during the week of 5-18-64. During that outage the remaining 55 enriched metal columns from the E-Q block plus the nine test columns will be replaced with the usual pile loading. Figure 1 shows the location of these columns during the run from approximately April 19 to May 18.

BASIS AND JUSTIFICATION

The proposed discharge scheme was anticipated in the original production test¹, which states: "The enriched uranium charges will be discharged with the second group of thorium-oxide charges unless the Q charges are replaced with adequate compensating poison." This supplement is written to formally specify and authorize such "adequate" compensation and to establish procedures for associated charge-discharge and operating conditions.

The nine poison columns specified by this supplement will compensate the undischarged enriched metal to within 100 c-mk net pile reactivity. The test zone will be equipped with at least 20 spline caps which will provide a generous amount of flexibility for localized control of temperature distribution and reactivity in the zone.

¹HW-80828, Production Test IP-659-AC, Evaluation of a Thorium-Oxide Loading, RD Carter, and KL Hladek, February 28, 1964 (Secret)

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Making this alteration in the original discharge plans will preclude the low-exposure discharge of 55 enriched columns at this time and the premature discharge of 64 natural columns in May for a considerable cost saving in fuel fabrication costs. In addition the products obtained by irradiating the Li-Al and the Bismuth will help to fulfill existing IPD commitments for such irradiations; both the Li-Al and the B-Metal are available in quantities of previously-irradiated material requiring further exposure before product recovery is feasible.

TEST DETAILS

A. Reactor

Irradiation of the target columns will take place in F Reactor.

B. Fuel Elements

It will not be necessary to charge any fuel elements as a result of this test.

C. Target Elements

Both the B-Metal and the Li-Al elements have already been irradiated to an exposure short of goal and are now in storage. One hundred forty-four standard Li-Al elements and 216 B-Metal elements will be required for this test; no special or unusual shipping arrangements or sequence markings are necessary.

D. Process Channels

The nine channels shown on Figure 1 will contain the test charges.

E. Irradiation

1. Loading

This test will be charged in the following steps in order to assure that reactivity does not at any time exceed the operating configuration:

- a. The enriched columns shown in Figure 2 (in the odd rows) will be discharged and recharged with the standard pile loading.
- b. The nine test columns shown in Figure 1 (target columns in the even rows) will be charged. This will be done by discharging one column and then charging the Li-Al/B-Metal charge into that column before another column is discharged. Only one of the test columns is to be empty at a time. The charge pattern will be a repeating 2N:3B, with B upstream.
- c. The remaining ten thorium-oxide columns shown in Figure 2 (in odd rows) will be discharged last, and replaced with the usual pile loading, after step b is completed.

Both the Li-Al and the B-metal, which have been previously irradiated, will have to be handled with short tongs preceding and during the charging operation; however, this should present no unusual problem.

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2. Supplemental Control

Supplemental control requirements will be affected by this test only in the amount that the enrichment value exceeds the test poison value (calculated to be approximately 100 c-mk, or 1/10 of 1%k). This is to be taken into account by the reactor physicist in the total control calculation.

3. Goal Exposure

The goal exposure of the test elements will be such that they are ready for discharge during the outage scheduled for the week of May 18.

4. Operating Conditions and Limits

The enriched metal charges are already in the reactor. No unusual temperature problems were encountered in reactor operation. This test should not increase heat generation in the test zone; however, spline caps will be in place during operation to give greater flexibility for localized temperature distribution control. PT IP-659-AC¹ evaluates the vanstone flange stresses encountered on poison columns. This test should not increase the probability of process tube failure.

5. Discharge (During the May outage)

The enriched columns must be discharged before the test (Li-Al/B-Metal) columns. The test columns are to be recharged with the normal central zone loading. No special pickup procedures will be necessary for the nine test columns other than normal separate storage of Li-Al and B-Metal pieces.

F. Hazards

Standards H-020 and C-130.2 cover the hazards involved with this test. They are identical with those for the parent Production Test, IP-659-AC¹.

G. Schedule

These test charges will be charged during the scheduled outage of April 19, 1964, and discharged during the outage currently scheduled for the week of May 18, 1964.

H. Costs

The time required for makeup and special handling of the test columns will be more than offset by the time gained by not discharging the 55 enriched columns now in the reactor.

¹HW-80828, ibid

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RESPONSIBILITIES

Research and Engineering Section

Process Technology Subsection shall be responsible for specifying operating limits and design of the downstream dummy pattern of the test charges - J. E. Morrissey.

Operational Physics Subsection shall be responsible for taking the block reactivity effect of the test into account for all calculations and for recommending spline usage in the test zone - G. C. Masche.

Manufacturing Section

Processing Operation shall be responsible for operational safety and production continuity of the reactor, for planning and scheduling the test activities, and for charging test material and discharging test material.

Production Operation shall be responsible for maintaining accurate records of material charged under this test and for scheduling the discharge of the test columns and of the 55 supporting enrichment columns during the same future outage.

File Physics Unit
Operational Physics Subsection
Research and Engineering Section

GC Masche:gs

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Figure 1
Test Zone for Run From Approximately
4-19-64 to 5-18-64

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Figure 2

Discharge Map for Outage of 4-19-64

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