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INTERIM GOAL EXPOSURE PLANS FOR
O-III-NB AND O-III-EB MATERIAL FOR
B, D, DR, AND F REACTORS

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INTERIM GOAL EXPOSURE PLANS FOR
O-III-NB AND O-III-EB MATERIAL FOR
B, D, DR, AND F REACTORS

Introduction

The purpose of this report is to recommend variable goal plans for natural and enriched bumper fuel elements, specifically for O-III-NB and O-III-EB materials, to be irradiated at the B, D, DR, and F reactors.

The average goal exposure for all bumper fuel elements at D reactor was specified to be 900 MWD/T⁽¹⁾, with provisions being made for revision by normal procedures. Exposures for enriched bumper material at the B, DR, and F reactors were not specified in the PITA supplement⁽²⁾ authorizing charging of this material. This document, under a single cover, transmits interim goal plans for the irradiations authorized in references (1) and (2).

Details

Considerable reactor experience is needed before goals for bumper materials can be accurately determined on anything other than a quasi-theoretical basis. From experimental data and results accumulated to date, it is concluded that the rupture rate of bumper fuel elements will be controlled to a large extent by so-called uniform corrosion of the fuel jackets*. The two ruptures recently incurred in natural bumper material at D reactor may have been caused by uniform corrosion. Radiometallurgical examination of these failures is scheduled and will help to confirm or deny this postulated causal relationship. Other factors, for example, position in the process tubes and the appearance of the failures, are not inconsistent with expected patterns if uniform corrosion were the controlling mechanism. The tubes that incurred the ruptures were high powered, "new" tubes, and contained no water mixing pieces. Theoretically, the total effect is to create a severe fuel element corrosion environment.

Embodied in the goal plans transmitted herein, is what we believe to be a reasonable risk of incurring ruptures. The risk is believed to be highest for the natural material.

(1) HW-67414, Benson, JL, "PITA-IP-14-I - D Reactor Full Pile Loading of Bumper Fuel Elements," November 18, 1960, (Secret).

(2) HW-67414-A, Benson, JL, "PITA-IP-14-I, Sup. A - Enriched Bumper Fuel Element Loadings at B, DR, and F Reactors, (To be issued), (Secret).

*We can also expect some ruptures from end-closure defects as a result of the increased residence times.

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It is anticipated that the fuel failure rate for a given exposure, when controlled by uniform corrosion, will be extremely sensitive to changes in tube outlet water temperature -- much more so than is the rupture rate of non-supported elements. At constant exposure, a 2°C change in outlet water temperature might change the failure rate by approximately a factor of two. Thus, if an unreasonably high rupture rate were to be incurred with these interim plans, very modest temperature reductions could alleviate the problem.

Regarding the positioning of water mixing fuel elements, Miller⁽³⁾ has recommended the tenth position from the rear of the charge for 32-34 piece natural charges; eighth position from the rear for 34 piece enriched charges; and the ~~tenth~~ position from the rear for 43 piece enriched charges; primarily for purposes of extending tube life.

From the standpoint of minimizing fuel element corrosion, positioning the mixer upstream perhaps as far as the fifteenth position from the rear (for 34 piece columns) would be best, however, this would substantially reduce tube life. Until the failure rate of the bumper fuel elements is better defined by experience, and/or additional testing of alternate mixer schemes is completed, it is not possible to make meaningful calculations to optimize mixer location from both tube and fuel performance considerations. Therefore, we believe that initially the mixer location in bumper charges should be selected primarily to maximize tube life. The Process Engineering Unit has considered reactivity effects, as well as the aforementioned corrosion factors, and will shortly issue recommendations to change mixer locations in both bumper and non-bumper charges at the old reactors. The mixer locations indicated below are in agreement with those recommendations.

Following are the recommended interim variable goal plans for O-III-NB and O-III-EB material, for the B, D, DR, and F reactors.

The general equation is:

$$(1) \quad G = I - sf$$

Where G is the goal exposure (MWD/Ton)
I is the intercept (MWD/Ton)
s is the slope (MWD/Ton)
f is tube factor

(3) HW-68424, Miller, NR, "Relocation of Water-Mixing Elements at the Five Oldest Reactors," (To be issued), (Secret).

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Type Material and Loading	<u>I</u>	<u>A</u>	Maximum Exposure
O-III-MB			
32-34 pieces, mixer	(1) 1500		
10th from rear	(2) 1600	600	1100
O-III-EB			
34 pieces, mixer			
0th from rear	2400	1030	1500
O-III-EB			
43 pieces, mixer			
13th from rear	1650	600	1500

(1) For "new" tubes with $f > 1.2$. "New" tubes are defined as tubes with two charges or less put through since date of installation. Tubes in this class have a much higher chance of incurring corrosion failures.

(2) For charges other than those of (1), above.

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