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August 6, 1959

"IRRADIATION SUMMARY - PT-IP-179-A-97-FP:
EVALUATION OF THE EFFECT OF A MODIFIED BETA-HEAT TREATMENT
CYCLE ON DIMENSIONAL STABILITY OF URANIUM FUEL ELEMENTS"

INTRODUCTION

Laboratory work performed in an attempt to reduce fuel element dimensional instability by optimizing the time allowed for the air quench (delay) prior to the water quench during core heat treatment indicated a 43 sec. delay to be optimum. Previous tests have indicated this effect does exist and could be utilized as a method of controlling slug distortion. In August, 1959, a production test⁽¹⁾ authorized the charging of 16 tubes of 43 second air quench material alternated with standard control material in C-Reactor. The test was charged on November 24, 1958, and discharged on April 26, 1959. This report summarizes and evaluates the irradiation performance of the material of the test.

SUMMARY

Eight columns were irradiated in each of two groups to 576 and 912 MWD/T average exposure. No significant difference was observed between the test and control material with respect to warp, end diameter change, and center diameter change. The average warp value of the test material was 8.4 mils as compared to 8.7 mils on the control material; the center diameter change on the test material was 3.1 mils as compared to 2.6 mils on the control material; and the end diameter change of the test material was -0.4 mils as compared to -0.5 mils on the control material.

DISCUSSION

The present method of Beta-Heat treatment incorporates a 15 second air quench prior to the water quench. Recent laboratory tests have indicated that optimum dimensional stability would be obtained utilizing a 43 second air quench (delay) to control grain size and orientation. Sixteen columns of the Delay Quench Material was alternately charged with standard control material at C-Reactor to test the Delay Quench technique. Eight columns were irradiated to an average exposure of 576 MWD/T and the remaining eight tubes were irradiated to an average exposure of 912 MWD/T. The test was evaluated by assuming that two adjacent slugs located in the same tube experience identical operating conditions. An analysis was then made by comparing the differences observed between the test-control pairs, and then statistically validating the differences observed.

The average warp, center diameter change, and end diameter change observed on both the test and control material appear in Table I. Examination of these values shows the small differences observed between the test and control material, none of which approach any level of statistical significance.

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It is also noted that the control material used in this test exhibited dimensional changes similar to the control material used in PT-IP-93-A-93-FP at C-Reactor, which tends to validate the statistics of this test. Irradiation data and post-irradiation measurements are included in HW-56429-D.(2)

CONCLUSION

It is concluded that the Delay Quenched material utilized for this test was not statistically different from Standard Production material with respect to warp, center diameter change, and end diameter change.

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TABLE I
POST IRRADIATION DATA

<u>Effect</u>	<u>Class</u>	<u>Mean Value</u> <u>Delay Quench</u>	<u>Mean Value</u> <u>Control</u>	<u>Mean Value</u> <u>Difference</u>
Warp	576 $\bar{X}$ E	8.70 mils	8.31 mils	0.39 mils
	912 $\bar{Y}$ E	8.11 mils	9.10 mils	-0.99 mils
Center Diameter Change	576 $\bar{X}$ E	2.21 mils	1.94 mils	0.27 mils
	912 $\bar{X}$ E	3.98 mils	3.31 mils	0.67 mils
End Diameter Change	516 $\bar{X}$ E	0.04 mils	0.08 mils	-0.04 mils
	912 $\bar{X}$ E	-0.77 mils	-1.00 mils	0.23 mils

TABLE II
OPERATIONAL DATA

<u>Tube #</u>	<u>Exposure</u> <u>MWD/T</u>	<u>Tube Factor</u>	<u>Charged</u>	<u>Discharged</u>
1481-C	582	1.200	11-24-58	<div> </div> Low Exposure
1488-C	611	1.211	"	
1578-C	544	1.034	"	
2076-C	604	1.116	"	
2387-C	598	1.191	"	
2687-C	585	1.216	"	
2817-C	586	1.123	"	
2920-C	591	1.160	"	<div> </div> High Exposure
0757-C	889	0.980	"	
0784-C	914	1.182	"	
1287-C	902	1.203	"	
1320-C	922	1.166	"	
2121-C	904	1.189	"	
2087-C	922	1.168	"	
2200-C	938	1.210	"	
2687-C	918	1.189	"	

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REFERENCES

- (1) HW-56429-C, "Production Test IP-179-A-97-FP Evaluation of the Effect of a Modified Beta Heat Treatment Cycle on Dimensional Stability of Uranium Fuel Elements, R. E. Hall 8-15-58, Secret.
- (2) HW-56429-D, PT-Data Sheets - IP-179-A, R. E. Hall, 7-24-59.

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