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SUBJECT: MTR Experimental Fuel Element, Mark XII-C

TO: J. H. Frye, Jr.

FROM: R. J. Beaver

CLASSIFICATION CANCELLED

DATE FEB 14 1957 *OC*

For The Atomic Energy Commission

H. F. Cancele
Chief, Declassification Branch~~RESTRICTED DATA~~

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INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

To: J. H. Frye, Jr.

Subject: MTR Experimental Fuel Element,
Mark XII-C

Copies: Listed Distribution

Ref: (a) Letter from H. M. Roth to J. A. Swartout, ORA:ANL, dated
March 15, 1956.

In accordance with item 5 of reference (a), an experimental MTR fuel element in which the fuel plates were clad with an intended 0.10 w/o boron-aluminum alloy was manufactured and shipped to the MTR. It is estimated that the fuel element may be placed in the reactor on April 18, 1956.

The fuel element is physically the same design as the present Mark XI MTR fuel element, the only difference being that the fuel cores were clad with the boron-aluminum alloy. Cladding with this alloy caused no difficulty in the manufacturing procedure, and the fuel plates were fabricated and the assembly brazed using the conventional practices for manufacturing standard MTR fuel units. The cladding alloy is more susceptible to blistering than type 1100 aluminum. Of 25 fuel plates fabricated, 8% were rejected for this defect.

A statistical analysis was made of the core and clad thickness of the long and short plates in this test assembly, with the results listed in Table 1. Analytical results of the boron content in the alloy cover plate material is listed in Table 2. Based on these analyses, the average cladding thicknesses, and the dimensions of the fuel plates, the average boron content in each fuel plate is tabulated in Table 3. These data are based on analyses shown in Table 2. The total average content in the fuel element is 1.92 gms. The uncertainty of this value, based on 7% uncertainty in analytical chemistry procedure, 1.0% deviation in precision of analyses, and 3.4% uncertainty in volume of alloy clad, appears to be 11.4%.

This fuel element is tentatively scheduled for a twelve week irradiation period in the MTR, and has been designed to permit removal of individual fuel plates for post irradiation examination.

R. J. Beaver
Metallurgy Division

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Table 1

Summary of Clad and Core Thickness Measurements on
Enriched Alloy Fuel Plates

Plate	Mean Clad Thickness (in.)	Av. Deviation From Mean Clad Thickness (in.)	Mean Core Thickness (in.)	Av. Deviation From Mean Core Thickness (in.)	Maximum Clad Thick- ness (in.)	Minimum Clad Thick- ness (in.)	Maximum Core Thick- ness (in.)	Minimum Core Thick- ness (in.)
E-5 (Short)	0.0148	±0.0005	0.0203	±0.0005	0.0161	0.0133	0.0217	0.0191
I-4 (Long)	0.0223	±0.0006	0.0188	±0.0009	0.0233	0.0200	0.0216	0.0173

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Table 2Boron Content of Slabs E through I

<u>Analyses</u>	<u>Analyzed Boron Content (%)</u>	<u>Av. Boron Content of Each Slab (%)</u>	<u>Precision of Analysis (Duplicate Determinations) (%)</u>	<u>Uncertainty Due to Segregation (%)</u>
E-Top	0.082	0.083	±0.6	±1.2
E-Middle	0.084			
F-Top	0.090	0.099	±0.7	±21 -11
F-Middle	0.088			
F-Bottom	0.120			
G-Top	0.102	0.119	±1.0	±21 -14
G-Middle	0.112			
G-Bottom	0.144			
H-Top	0.088	0.099	±0.8	±5 -11
H-Middle	0.104			
H-Bottom	0.104			
I-Top	0.108	0.109	±0.8	±10 -8
I-Middle	0.100			
I-Bottom	0.120			

Table 3Boron Content in Mark XII-C MTR Fuel Element

<u>Plate Number</u>	<u>Average Boron Content, %</u>	<u>Weight of Boron, gms</u>
I-2	0.110	0.174
H-5	0.096	0.087
G-4	0.100	0.090
F-3	0.093	0.084
E-4	0.082	0.074
H-4	0.101	0.091
F-1	0.115	0.104
F-4	0.088	0.080
F-5	0.089	0.080
G-5	0.107	0.097
H-3	0.104	0.094
E-6	0.084	0.076
F-6	0.090	0.081
G-3	0.117	0.106
G-2	0.128	0.116
F-2	0.104	0.094
G-1	0.138	0.125
H-6	0.091	0.082
I-1	0.117	0.185
		<hr/> 1.92 gms