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OAK RIDGE, TENNESSEE

ORNL
CENTRAL FILES NUMBER

CF-56-8-26

DATE: August 3, 1956
SUBJECT: MTR Fuel Elements Containing Plates with Pu-Al Alloy
TO: J. E. Cunningham
FROM: R. J. Beaver

Attached herewith are minutes of a meeting held at ORNL on July 11 and 12 to clarify the present and future status of the subject fuel elements.

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INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

CLASSIFICATION CANCELLED	
DATE	APR 1 1957
For The Atomic Energy Commission	
<i>H. B. Canale</i>	
Chief, Declassification Branch	

To: J. E. Cunningham

Subject: MIR Fuel Elements Containing Plates with Pu-Al Alloy

The meeting was initiated with a review of the fabrication of the Pu-Al fuel plates. Forty-two plates have been fabricated at ORNL with the following results:

Standard Fuel Element Plates

Specified length, inches	23-5/8
Specified width, inches	2-1/2
Specified clad-core-clad thickness, inches	.015-.030-.015
Number fabricated	19
Number rejected	19*
Cause of rejection	Excessive length

*8 can be salvaged as the long plates in fuel units

Control Rod Fuel Element

Specified length, inches	23-5/8
Specified width, inches	2-15/32
Specified clad-core-clad thickness, inches	.020-.020-.020
Number fabricated	23
Number rejected	15
Cause of rejection	(1) Excessive length -12 (2) Blisters -3

The first 20 standard plates and 16 control rod plates that were fabricated were rejected for excessive length, which was caused by a "flashover" at the ends of the core as well as insufficient spread in width during rolling. Evidence also existed that the cover plates were thicker than specified as listed below:

	Thickness		
	(in.)	(in.)	(in.)
<u>Standard Fuel Billet:</u>	Cover	Core	Cover
Specifications	.188	.383	.188
Actual	.195	.383	.195
<u>Control Rod Fuel Billet:</u>			
Specifications	.240	.243	.240
Actual	.248	.243	.243

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It was explained that the "flashover" is the thin metal shaving caused by shearing of the core as it is pressed into the frame. In the first 20 standard plates rolled, this flashover alone caused a 1-5/8 inch increase in the core length.

In a meeting held at Los Alamos subsequent to rolling the first 36 plates, it was felt that modifications which consisted of enlarging the hole in the frame slightly, and reducing the thickness of the core to match the thickness of the frame, would greatly minimize and possibly eliminate flashover. Four standard and four control rod experimental plates were prepared by Los Alamos to determine whether or not these modifications improved the final plate dimensions. Three control rod billets assembled in this manner and rolled into plate had a minimum of flashover and were within length specifications. However, blisters were observed at the ends of these plates, which may have been caused by the looser fit between core and frame. The three standard billets assembled in this manner and rolled into plate had reduced flashover but were rejects because of excessive length. Since the plates were not yet tested for blisters, it was not possible in the meeting to determine whether the looser fit could have resulted in blisters in these plates. One plate from each group was rejected during rolling.

Los Alamos felt that they could essentially eliminate flashover in press-fit cores. It was decided to concentrate immediately on fabricating control rod plates using the original specified procedures since the latest control rod plates rolled within length specifications.

It was decided that all of the control rod plates would be manufactured before the standard fuel element plates. It was deemed advisable to proceed cautiously, and Los Alamos was requested to make up only 12 billets in this manner and withhold further billet preparation until they received word from Oak Ridge that the plates fabricated satisfactorily insofar as dimensions and blistering were concerned.

It was felt that the excessive length in the standard plates was related to the fact that the core was thicker than the core in the control rod plate. A decision was made to change the specifications from a clad-core-clad thickness specification of 15-30-15 mils to a 20-20-20 mil specification and increase the concentration of plutonium in the alloy to approximately 15% in order to obtain a plate with a maximum content of 8.7 grams of plutonium. It was not felt that the 2.19 inch wide cores used in the control rod plates would spread sufficiently to produce a core width of 2.5 inches in the finished plate. It therefore appeared very likely that it would be necessary to substitute a die, already available, which could punch cores 2.3 inches wide. This switch to the 15% plutonium alloy was originally suggested by Los Alamos and greatly favored because they felt there would be no insurmountable problems connected with casting this alloy, and that work could be reduced since more cores could be obtained per casting.

Between the time the 12 control rod fuel billets are shipped to ORNL and the signal given to proceed with the 30 remaining plates, Los Alamos will cast 15% alloy and assemble 4 billets with cores punched from the same die used in

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punching the cores for the control rod fuel plates. These billets will be shipped to ORNL to determine the degree of spread with a core containing 15 w/o Pu. The first two of these billets are to be rolled at a 50% reduction per pass. If the nominal width specification of 2 $\frac{1}{2}$ inches is exceeded under this practice, then the reduction per pass is to be decreased to 30%. It is not anticipated that these plates will meet dimensional specifications, but the information concerning the spread of the core will be valuable in establishing whether or not the 2.3 inch wide die can be substituted for punching standard fuel plate cores. If this work indicates that the 2.3 inch wide die will not be suitable, it will then be necessary to design a completely new die. However, it is anticipated that the 2.3 inch wide die will be satisfactory. As soon as Los Alamos is notified by ORNL, they will prepare 4 billets from 2.3 inch wide die and ship to ORNL to be fabricated as test plates. It is presumed that by this time Los Alamos will have completed the preparation of all control rod billets. After ORNL has fabricated the 4 test plates and they meet dimensional specifications, then Los Alamos will be notified to prepare the balance of the material required.

Los Alamos is to notify ORNL of the number of .240 inch cover plates that they will require in order to manufacture the necessary number of fuel plates. These plates are to be measured by ORNL before shipment to determine that they do not exceed the .240 inch thickness.

In order to still allow some degree of freedom in plate manufacture, ORNL will investigate with PFCO the possibility of acceptance of a fuel element consisting of eighteen .063 inch thick fuel plates.

Prior to the conclusion of the meeting, target dates were established for ultimate manufacture of control rod fuel and standard fuel elements. These target dates are listed below.

<u>July 17</u>	Return blistered control rod fuel plates and rejected fuel element plates to Los Alamos for core-clad thickness measurements.
<u>Aug 1</u>	Los Alamos to ship 12 control rod plates to ORNL.
<u>Aug 10</u>	Los Alamos to ship ORNL 4 billets containing the 15 w/o Pu cores.
<u>Aug 15</u>	ORNL to roll 12 control rod fuel plates.
<u>Aug 22</u>	ORNL to notify Los Alamos whether or not to assemble the 30 remaining control rod billets.
<u>Aug 27</u>	ORNL to roll the 4 plates containing the 15 w/o alloy.
<u>Sept 1</u>	ORNL to braze first control rod fuel unit

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Sept 7 ORNL to notify Los Alamos regarding proper die to use for the standard fuel plates.

Sept 7 Los Alamos to ship the 30 remaining control rod fuel plates.

Sept 24 ORNL to roll the 30 remaining control rod fuel plates.

Oct 1 Los Alamos to ship 4 billets containing cores punched from the 2.3 inch wide die.

Oct 15 ORNL to braze the remaining two control rod fuel elements.

Oct 15 ORNL to roll billets with cores punched from the 2.3 inch wide die.

Nov 8 MIR to receive first control rod containing the Pu-Al fuel element.

Jan 57 MIR to receive the 2 remaining control rods containing the Pu-Al fuel element.

11-1-56
to
1-1-57 Los Alamos to ship 85 standard fuel billets in lots of 20 to ORNL,

12-15-56
to
3-15-57 ORNL to deliver the required standard fuel elements to the MIR.

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