Classification Cancelled/Changed

TO UNCLASSIFIED

by Authority of

DPW-55-408

SR/A--773

1. *J. Banick* AED CO 2/4/89

Name Title Date

E. I. du Pont de Nemours & Co.

Explosives Department

Atomic Energy Division

Wilmington, Delaware

- 1 - H. Worthington
- 2 - J. C. Woodhouse
- 3 - N. F. Spraggins - R. E. Fisher
- 4 - W File
- 5 - M. H. Wahl - C. W. J. Wende
- 6 - J. W. Croach - P. H. Permar
- 7 - B. W. Dunnington - R. T. Huntoon
- 8 - TIS File

MEMORANDUM TO FILE

October 11, 1955

This document consists of 4 pages

FROM: Robert E. Fisher

No. 1 of 8, Series A

Beta Transformation of Zirconium-Clad Uranium Tubes at
Atlas Steels Ltd., Welland, Ontario

INTRODUCTION

Seven zirconium-clad uranium tubes were beta-transformed in a vertical salt bath at Atlas Steels, Welland, Ontario. Two tubes were heat-treated on September 23 and the remaining five were transformed on October 7.

Visitors at Atlas on September 23 were Messrs. Woodhouse, Spraggins, and Fisher of Du Pont; J. L. Klein of NMI; and Reynolds of SROO. Messrs. Muscato and Rowland directed the processing for Atlas Steels.

On October 7, observers were Messrs. Spraggins and Fisher of Du Pont, Klein of NMI, and Donohue of SROO. A. R. Muscato of Atlas directed the processing.

SUMMARY

All tubes were vertically heat-treated at about 1350°F for 10 minutes in molten Houghton "Liquid Heat #980" followed by cooling in air, water rinsing, and furnace drying. From the bottom end of each tube a 75-pound weight was suspended to minimize possible warp.

After beta-treatment, the tubes appeared to be straight and concentric with a moderately oxidized surface free of salt except for small areas adjacent to the fixture and weight holes on the ends of the tubes.

DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION

DISCUSSION

Preparation for Heat Treat

Tube Preparation

Two 5/8" diameter holes, diametrically opposed, were cut out of the zirconium portion on both ends of the tubes. These holes were centered about one inch from the ends of the

Reviewing Official: *J. Banick* 2/4/89
C. J. Banick, AED Class Officer

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

tubes. The holes at one end were for vertically suspending the tube from the supporting fixture in the heating, cooling, rinsing, and drying cycles. The holes at the other end were for the suspension of the 75-pound weights.

Salt Bath Temperature Checks

Prior to the heat treatment on both dates, the salt bath was probed at one-foot intervals from top to bottom to determine temperature variations. The results of the probe thermocouple checks showed a maximum variation of 10 degrees F in the working zone of the bath. The working zone is considered to be within the upper 16 feet of the salt bath. The results of the probe temperature checks are given in Table I.

Following the probe checks, the furnace temperature was adjusted to give the desired bath temperature for beta-treatment.

Processing

The extruded clad tubes were individually removed from the shipping containers and placed securely in a steel channel beam in a horizontal position and the fixture, for suspending the tube in the bath, was attached. The channel beam was used to prevent any bending of the tube while elevating to a vertical position. After elevating the beam to a vertical position, the tube was removed from the channel, suspended from the fixture, and a 75-pound weight was attached to the bottom of the tube. The weight had been preheated to approximately 1400°F to prevent chilling the salt when placed in the bath.

The first two tubes were apparently dry upon removal from the shipping containers and were therefore transferred directly to a position over the salt bath. However, the second lot of five tubes was covered with condensate and was therefore dried by suspending in a gun-barrel annealing furnace operating at 400°F for 1-1/2 to 2 minutes.

After transferring to a position directly over the salt bath, each tube was lowered into the bath where it was held for 10 minutes at transformation temperatures ranging from 1345 to 1365°F. Following the heating, the piece was removed from the bath and allowed to cool directly over the bath for three minutes. These data are given in Table II. Following the air-cool, the piece was transferred to a rinse tank containing water at 120°F in which it was dipped to remove the solidified salt.

It was observed that the solidification of the salt on the exterior of the tubes was complete in 100 to 120 seconds. Because the pieces were removed from the bath at 1350°F and the salt solidification temperature was approximately 960°F, it may be extrapolated that the cooling rate in air for the zirconium-clad uranium tube was in the neighborhood of 5°F

per second. The temperature of the tubes when rinsed would, therefore, be approximately 450°F.

After dipping in the rinse tank, the tube was transferred to a vertical gun-barrel annealing furnace operating at 400°F where it was held two minutes for drying.

Upon removal from the drying furnace, the weight was removed and the tube was again fastened to the channel beam which was lowered to a horizontal position. After a general examination of the tube, it was repacked in the shipping container.

The visual examination of both the I.D. and O.D. of the tubes indicated the surfaces were smooth and clean, although moderately oxidized. The tubes appeared to be straight and concentric.

Table I
Salt Bath Temperature Uniformity

<u>Probe Results on Sept. 23</u>		<u>Probe Results on October 7</u>	
<u>Distance from</u> <u>Bath Surface</u> <u>(Feet)</u>	<u>Temperature</u> <u>(°F)</u>	<u>Distance from</u> <u>Bath Surface</u> <u>(Feet)</u>	<u>Temperature</u> <u>(°F)</u>
1	1400	1	1380
2	1400	2	1380
3	1400	3	1380
4	1400	4	1375
5	1395	5	1375
6	1395	6	1375
7	1390	7	1375
8	1390	8	1375
9	1390	9	1370
10	1390	10	1370
11	1390	11	1375
12	1390	12	1375
13	1390	13	1370
14	1395	14	1370
15	1395	15	1370
16	1390	16	1370
Bottom	1375	17	1370
		Bottom	1365

Table II
Heat Treat Data

Tube Number	Elapsed Loading Time (Sec.)	Time at Heat (Sec.)	Elapsed Removal Time (Sec.)	Air-Cool Time	Bath Temperature at Loading (°F)	Bath Temperature at Removal (°F)	Outer Furnace Temp.		
							Upper Zone	Middle Zone	Bottom Zone
6930	56	600	12	180	1365	1360	1500	1440	1440
6920	53	600	8	180	1365	1350	1460	1420	1420
6985	55	600	19	180	1355	1350	1400	1380	1380
6984	21	600	10	180	1355	1350	1440	1420	1420
6988	14	600	8	180	1365	1355	1400	1380	1380
6987	12	600	8	180	1350	1345	1420	1400	1400
6986	12	600	8	180	1350	1350	1440	1420	1420

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.