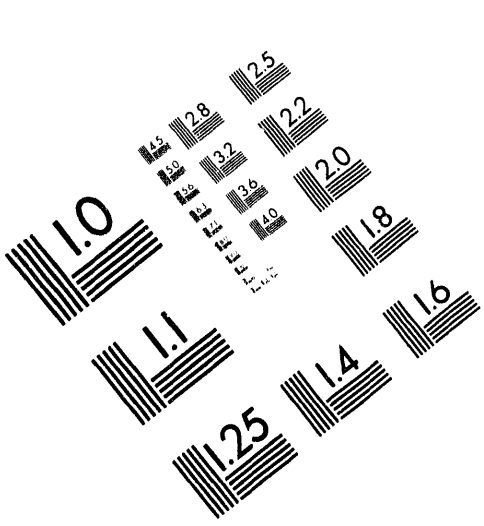

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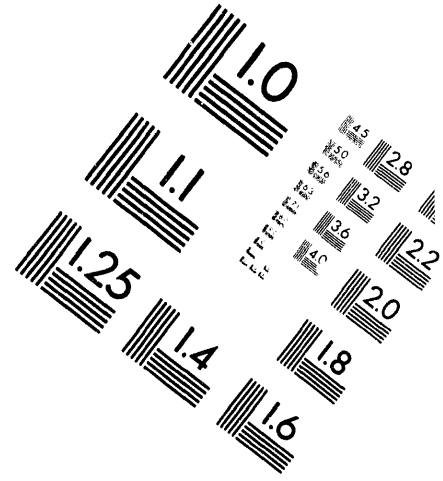

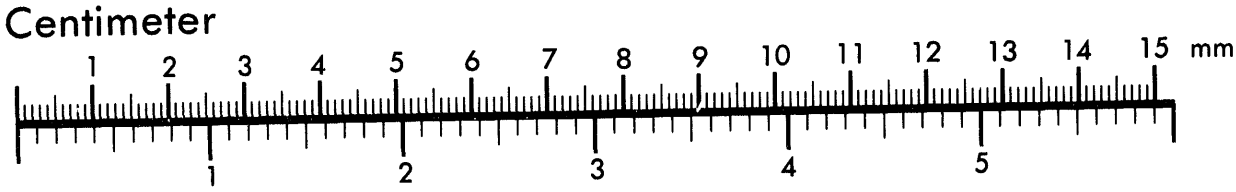

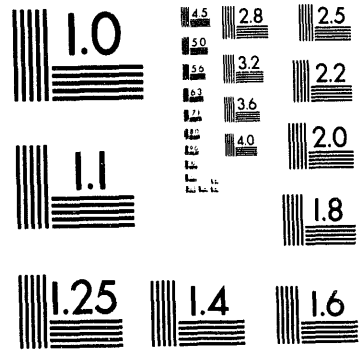

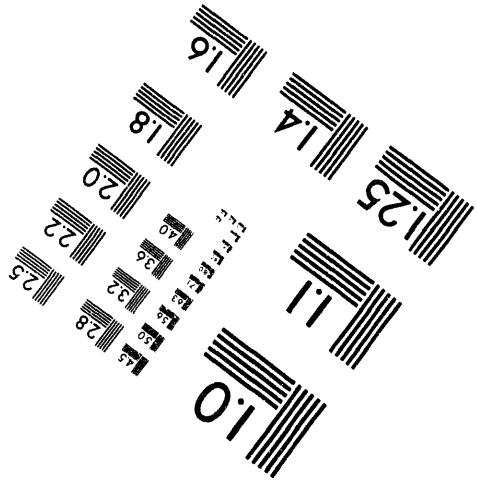

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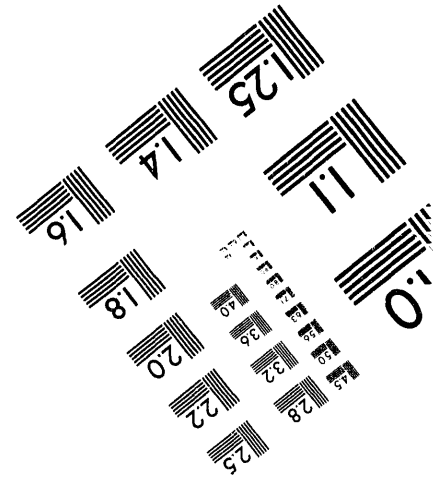

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DPW-55-24-7
(SRH-802)

1 - H. Worthington - D. F. Babcock
2 - J. C. Woodhouse - N. F. Spraggins
3 - K. G. Jones - W. J. O'Leary
4 - A. Pocalyko - R. R. Herries
5 - E. E. Hayes - R. E. Fisher
6 - W File
7 - M. H. Wahl - J. W. Croach - P. E. Permar
8 - C. D. Smith - C. C. McBride
9 - V. I. Montenyohl
10 - B. W. Dunnington - R. T. Huntoon
11 - B. L. Richards - E. A. Wick
12 - TIS File

E.I.du Pont de Nemours & Co.
Explosives Department
Atomic Energy Division
Wilmington, Delaware

MEMORANDUM TO FILE

May 4, 1955

FROM: R. R. HERRIES R. R. Herries

[redacted]

Trip Report
BATTELLE MEMORIAL INSTITUTE
April 26-27, 1955

W. J. O'Leary and R. R. Herries visited BMI to discuss the progress of subcontract research on both the natural uranium and the enriched uranium fuel element programs.

SUMMARY

1. Forty-eight "half-dollar" size corrosion specimens were press-clad at 950°F for 5 minutes with 3, 4, 5, and 6 thousand psi to establish a standard sample for the evaluation of the effects of outgassing on the corrosion resistance of nickel-plated uranium.

2. Materials are on hand for the fabrication of tools with which to carry out preliminary work on the internal cladding of natural uranium tubes.

3. At a meeting with BMI and du Pont personnel, Mr. DeBuigne of Moczik Tool and Die Co. recommended a co-axial method for extrusion-cladding uranium plates. Design and fabrication of tools for this w[illegible] Moczik. work would be done by Moczik.

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DISCUSSION

Uranium

Outgassing Nickel-plated Uranium

2. Forty-eight corrosion specimens have been press-clad at less than standard pressure, 12 each at 3, 4, 5, and 6 thousand psi, to establish a minimum bonding pressure which will give reproducibly good samples

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that are sensitive to variations in preparation. The standard samples for this evaluation must fail by undercutting within a relatively short time (10-30 days) in order to show unequivocally the effects of the outgassing variable.

Following this preliminary test, half-dollar size samples, 1" dia. X 0.180" thick, will be plated with 0.3-0.5 mil nickel and will be press-clad at 950°C for 5 minutes, with the selected bonding pressure. These specimens will serve as a basis for evaluating two sets of similar specimens which will be (1) vacuum outgassed prior to pressing in air, and (2) outgassed and pressed in vacuum. The specimens will be corrosion-tested as pinhole samples and will be examined metallographically.

Extrusion Cladding

BMI and du Pont personnel met with Mr. DeBuigne of Moczik Tool and Die Co. to discuss possible methods of extrusion cladding uranium plates. It was Mr. DeBuigne's opinion that the most promising approach would be a direct co-axial extrusion, using a porthole die and a hollow ram through which the uranium plate would pass.

It was agreed that:

(1) Moczik will design and fabricate tools adaptable to the BMI press.

(2) BMI will contact Moczik in the near future to discuss design of the tools.

(3) Du Pont will try to arrange for the use of the piercing-mandrel press at Adrian for a continuation of this work when it is feasible.

(4) Du Pont will look into the advisability of BMI personnel visiting the Bell Laboratories to observe and discuss the Bell cable cladding technique.

A report, BMI-989, on the previous extrusion cladding work at BMI has been issued.

Internal Cladding of Tubes

Materials are on hand for fabrication of the necessary tools to begin internal cladding experiments. The first attempts will use 1 ft. to 2 ft. nickel-plated steel tubes held in a simple, heated steel jig. A plug will be drawn through a hollow aluminum billet placed in the "dummy"tube in an attempt to produce a bonded 30-mil cladding.

Concurrently with this work, Moczik and Ajax will be consulted on the design and fabrication of a more versatile container and tools, which could be used in several proposed schemes for internal cladding. These tools would minimize the delay in changing from one variation of the cladding method to another, should results warrant such a change.

Uranium-Aluminum Alloy

Graphite molds are being machined, and melting stock is on hand for casting SRL co-extrusion size billets. The objective will be to determine what controls are necessary to produce homogeneous castings in the range 14% to 18% uranium.

A billet radiographing device is being built at BMI as an aid in evaluating the castings.

Alloys have been made and work has begun to determine more accurately the liquidus line above and below the peritectic point (16% to 40% uranium), and the composition of the alloy at the peritectic point for the uranium-aluminum system.

Miscellaneous

Ni-Sn Plating of Uranium

Interest has been shown in Ni-Sn alloy as a diffusion barrier between uranium and aluminum because of the pore-free nature of the plate and its low neutron cross-section. Consequently, BMI attempted to plate six 1-inch dia. X 0.180" thick uranium pieces using the fluoride bath recommended by the Tin Research Institute. The plate had completely flaked from two of the samples when they were removed from the bath. Two other samples were partially plated, and the remaining two appeared satisfactory; however, the Ni-Sn plate chipped away from the uranium surface when tapped lightly. Metallographic examination showed little or no adherence of the Ni-Sn to the uranium.

A second group of samples will be plated with a flash coat (about 0.01-mil) of nickel under the Ni-Sn. From these, the four best samples will be used for evaluation. One will be sectioned for examination (as plated); the remaining three will be press-clad with 30-mil aluminum at 950°C, 6000 psi, for 5 minutes. If these are successfully bonded, two will be pinhole corrosion-tested and one will be sectioned for examination of the bond.

[redacted] DPW-55-24-7

Effect of Nickel on Corrosion Resistance of 2S Aluminum

A thin plate of nickel, or a small percentage added as an alloy, has been suggested as a means of increasing the corrosion resistance of 2S aluminum. Work done at ANL indicates that the nickel serves as a cathode to liberate H_2, thereby inhibiting blistering and corrosion of the aluminum in water at 300°C at a pH of 3.0 to 3.5.

It was, however, Dr. Pray's opinion that there is no evidence that nickel will improve the corrosion resistance of aluminum in 95° to 100°C water. He also felt that the corrosion of aluminum was not a problem with the conditions of use at SRP.

V. I. Montenyohl of SRL has been in contact with J. Draley of ANL, and will discuss the subject at greater length during the May 17 corrosion meeting at SRP.

R. R. Herries

RRH/jss

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10/17/94
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