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TITLE One-Pressure Loading and Evaluation of Aluminum-Clad, Nickel-Plated Uranium Fuel Assemblies CDDR-141		CIRCULATING COPY RECEIVED 300 AREA MAR 21 1963 RETURN TO		
AUTHOR John E. Davis BNL				
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May 15, 1962

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By Authority of DS Lewis

PR-24, 4-19-94

By Quinn Maly, 4-20-94

Verified By DK Hanson, 4-21-94

Mr. V. G. Fos, Specialist
Contract Administration
703 Building, 700 Area
General Electric Company
Hanford Atomic Products Operation
Richland, Washington

Dear Mr. Fos:

We are enclosing three copies of a proposal concerned with the preparation for preliminary evaluation of up to 128 Hanford CV size I and II fuel elements to determine an optimum gas-pressure bonding cycle for the fabrication of this type of fuel element. This proposal is based on your request as outlined in your letter dated May 7, 1962, and document No. H-72417. Included is a cost estimate of the funding required to conduct this experimental study. All of the aluminum-clad uranium fuel assemblies are to be prepared and furnished by GE-HAPD for gas-pressure bonding at Battelle in existing equipment.

To implement the proposed program we have also enclosed six copies of the BNL-ARG research agreement (Serial No. 880R). The agreement provides for a six-month research period with an estimated total cost of \$24,780. This sum includes \$1,180 fixed fee as established in Contract No. H-7405-Eng-92. Receipt of two fully executed copies of the agreement, classification guidance, and the specimens will allow us to proceed.

Very truly yours,

John E. Davis
Project Administrator

JED/tiv
In triplicate
Enc.

RESTRICTED DATA

This document contains restricted data as defined by the Atomic Energy Act of 1954. Its transmission or disclosure of its contents in any manner to an unauthorized person is prohibited.

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THE DESIGN, CONSTRUCTION AND EVALUATION OF
A HIGH-PRESSURE, HIGH-TEMPERATURE REACTOR

GENERAL ELECTRIC COMPANY
ATOMIC PRODUCTS OPERATION

RESEARCH REPORT
R-1111

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GENERAL ELECTRIC INSTITUTE
905 King Avenue
Columbus, Ohio

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**UNDOCUMENTED
PROPOSED RESEARCH PROGRAM**

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**GAS-PRESSURE BONDING AND EVALUATION OF
ALUMINUM-CLAD NICKEL-PLATED URANIUM FUEL ASSEMBLIES**

**to
GENERAL ELECTRIC COMPANY
HARTFORD ATOMIC RESEARCH OPERATION**

**from
BATTILLE MEMORIAL INSTITUTE**

May 18, 1962

INTRODUCTION

Solid-state diffusion bonding of many metal and nonmetal systems of complex configurations has been achieved at Battelle through the development and application of the gas-pressure-bonding technique⁽¹⁾. The gas-pressure-bonding process employs a gas at high pressure and elevated temperature to produce metallurgical bonds between similar or dissimilar metals.

Current pressure-bonding studies conducted by Battelle for NAFD have established that strong bonds between aluminum and nickel-plated uranium can be produced at pressures and temperatures of 10,000 psi and 500 C. To obtain suitable bonds and to determine the optimum bonding cycle, however, further investigations into the effects of time, pressure, and temperature are required.

With autoclave equipment presently available at Battelle, pressures up to 15,000 psi at temperatures up to 1650 C are attainable. The conditions required for this proposed bonding study are well within the capacity of existing equipment.

⁽¹⁾ Fugroed, S.J., Hedge E.S., and Gryshover, P.J., "Gas-Pressure Bonding", Defense Materials Information Center Report No. 159, September 25, 1961.

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PROPOSED PROGRAM

This program will involve an investigation to define the optimum cycle conditions for the gas-pressure bonding of Hanford CV size I and E fuel elements. There will be up to (16) sixteen gas-pressure-bonding cycles to investigate the effects of time, pressure and temperature in obtaining a satisfactory diffusion bond between the aluminum components and nickel-plated uranium cores. Each cycle will contain as many as (8) eight I and E fuel elements. The bonding cycles are planned in accordance with the parameters outlined in Hx-72417 and given in Table 1.

Battelle will assist in examination and evaluation of the nature and quality of the diffusion bonds produced in the various bonding cycles. At least one element from each of the (16) sixteen cycles will be evaluated for bond integrity by metallography and destructive tests to determine bond strengths.

All fuel elements will be pressure checked before and after bonding. This will be done by placing the tubes within a room temperature autoclave and slowly applying helium pressure to 300 psi. This pressure is held for approximately ten minutes at which time the pressure is rapidly exhausted from the autoclave and the tubes are submerged in an alcohol bath. Leaks in the tubes are made evident by the bubbles in the bath caused by helium escaping through areas of leakage. This has been found to be an effective method of leak testing specimens for the pressure bonding process.

A complete record will be maintained on all fuel elements and of the bonding parameters attained during each pressure-bonding cycle. This record will include a chart of heat up, time at temperature and the cooling cycle used.

MATERIALS

The Hanford CV size (1-1/2-in. OD by 9-in. long) I and E elements will be prepared by HAPCO. The natural uranium fuel cores will be plated with a nominal 0.001-in. thick nickelplate and jacketed with aluminum (X-8001 alloy) components.

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TABLE 1. BONDING PARAMETERS PLANNED

Run	No. of Specimens	Time, Min.	Temperature, C	Pressure, psi
A	8	20	500	8,000
B	8	30	450	8,000
C	8	40	500	8,000
D	8	30	550	8,000
E	8	20	450	9,000
F	8	40	450	9,000
G	8	40	550	9,000
H	8	20	550	9,000
I	8	20	500	10,000
J	8	30	450	10,000
K	8	40	500	10,000
L	8	30	550	10,000
M	8	30	500	9,000
N	8	30	500	9,000
O	8	30	500	9,000
P	8	30	500	9,000

Proposal to EAPO - May 18, 1962

Revised per Mr. Poe's request of
June 21, 1962.

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Battelle will furnish all other materials and the equipment for the gas-pressure bonding program.

TIME AND COST ESTIMATES

It is recommended that the proposed program be allotted a six-month period after receipt of the fuel elements. The estimated cost of the six-month program is \$24,780 including fixed fee of \$1,180 as established in Contract No. W-7405-Eng-92. The estimated cost may be broken down as follows:

Salaries and wages	\$ 7,000
Supplies, materials, etc	3,200
Use of equipment, technical services, travel, and miscellaneous	7,050 (a)
Indirect costs	<u>4,350</u>
Estimated operation cost	\$23,600
Fixed fee	<u>1,180</u>
Estimated total cost	\$24,780

(a) Includes estimated \$7,300 for use of pressure bonding apparatus and associated equipment.

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GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

SERIES AND COPY NO.

June 26, 1964

RECORD CENTER FILE

TITLE

PRODUCTION TEST IP-695-A
THORIUM OXIDE IRRADIATION - K REACTORS

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AUTHOR

K. L. Hladek
and
P. D. Gross

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This is a rough draft of the proposed test document, for comment only.
It is not to be construed to be authorization for the test. The authorizing document will be routed for approval during the week of June 29, 1964.

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