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EXTRACT

VOLUME II

DESIGN AND PROCUREMENT HISTORY

OF

HANFORD ENGINEER WORKS

U. S. CONTRACT W-7412-ENG-1

DU PONT PROJECT 9536

AND

CLINTON SEMI-WORKS

U. S. CONTRACT W-7412-ENG-23

DU PONT PROJECT 9733

Handwritten notes:
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ENGINEERING DEPARTMENT

E. I. DU PONT DE NEMOURS AND COMPANY (INC.)
WILMINGTON, DELAWARE

DECEMBER, 1945



Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

*Downgrading
Instructions from SRO*

Mr. R. R. Beckmeyer, Assistant Superintendent
Procurement and General Services Department
Savannah River Plant
E. I. du Pont de Nemours and Company
Aiken, SC 29808

Dear Mr. Beckmeyer:

DECLASSIFICATION REVIEW

Volume II, Design and Procurement History of Hanford Engineer Works and Clinton Semi-Works, has been reviewed for declassification in response to a request from S. W. O'Rear. Initial review request was from L. F. Shafranek, AES, Wilmington, to S. W. O'Rear.

I have determined Volume II, Design and Procurement History of Hanford Engineer Works and Clinton Semi-Works, may be declassified. Accordingly, by my authority, Volume II is declassified effective May 4, 1984. Volume II has been determined to contain no Section 148 information; however, since it has not been reviewed for patent, it should not be released without such review.

Sincerely,

Original Signed By J. M. Bauer:

J. M. Bauer
SR Classification Officer

OPMC:JMB:ma

Enclosures

Vol. II and Form SR-60

cc: L. Lewis, Chief Engineer, DOE
w/cy Form SR-60; w/o Vol. II
P. Hansen, RL, w/cy Form SR-60;
w/o Vol. II
S. Gydesen, PNL, w/cy Form SR-60;
w/o Vol. II

TO: These Listed Below **BAUER**

Please review and return with your comments to **S.W. O'REAR**

RE: Contract **W 7412-ENG-1 and W 7412-ENG-23: Proj 9536+973**

Document No.:

Title: **Vol. II Design and Procurement History of Hanford Eng. Works and Clinton Semi works**

Author(s): **Eng. Dept E I Descent of Hanford Co Inc. Dec 1945**

Present Classification: Unclassified Confidential Secret

Reason for Review: Declassification Publication External Distribution

1. PATENT COUNSEL

From a patent standpoint, there is no objection to publication or declassification as proposed.

No items of patent interest noted.

Released on basis of patent review by contractor representative.

Subject matter previously released for publication in _____

DOE Case No. _____

Release will not adversely affect this case.

Release subject to deletions or restrictions noted.

Contractor and DOE restrictive stamps cancelled; DOE disclaimer stamp affixed. THIS SHOULD BE DONE TO ALL COPIES TRANSMITTED.

Publication withheld pending patent action.

PATENT COUNSEL, SR

(DATE)

2. TECHNICAL AND PRODUCTION DIVISION

CLASSIFICATION OPINION

CATEGORIZATION _____

*Unclassified
No Section 148 Info*

J. M. Bauer
SR CLASSIFICATION OFFICER

5/1/89
(DATE)

3.

SIGNATURE

(DATE)

metal laboratory and thus was altered for the immediate execution of this order. The scope of the order on Baker was then altered to include only the work preparatory to the grinding operation. Because of this change, Baker was able to increase greatly its production by using equipment which was suitable to the wider range of tolerances acceptable for rough-turning.

The only difficulties experienced in the fulfillment of these contracts were attributed to the pyrophoric character of the metal when reduced to grindings, and with its tendency to react with water. So hazardous were these conditions that it was necessary to incinerate all grindings in order to accumulate and ship safely the scrap generated from the operation.

In September of 1943 it became evident that, in order to perform a satisfactory test on the unbonded slugs, revisions to testing methods and slug design would be necessary. The Engineering Department had suggested that a longitudinal groove be milled on the machined surface for the full length of the slug to accomplish this result. Later, after it had made certain tests, the Metallurgical Laboratory accepted this idea and worked out the mechanics of the deflection test. Accordingly, it was planned to mill the groove in all Clinton slugs then uncanned.

As this operation involved merely the milling or shaping of a 60 deg V-groove approximately 0.010 inch wide at the top, no difficulty was experienced in the performance of any of the orders.

The Clinton Laboratories advised soon after this that it was in process of stripping the cans from a quantity of 15 tons of rejected slugs. As these slugs constituted a portion of the original requirements for this project, it was thus the responsibility of the Engineering Department to arrange for grooving, refacing the ends, and recanning. Since Baker was the only fabricator then performing any machining of uranium for the Engineering Department, it was thought advisable to place the grooving and refacing work on this firm also, on order XPG-1795-1/2, and thereby effect a saving by eliminating the need for additional guard service, which was already provided on order RPG-800-1/2.

With the completion of order XPG-1795-1/2 in April of 1944, the machining and grooving phases for Clinton Engineer Works came to a close.

DEVELOPMENT OF CANNING METHODS

Introduction

Owing to the peculiar properties of uranium, and to the absolute necessity that its performance in the pile conform

to certain requirements, it was essential that the exterior surface of the slugs be protected in some manner which would prevent its reaction with the water in the pile. The earliest consideration proposed as a means of protecting these surfaces visualized the application of a metallic coating to the machined slug, either by electroplating or by a hot-dip process. The Office of Scientific Research and Development placed a separate contract with the Grasselli Chemicals Department Research Laboratory, located in Cleveland, Ohio, for the development of a satisfactory coating process utilizing this conception. Despite considerable research work and experimentation by this latter group, the electroplating process subsequently proved unfeasible for commercial production, and ultimately was abandoned in favor of a hot-dip process that also was being evaluated, and which, it was believed, would satisfy more fully the requirements.

Past research had determined that the most suitable covering for the protection of the uranium slug and for its efficient operation in the pile was aluminum. Therefore, with but few exceptions, virtually all investigations and developmental work incurred in the protective coating of slugs employed aluminum in one form or another.

Whereas the responsibility for the development of the canning methods was vested in the Metallurgical Laboratory, the Engineering Department was responsible for the quantity production of the finished slugs and for the procurement of all special equipment — whether to be used at the fabricators or at the Hanford Engineer Works — which was required for this production. Since the fabrication of each of the component parts making up the finished slug assembly necessarily required experimental work to varying degrees, it was but a short step for the Engineering Department to absorb the attendant responsibilities therefor in the prosecution of its duties to provide adequate production. The actual developmental work, however, was subcontracted to firms familiar with that particular type of fabrication. Furthermore, to effect the start of production, or to maintain it, necessitated that the Engineering Department on several occasions accept the present method as satisfactory, rather than to jeopardize the program by waiting for more-advanced information or subsequent revisions to the process.

Clinton Slugs

On March 3, 1943, it was agreed between representatives of the Clinton Laboratories and the du Pont Company that the coating of uranium slugs by a hot-dip process could best be carried out at Clinton Laboratories, and that the Engineering Department would arrange, in cooperation with the Grasselli Laboratory, to see that the necessary equipment facilities for housing it were installed in time to carry through the coating operation on the 100-ton initial quantity of slugs.

It was recognized, however, that there was a distinct possibility that the hot-dip coating would not be satisfactory for the Clinton slugs, and in this event some other coating technique would need to be developed. Grasselli Laboratory was still working on the electroplated coating as a possible alternative, and the Metallurgical Laboratory was studying the possibility of fabricating aluminum jackets on the metal slugs.

No suitable coating method had been demonstrated by the latter part of March, 1943. While electroplating or hot-dip coating conceivably might still be developed for Clinton, it remained entirely possible that canning in aluminum, which was anticipated for Hanford, might have to be extended to Clinton. However, no commitments for work on canning were undertaken by the Engineering Department at this time.

In view of the original schedule which called for the completion by June 1, 1943, of the coating of the total number of slugs required for Clinton, Grasselli had proceeded with the preliminary work of laying out coating plants for both the hot-dipping and electroplating processes, locating suppliers for required equipment, and securing estimates of delivery dates. These plans for a commercial coating plant were tentative only, and no commitments were made. It was apparent, moreover, if large-scale coating by either of these processes was to be started by May 1, that construction of the coating plant must be started at once. There was serious doubt, even then, that the construction of a plant would be accomplished in the allowable time.

Representatives of the Metallurgical Laboratory and the Grasselli Laboratory then agreed that sufficient evidence to justify the construction of an electroplating or hot-dip coating plant was not then available, and the Grasselli Laboratory discontinued any further activity in connection with the design or recommendation for construction of any such plant. This left the possibility of applying an aluminum jacket, or can, around the slug as the only feasible method.

The Engineering Department immediately investigated two avenues of endeavor to develop a satisfactory canning method. Developmental work was initiated at the Aluminum Company of America in New Kensington, Pennsylvania, and at the Wolverine Tube Division of the Calumet & Hecla Consolidated Copper Company in Detroit, Michigan. Alcoa was requested to develop a method for sealing the slug in the can by the insertion of a cap over the open end of the slug, and then to braze or weld the can to the cap. An alternate endeavor by Alcoa was directed toward closing the can by spinning it over the end of the slug, followed by brazing or welding over the resultant small opening. Wolverine's activities were occupied only with this alternate method.

From the start [redacted] contributed invaluable assistance in the development of its method. Preliminary tests made on a few experimental canned slugs proved that brazing, as attempted, was unsuitable and that, unless this method could be considerably improved, canning by this means must be considered as impracticable and without justification for further development along these lines.

In order to prevent any deleterious effects on the process in the pile, it was recognized that no impurities or particles of foreign matter should be contained within the sealed can. This requirement therefore excluded the use of any welding flux, and imposed upon all groups an assignment that already was extremely difficult to conquer. Fluxless welding of thin aluminum sheets was virtually an uncharted field, and, though commercial equipment had been developed to weld heavier-gauge sheets, the attendant burning of the sheets and running of the weld with extremely light-gauge stock ultimately proved to be the major obstacle to the canning program.

This exigency accordingly prompted the investigation of seam welding and spot welding, and, although no experimental work had been performed on the former, it was believed that this method would quite probably be more adaptable than spot welding. However, both spot- and seam-welding experiments were to be carried on concurrently so that the respective merits of each could be determined and evaluated.

During April, 1943, many time-consuming attempts were made by Alcoa to obtain a sound type of fluxless spot weld on a riveted end. When welding was attempted with uranium slugs instead of with the steel slugs previously used, the results were uniformly disappointing. However, with the cooperation of the Taylor-Winfield Company, Alcoa later obtained some very promising examples of seam welding with this manufacturer's machines. These specimens were recorded as being sufficiently successful to warrant the installation at Alcoa of a Taylor-Winfield seam welder, with the thought that the New Kensington Plant be set up for production experiments.

By the end of April, 1943, Alcoa had progressed with canning to the point where samples of both seam-welded and spot-welded cans were ready for inspection by representatives of the Engineering Department. These samples were displayed for comparison, and a test made on the tightness of the cans proved conclusively that seam welding was the more satisfactory method.

By the early part of May, 1943, Alcoa had become sufficiently familiar with the problems involved to submit a firm quotation to cover the developmental work in connection with, and the production of, 90,000 canned Clinton-size slugs. Order XFC-423-1/2 was issued to cover this work.

It was decided also that order XPG-427-1/2 would be placed on the ~~General Electric Company for the development and~~ canning of 500 slugs to be produced by an alternate method.

Although the representatives of the Metallurgical Laboratory had expressed the thought that there would probably be some further improvements in canning technique, it was nevertheless agreed between Alcoa and du Pont that in order to meet the expected startup of production on June 1, 1943, the method as proposed would be considered satisfactory until proved otherwise. From this date on, experiments with seam welding continued to improve and progress was rapid.

As a part of the developmental work included in order XPG-423-1/2, Alcoa was requested on numerous occasions to fulfill various requests by the Metallurgical Laboratory or Grasselli Laboratory for specimen or special canned slugs. These were used for additional research or for development of testing methods, corrosion studies, or bonding techniques, and were not made available for later use at Clinton.

Early in August, Wolverine reported that progress was improving in the canning of the 500 experimental slugs. When du Pont explained that complete evaluation of these would be necessary before further steps could be taken for the procurement of additional quantities, Wolverine emphasized the fact that there was some doubt as to its ability to continue the development of new closures required for Hanford Engincer Works, in view of new fabricating business which it was then scheduling in its shops. This decision left Alcoa the only remaining source of canning for either the Clinton or the Hanford slugs, until canning facilities could be set up in the 300 Area at Hanford.

Wolverine endeavored to fulfill the requirements of order XPG-427-1/2, however, and ultimately completed a total of 487 canned slugs of the 500 requisitioned. ~~The great majority of these were not acceptable, and the order was later closed out without additional work having been performed.~~

By September, 1943, the welding operations at Alcoa had become somewhat standardized and performance was fairly predictable. However, the Engineering Department believed that the welding procedure could be improved to the extent that fewer rejects would be produced. In an endeavor to further the development of welding and to uncover any possible alternate methods, representatives of the Engineering Department visited the General Electric Company in Schenectady, New York, to investigate methods under development. Here it was learned that thin aluminum sheets could be welded satisfactorily by means of an alternating current tungsten arc working in an atmosphere of argon. Arrangements were made for metallographic examination of welded samples at the Engineering Department Experimental Station and, on order

~~XPG-1628-1/2, for the welding of additional components at the General Electric Laboratories.~~ After additional testing, this method was specified for the canning of Hanford slugs.

In the meantime, purchase order XPG-1628-1/2 had been placed on Alcoa for the canning of 60,000 Clinton slugs, to be sealed by resistance welding. Only 12,708 slugs had been canned when this method was considered unsatisfactory for higher-temperature pile operation. Although the fusion welding method had not then been fully developed, it was known to be superior to resistance welding under the proposed conditions, and order XPG-1628-1/2 was accordingly cancelled.

All canned slugs from Alcoa were tested by the hydrogen and the hot-air methods after their receipt at Clinton Laboratories. Both methods loosened the mechanical bond between the slug and the can because of the annealing characteristics of the test, and this loosened condition made possible the testing of slugs by the later-developed deflection test which, by November, 1943, indicated that a quantity of approximately 15 tons leaked and would require re-canning. Inasmuch as the Engineering Department was yet to supply 30 tons of Clinton slugs which were to be machined only, the Clinton Laboratories stripped the cans from these leakers and applied these slugs against the thirty tons. The Engineering Department then placed order XPG-1750-1/2 to cover the developmental work and canning, of slugs to replace the leakers, employing the fusion welding method developed by General Electric Company. This order, unlike the two previous orders placed on Alcoa, was awarded on the basis of du Pont's supplying all component parts required in the assembly, as well as furnishing the special arc welding machine for Alcoa's use.

Ultimately, the process was developed under du Pont direction and a total of 17,456 slugs was canned on this order. This completed the requirements for the Clinton Laboratories with respect to the Engineering Department's participation in the program.

Hanford Slugs

The development of canning methods for Clinton was necessarily extensive because of the paucity of information on any form of coating or welding process, and the lack of any firm specifications based on performance characteristics of the slug in the pile.

This situation was somewhat different with the Hanford slugs, as the information gained from the preliminary developments in canning the Clinton slugs was considered applicable to the larger slugs for Hanford. In addition, the machining and canning facilities to be installed in the 500 Area were expected to produce all the