**Cover Sheet for a Hanford
Historical Document
Released for Public Availability**

Released 1994

**Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830**

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute**

DISCLAIMER

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

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of D S Lewis

CG-NMP-1, 11-3-94

By J E Savelly 12-19-94

Verified By S Roberts 12-20-94

NOT UCNI

TO: W. L. Schalliol

FROM: J. B. Burnham Jr.

RECEIVED

JUN 13 1956

**300 AREA
CLASSIFIED FILES**

HM-21586

DECLASSIFIED

- #1. W. L. Schalliol
- #2. G. McCullough
- #3. R. Ward
- #4. A. Smith
- #5. J. B. Burnham Jr.
- #6. 700
- #7. 300
- #8. Pink
- #9. Yellow

RECORD CENTER FILE

July 10, 1951

This Document consists of
3 Pages

RECOMMENDATIONS FOR SLUG IMPROVEMENT

As has been recognized, a number of metallurgical improvements can be made in the present fuel slug. Following are several suggestions as to possible methods for achieving an element which will be more stable and less liable to canning failure than the present units. Some of these ideas have been previously advanced, in one form or another, by other members of the group.

1. The anisotropic nature of alpha uranium is such that low temperature irradiation is bound to cause preferential growth of the crystal. The optimum metallurgical condition of the uranium metal, as has long been recognized, is a fine grained, randomly oriented structure. The achievement of this structure might be attained by a very fast heating into the mid-beta phase followed by a drastic quench back into the alpha phase. In order to be most effective this single beta heat treatment should be given to metal which has a minimum degree of preferred orientation. Such metal could be obtained with a breakdown by gamma extrusion followed by carefully controlled rolling at 600°C in shaped rolls. The fast beta heat treatment might be accomplished either in a salt bath or in an induction coil - preferably the latter for reasons of speed.
2. Canning could now be done by the lead-dip method. It might be advantageous to furnace anneal the slugs (either before or after canning) to achieve equiaxed grains. It has been shown that a four-hour anneal at 600°C results in a uniform, equiaxed structure.
3. Two possible methods of closure should be investigated. The first of these has been previously suggested by the author. This consists of spinning the top of the can over the cap. A weld bead is then run around the top of the cap rather than the edge of the cap. This method has the advantage of welding over aluminum rather than over the Al-Si bond. It mechanically disengages weld areas, forms a mechanical can-to-cap seal, and leaves the weld bead further removed from the critical can-cap intersurface. The top view of the canned slug would then be as shown:

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED DT

DECLASSIFIED

This method of closure would also be of use in any unbonded canning process.

The second method of closure would involve the solving of several engineering problems before it would be practical. The cap shape would be as shown below:

Can size would be such that it would extend approximately $5/8$ " above the uranium slug. After canning, the excess metal of the can would be rolled over on the beveled portion of the cap. This rolling will bring the two surfaces into intimate contact. If the Al-Si layer could be removed from the top of the can and from the beveled portion of the cap, the welding procedure would be simple. A resistance weld could be run around the middle of the bevel and a fillet weld could be run around the top edge of the can. This method would afford an Al-Si protective layer, a mechanical closure, and a double weld with both welds removed from the can-cap critical area. The top of the cap could be machined down to size. If the removal of Al-Si from the can and cap surfaces mentioned above proved impractical, it might be profitable to investigate the resistance welding properties of aluminum having an Al-Si coating. Even if the resistance weld cannot be made successfully, there might be some advantages to the above method of closure with its increased leakage path and weld removed from the critical area.

4. The above methods of can closure are based on the retention of the present practice of bonded canning. If an unbonded slug were tried, method 3 above might be of practicality in the slug closure. The caps themselves could be easily designed so as to relieve any stresses which may occur as a result of the differential thermal expansion of the slug center and periphery. According to S. S. Jones, the temperature differential between the center and outside of a slug is between 200 and 300°C. An assumption may be made that the aluminum can and Al-Si bonding layer have little effect on the differential expansion between center and outside of the slug. This assumption is not unwarranted in view of the relative volumes of metal involved and the higher coefficient of expansion of the aluminum. In any event, the differential expansion might be expected to be between 0.020" and 0.030" in a 4-inch slug. If this expansion were evenly divided between each end, the deflection would be on the order of 0.01". This is an exaggerated condition, of course, since the forces involved will tend

to minimize this differential expansion. In any event, an unbonded slug could be cased with a cap shaped as illustrated below:

This would relieve any direct stresses or cycling stresses which may occur during exposure.

DECLASSIFIED

John B. Burnham Jr.
J. B. Burnham Jr.
Metallurgy Section
PILE TECHNOLOGY DIVISION

JBB:hh

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.