(CLASSIFICATION)

RL-NRD-163

DATE
January 8, 1965

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

TITLE

N-FUELS ENGINEERING PROGRAMS - CY-1965

OTHER OFFICIAL CLASSIFIED INFORMATION

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U. S. C. , SECS. 793 AND 794, THE TRANSMISSION OR REVELATION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

AUTHOR

J. W. NICKOLAUS

ISSUING FILE

THIS DOCUMENT MUST NOT BE LEFT UNATTENDED WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS TO IT. WHEN USE MUST BE CARED IN IMPROVED, THE RELEVANT WITHIN APPROVED COUNTRIES ARE AVAILABLE TO YOU. SIGN AND RETURN TO THE OFFICE A SIGNED FROM THE RELEVANT COUNTRIES IS YOUR RESPONSIBILITY TO KEEP IT AND IT IS INTENDED TO BE WITHIN THE LIMITS OF THIS PROGRAM AND ANY UNAUTHORIZED PERSON, IT IS SMITH AND A RANGE AT YOUR PLACE OF RESIDENCE IS NOT INTENDED TO BE NO TO BE REPLICATED. ADDITIONAL COPIES ARE REQUESTED TO BE RETURNED FROM THE OFFICE TO THE FILE. PERSONS FINDING THIS DOCUMENT ARE REQUESTED TO SIGN IN THE SPACE PROVIDED BELOW.

ROUTE TO:

PAYROLL NO.

LOCATION

FILE	ROUTE	DATE
100-443888-100	100-443888-100	100-443888-100

SIGNATURE AND DATE

54-3000-340 (3-57)

AEC-GE RICHLAND, WASH.

(CLASSIFICATION)

DECLASSIFIED

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, make 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.

DISCLAIMER

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

DISTRIBUTION

Вот тебе Векундот

1. C. J. Denton
2. J. E. Minor/G. A. Last
3. J. C. Spanner/D. C. Worlton

General Electric

4. A. C. Callen/T. W. Evans	17. M. Lewis
5. D. L. Cornell	18. L. M. Loeb
6. R. G. Curran	19. T. D. Naylor
7. D. W. Darsow	20. J. W. Nickolaus
8. R. L. Dickeman	21. J. W. Riches
9. A. E. Guay	22. J. E. Ruffin
10. W. G. Hudson	23. R. H. Scanlon
11. H. P. Kraemer	24. W. M. Scott
12. W. R. Krehbiel	25. R. R. Studer
13. H. S. Krider	26. 700 File
14-15. D. C. Lehfelddt	27. Record Center
16. M. C. Leverett	

This document consists of
9 pages, [REDACTED]

N-FUELS ENGINEERING PROGRAMS - CY-1965

by

J. W. NICKOLAUS, MANAGER
N-FUELS ENGINEERING

N-REACTOR FUELS
N-REACTOR DEPARTMENT

JANUARY 8, 1965

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of DS Lewis
PR-24 4-22-94

By DK + Hanson, 5-11-94

Verified By J E Savelly 5-16-94

This document contains Restricted Data as defined in the Atomic Energy Act of 1946. It is transmitted for the disclosure of information in a manner to be authorized by the person is prohibited.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DECLASSIFIED

N-FUELS ENGINEERING PROGRAMS - CY-1965

Programs undertaken by N-Fuels Engineering should be designed to achieve the following general objectives.

1. Maintain and/or improve fuel element quality level necessary to assure satisfactory reactor performance.
2. Develop the fuel fabrication technology required to support the development and testing of new fuel designs.
3. Reduce fuel manufacturing costs to achieve projected operating cost targets.
4. Reduce the uranium metal costs charged to N-Reactor.

Further, these programs must be integrated to provide maximum support to identifiable Section and Department goals. The specific goals for CY-65 are:

- I. Develop technology necessary to support conversion to co-product operation early in CY-66.
- II. Conduct a program of uranium fabrication development to improve fuel element quality and reduce uranium costs.
- III. Improve fuel element quality, manufacturing yields, and conversion costs for the current production fuel design.
- IV. Develop fuels capable of extended exposure and/or higher power level operation in support of alternate reactor operating plans.
- V. Develop new fuel fabrication techniques to extend the capabilities for fuel fabrication within the N-Reactor Department.
- VI. Initiate equipment design and procurement actions as necessary to provide capability to meet production schedules.

Manager, N-Fuels Engineering

JW Nickolaus:bt

Attachments

DECLASSIFIED

I. Develop Technology Necessary to Support Conversion to Co-Product Operation Early in CY-66

A. Co-Product Fuel Fabrication

Present plans schedule conversion of the fuel plant to co-product production in the second quarter, CY-66. In order to achieve this conversion, it is necessary to accomplish the following:

1. Complete the work necessary to obtain a decision by February 1, 1965, on the scope of the target fabrication facilities to be installed at HAPO.
2. Complete by February, 1965, a detailed punch list of all equipment modifications and/or procurements necessary to modify the plant for processing driver fuels.
3. Complete the project proposal for acquisition of target fabrication facilities and request authorization for funds in April, 1965.
4. Complete by June, 1965, the design criteria for all components and tooling necessary to initiate long-lead time procurement actions.
5. Complete by December, 1965, the Engineering Specifications for manufacture of both the target and driver fuels.

B. Simulated Driver Tube Fabrication

This program will provide experience necessary to develop,

- a. The co-product fuel fabrication technology and provide prototypical test fuels for evaluation of new design features and modified uranium alloys.
- b. The single-tube fabrication technology necessary to provide the "least cost" fuel design needed to support base case plutonium production.

Key target dates in this program are as follows.

1. Complete, for reactor charging, by June, 1965, SDT fuels with the uranium compositions of interest for irradiation testing.
2. Complete for reactor charging by July, 1965, SDT fuels with TIG brazed closures and revised design features as specified by Research and Engineering, which require irradiation testing.
3. Complete for reactor charging by November, 1965, the balance of the SDT fuels authorized by the production test using prototypic fuel design and manufacturing processes.

DECLASSIFIED

II. Conduct a Program of Uranium Fabrication Development to Improve Fuel Element Quality and Reduce Uranium Costs

1. Complete the feasibility study of direct extrusion of billets to finished dimensions by June, 1965.
2. Establish fabrication processes for the uranium alloys selected for irradiation testing. Includes casting, heat treating (beta and gamma), and extrusion development.
3. Evaluate by June, 1965, the application of billet upsetting and piercing toward reducing fabrication costs and improving fabricability.
4. Develop tipped mandrel extrusion techniques as required for production application by February, 1965.
5. Evaluate the feasibility of direct casting of uranium alloy billets by February, 1965.
6. Continue development of Class II specification system to control quality levels and improve feed stream yields.
7. Continue close liaison with NLO-RMI to effect close control of feed stream quality and metal costs.

III. Improve Fuel Element Quality, Manufacturing Yields, and Conversion Costs for the Current Production Fuel Design

A. TIG Braze Closure Development and Testing

The TIG braze closure is expected to combine high integrity and reliability with significantly reduced manufacturing cost. Since conversion to this design requires irradiation testing of significant quantities of end closures, it is necessary to provide test quantities in all fuel designs.

1. Fabricate one column of SDT fuels for charging during February, 1965.
2. Fabricate two to four columns of outer tube fuels for reactor charging during February, 1965.
3. Fabricate and have ready to charge SDT and/or outer fuels in quantities sufficient to have at least ten (10) columns of fuel ready for charging at all times after March 1, 1965.
4. Develop the process for TIG brazing inner fuels by June, 1965.

DECLASSIFIED

5. Procure and set up the equipment for producing forty (40) columns per month (outer tubes only) by July, 1965. Increase the capacity of this equipment to include production of a like amount of inner tubes by September, 1965.
6. Initiate equipment procurement for TIG braze conversion of plant prior to June 30, 1965.
7. Initiate plant conversion to TIG braze by December, 1965.

B. Braze Wire Vendor Development

The wire preforms used in the TIG braze process are difficult to fabricate. To date, all wire has been produced by BNL using a hot swaging process. The program of vendor development will include determining the costs of local fabrication in order to make a "make or buy" decision early in CY-65.

1. Initiate an offsite vendor development program to obtain braze wire from an offsite source by March, 1965.
2. Complete make or buy analysis by April, 1965.
3. Continue efforts to develop alternate fabrication methods.

C. Forged Supports

This design provides increased support strength for outer tubes. It is fabricated from zircaloy wire and should be less costly to fabricate than the present design which is made from ductile zircaloy strip. In order to convert production to the use of forged supports, it is necessary to develop a source of supply. The vendor development program should provide at least two qualified sources of supply for this component. Production testing should be completed by March, 1965, and conversion to full production on forged supports should be completed by August, 1965.

In the event that the forged support design significantly increases fuel manufacturing costs, the decision to convert to this design will be reevaluated when cost data is available.

D. Chevron Braze Closure

The chevron braze closure is considered a backup design in the event of clad shear failure at the cap-core interface in the present braze closure. To back up the present process it is necessary to have all component designs completed and enough operating experience to insure an orderly transition.

DECLASSIFIED

1. By January, 1965, complete detail design of components and tools necessary to manufacture chevron brazed end closures on the present tube-tube fuel design.
2. By March, 1965, complete a pilot run on outer fuel tubes to establish firm operating requirements.
3. By April, 1965, complete a pilot run on inner fuel tubes to establish firm operating requirements.
4. By May, 1965, complete the final component and tool designs and process specifications necessary to initiate manufacture of chevron braze closures.

E. Extrusion of Zircaloy Components

Zircaloy cladding represents the major single cost component in N-fuel manufacture. Good progress has been made in reducing zircaloy costs by improved purchasing practices and competitive bidding, however, future gains from this area will be limited. In order to insure further reductions in zircaloy costs, it is necessary to develop improved fabrication techniques. Due to the high cost of starting material the greatest gains will be realized by developing processes which improve ingot to finished product material yields. Since extrusion is already a necessary operation in all vendor's fabrication cycles, it appears logical to attempt to develop extrusion technology to the point that the extruded product is satisfactory for use in the coextrusion billet without further scrap-producing secondary operations.

1. By March, 1965, evaluate the effect of component wall thickness variation on coextruded clad thickness variation.
2. By May, 1965, determine capability for producing directly extruded tubes with satisfactory surface condition and good dimensional control.
3. Assuming that feasibility is established by 1, and 2, revise by June, 1965, component specifications as necessary to initiate procurement of components fabricated by direct extrusion. In the event that problems are encountered with use of as-extruded surfaces on the clad-core interface, initiate use of components with only one surface machined.

F. Optimize Tube-Tube Billet Design

Material utilization in the extrusion operation can be improved by redesigning the extrusion billets to produce a maximum number of fuel pieces per extrusion.

DECLASSIFIED

1. Complete during January, 1965, the test work necessary to determine the design factors necessary to design new tube-tube billets to improve material utilization.
2. Complete by February, 1965, a detailed cost analysis of billet design alternates.
3. Complete by April, 1965, an alternate billet design for outer tubes including material specifications and component and tooling designs.
4. Complete by August, 1965, an alternate billet design for inner tubes.

G. Improvement of Current Process

Several operations in the current process require improvement in order to improve both quality and yields. The main areas of current concern are:

1. Braze (Ref: RL-NRD-78)

The programs for improvement of the braze process are presented in the referenced document. They can be summarized as follows:

- a. Characterize outgassing properties of ready-to-braze assemblies and evaluate the feasibility of a pre-braze outgassing cycle.
- b. Improve station calibration procedures.
- c. Control/evaluate uranium contamination by:
 - (1) Chevron cap design
 - (2) Intentional coil offset
 - (3) Improve coil fuel alignment
- d. Improved contamination measurements.
- e. Evaluate adequacy of present induction heating system.
- f. Characterization of braze rings.
- g. Evaluate use of powder braze rings.
- h. Evaluate alternate end cap designs (reduce cost).
- i. Reduce station rejects by:
 - (1) Braze ring design
 - (2) Procedural changes
 - (3) Recess design

DECLASSIFIED

2. Extrusion

Present defective rates have shown an apparent increase in the

- a. clad and bond test rejects (outer clad variation, bonding, minimum clad),
- b. extruded surface and wall thickness

reject categories. It is necessary to identify the cause of these rejects and reduce the defective rate significantly in order to meet projected cost and yield goals.

Although extrusion unbond (peel test) defective rates were sharply reduced during CY-64, further improvement should result from improvements in copper weld joint strength.

Continued work on extrusion lubrication and uranium billet fabrication is needed to eliminate inner clad thickness variation on outer tubes. The goal should be to reduce this defective rate to less than 1% of the 12 mil variation limit by late 1965.

3. Warp

Lack of control on warp has resulted in heavy losses during CY-64. The cause(s) of warp must be defined in order to control the inner tube warp defective rate.

4. Welding

The end welding process must be thoroughly checked out to reduce weld related defects. This is closely related to the braze program since some of the weld defects are braze associated.

Reweld processes must be developed, evaluated, and put into production early in the calendar year.

IV. Develop Fuels Capable of Extended Exposure and/or Higher Power Level Operation in Support of Alternate Reactor Operating Plans

- 1. Complete fabrication by April, 1965, of fuels fabricated with selected uranium alloys designed to improve in-reactor performance of tube-tube fuels.

DECLASSIFIED

V. Develop New Fuel Fabrication Techniques to Extend the Capabilities for Fuel Fabrication within the N-Reactor Department

The coextrusion process is presently limited to using massive metallic uranium billets. The physical size of the billet sections limits the possibilities for improving metallurgical properties by high reduction hot working, high quench rate heat treatments, or utilizing advanced metal casting techniques to produce uniform dispersion of alloying agents. Development of a coextrusion technology to utilize finely divided metallic uranium could provide important flexibility in the design of improved metallic fuels.

1. Investigate the feasibility of producing coextruded fuels using finely divided uranium (shot-splat) as starting material.
2. Investigate the feasibility of producing coextruded fuels using small diameter rolled or extruded rods as starting material.

VI. Initiate Equipment Design and Procurement Actions as Necessary to Provide Capability to Meet Production Schedules

1. Complete installation and startup of counterbore machine by May, 1965.
2. Design, install, and evaluate an extruded tube roller by March, 1965.
3. Initiate procurement action on a new cutoff saw by June, 1965.
4. Prepare a project proposal for co-product conversion by April, 1965.
5. Begin development of station handling devices necessary to accommodate high production rates and heavier fuel sections.
6. Begin development of intrastation handling devices necessary to improve productivity.
7. Procure equipment necessary to convert to TIG braze closure production by December, 1965.

DECLASSIFIED