

SUBJECT				S.P. NO.
SPECIFIC CRITICALITY PROCESS CONTROL PROCEDURES FOR AKTIEBOLAGET ATOMENERGI R2 MATERIALS TESTING AND RESEARCH REACTOR				CR-17-A
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GENERAL

This Standard Procedure has been prepared to establish criticality control in the fabrication of fuel elements for the R2 Materials and Testing and Research Reactor. The fuel elements will be fabricated under contract to

Nuclear Products - ERCO Division
ACF Industries, Inc.
508 Kennedy St., N. W.,
Washington 11, D. C.

Purchase Order No. 03-4964-1476.

The following fuel elements will be fabricated:

- Item 1 8 each 14-plate 90% enriched fuel elements
 in accordance with ACF Dwg. 6E-03041-000 Rev. A
- Item 2 41 each 18-plate 90% enriched fuel elements
 in accordance with ACF Dwg. 6E-02003-000 Rev. A

(Each 14-plate element shall contain 96.3 ± 2 grams
of 90% enriched uranium.)

(Each 18-plate element shall contain 130.0 ± 2.6 grams
of 90% enriched uranium.)

A. MELTING AND ALLOYING (VIRGIN METAL)

The amount of uranium, with a U-235 enrichment of 90 to 93%, which will be issued as a batch from the vault at any one time will not exceed 1535 grams. This uranium will be in the form of broken buttons. It will be alloyed with approximately 10,500 grams of 3A aluminum. This alloy will contain approximately 12.8% of total uranium by weight. This will result in U-235 maximum content per melt of 1430 grams. Later melts will utilize remeltable aluminum-uranium scrap as indicated in Section B.

1. Material flow to casting stage.
 - a. Uranium buttons will be issued in a tote pan. (1) (2)
 - b. Metal will be melted, alloyed, and cast into ingots.
 - c. Four cast ingots with "skull" from the melt will be returned to the vault for accountability check.

2. Technical Data for Criticality during melting and alloying.
 - a. Crucible size 7 inches OD x 6-1/8 inches ID x 9-1/2 inches deep.
 - b. Maximum alloy melt crucible could contain is 22,000 grams with a total uranium content of 2820 grams resulting in a maximum U-235 content of 2620 grams.
 - c. Normal ingot size 1-1/4 inches x 5-1/4 inches x 8.6 inches.
 - d. Maximum total weight of ingot is approximately 3000 grams resulting in a maximum U-235 content of 358 grams per ingot.

B. MELTING AND ALLOYING (REMELT MATERIALS)

For efficient utilization of materials it is required that uranium bearing trimmings, etc. be remelted.

1. A Melting Practice Card will be issued to the Vault Custodian indicating a nominal uranium content of each heat.

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- (1) All tote pans will be numbered and tared to assist in process flow and control.
 - (2) All tote pans will bear a broad BLUE stripe--to identify all material for these fuel elements.

- a. A typical melt would consist of 1279 grams of enriched uranium buttons, approximately 2000 grams of uranium-aluminum scrap containing 256 grams of enriched uranium plus proper amount of aluminum ingot to meet composition specifications.

2. Technical data and handling will be identical to Section A.

C. HOT ROLLING OF INGOT

1. Four ingots having a total weight of 12,000 grams will be issued in a tote pan.

- a. The pan will be conveyed to the Small Rolling Mill Area (see Dwg. B523).
- b. Four ingots only will be hot rolled in a continuous sequence.
- c. The pan containing four strips will be conveyed to the Niagara Shear (see Dwg. B523) for shearing of the header.
- d. Upon completion of hot rolling and shearing, the four strips will be returned to the vault in the tote pan for accountability check.

2. Technical Data.

- a. A roller hearth, Globar type furnace will be used for heating ingots and rolled material. The furnace hearth is 18 inches wide x 16 feet long.
- b. Each ingot or billet will be carried through the furnace on a stainless steel tray.
- c. Final size of the hot-rolled material will be 0.325 inch thick x 5-1/4 inches wide x 24 inches long (+ 5% on all dimensions).
- d. Maximum weight of any strip is 3000 grams resulting in a maximum U-235 content of 358 grams.

D. FINAL COLD ROLLING

Four hot-rolled strips from the previous operation will be issued from the vault in a tote pan which will be conveyed to the Small Rolling Mill Area (see Dwg. B523).

1. Following the reduction to finish thickness, the material will be returned to the vault for accountability check.
2. Technical Data.

Cold-rolled strip will be 0.315 inch thick x 5-1/4 inches wide x 25 inches long ($\pm 5\%$ on all dimensions).

Maximum weight of the strip and U-235 content will be the same as indicated in Item 1 above.

E. SHEARING AND PUNCHING FILLERS

Four cold-rolled strips from the previous operation will be issued from the vault in a tote pan and conveyed to the Niagara Shear and Punch Press Area (see Dwg. B523) for shearing and punching.

1. Following shearing and punching of the fillers, stock will be returned to the vault in the same tote pan.
2. Technical Data
 - a. Fillers will be punched on a Bliss press.
One filler will be punched per stroke.
 - b. Fillers will be approximately 1.47 inches x 2.54 inches x 0.315 inch.
 - c. A maximum of 48 fillers can be obtained from each strip.
A total of 192 fillers can be obtained from the four strips.

- d. The total weight of each filler will be approximately 62 grams, resulting in a maximum U-235 content of 7.35 grams.

F. FILLER WEIGHING AND INSPECTION FOR FUEL ELEMENT LOADING

1. One lot consisting of a maximum of 192 fillers will be issued from the vault in a tote pan and conveyed to Inspection Area No. 1 (see Dwg. B523). Fillers will be weighed and inspected.
2. Acceptable fillers will be returned to the vault for accountability check.
3. Rejected fillers will be returned to vault for accountability and storage for realloying (see Sec. B).

G. SUBSEQUENT OPERATIONS

1. In all subsequent operations a maximum of 6 lots of 18 fillers each will be located in one work area at any one time. Therefore, a maximum U-235 content of 795 grams will not be exceeded. These operations include roll bonding (Small Rolling Mill Area), assembly of plates (Preparation Braze Area), brazing of assembly (Preheat and Brazing Furnace Area), welding of nozzles (Weld Area) and inspection (Inspection Area 1 or 2) (see Dwg. B523).
2. No more than 6 complete fuel elements will be loaded in any area at any one time.
3. No aqueous cleaning is required in processing; therefore, there will be no U-235 pickup in process solutions.

H. REMELTABLE MATERIAL CONTROL

1. All remelt material will be in alloyed form, obtained from punchings and rejected plates, etc. Remelt material will be stored in the original tote pan for each melt. The limit for one remelt container is 12,000 grams of alloy with a maximum U-235 content of 1535 grams.

2. The tote pans containing remelt material will be stored on 15-inch centers in the storage rack in the vault.
3. The Vault Custodian will weigh and record all additions to or withdrawals from the remelt containers.

I. SCRAP CONTROL

1. Unusable scrap such as chips, dross, and filings will be kept in the same tote pan as the remelt materials for a particular melt. When all the remeltable material has been used, the remaining alloyed scrap from several melts will be combined until 4,000 grams with a maximum U-235 content of 476 grams are collected. This scrap is then placed in a one-gallon paint container and sealed by the Vault Custodian and stored in the vault in tote pans in the storage rack.
2. Fuel element assemblies which are rejected will be identified and stored in a section of the finish fuel element storage bins.
3. All scrap and remelt material is stored dry unless otherwise indicated.

J. CONTAMINATED LIQUID CONTROL

Contaminated liquid accumulation will result from chemical analysis. Since a total alloy weight required for all analyses will be less than 1000 grams, the U-235 content will not exceed 120 grams. This liquid will be stored in the vault in polyethylene carboys on 24-inch centers. Each carboy will have a maximum U-235 content of 100 grams.

K. SHIPPING

1. The external shipping container will be a wooden box approximately 30 inches wide x 6 inches deep x 48 inches long. Construction will conform to ICC Specifications 15A or B.

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2. Six fuel elements containing a maximum of 133 grams of U-235 per element will be placed in one box. The elements will be placed in a wooden rack which will insure positive separation of approximately 2 inches between elements in a single box, or those in adjacent boxes.
3. The maximum number of loaded boxes which may be stacked together, or shipped in a single shipment, is six.
4. Boxes will be monitored for radiation and labeled according to ICC Regulations.
5. Shipment will be made in conformance with applicable security requirements.

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