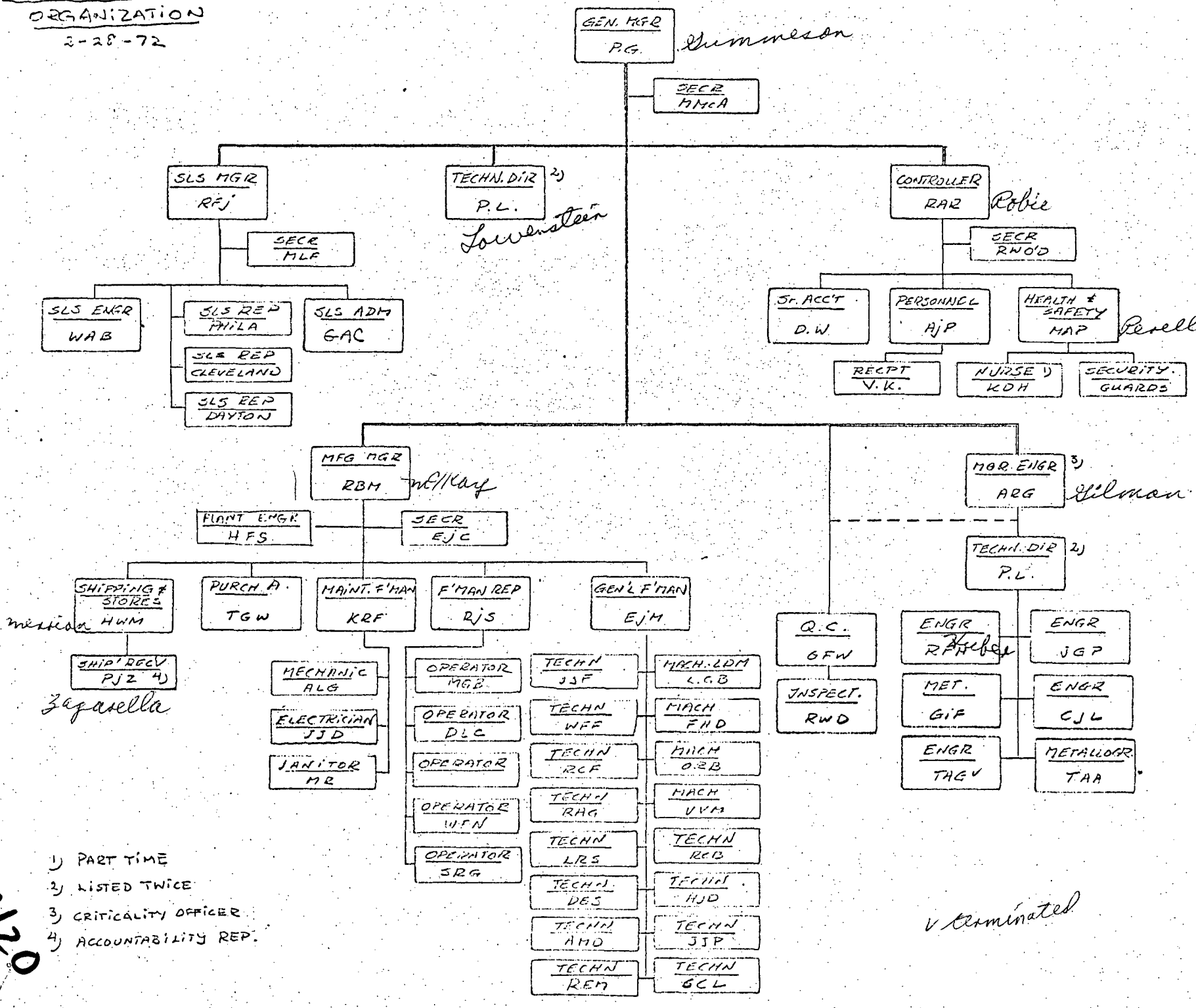
NUCLEAR METALS DIV
ORGANIZATION
2-28-72



1) PART TIME
2) LISTED TWICE
3) CRITICALITY OFFICER
4) ACCOUNTABILITY REP.

v terminated

ATTACHMENT A

A/20

P.S.

the final procedure, identical to this is properly dated and signed. NMD 7/31/72

Whittaker Corporation
Nuclear Metals Division
Concord, Massachusetts 01742

Document No.: NMD-CP-5-2
Revision No.: 0
Issue Date: June 5, 1972
Rev. Date:

Approved: _____ NMD

Accepted: _____ ANL

CASTING OF Al-U FOR CP-5

I. SCOPE

This document defines manufacturing procedures for Al-U castings for use as core components for CP-5 fuel element sub-assemblies.

II. REFERENCED DOCUMENTS

The following documents are incorporated herein by reference:

A. Contract No. 31-109-38-2621

B. ANL Specification RRO-PD-0351, Technical Specification for the Fabrication of Al Clad Al-U Alloy Fuel Tubes, CP-5 Fuel Element Sub-assemblies, August 1971.

C. NMD memorandum, Safe Handling Limits in Fabrication of CP-5 Fuel Elements, May 22, 1972.

D. NMD instruction sheet, Preparation of Uranium for CP-5 Casting Charges, as revised May 23, 1972.

III. FABRICATION PROCEDURE

A. Charge Preparation

1. All uranium shall be from the stock specifically supplied by Argonne National Laboratory for use under Contract No. 31-109-38-2621, and held segregated in the CP-5 area of the enriched uranium storage facility.

2. Only unalloyed uranium and clean recycle material processed in accordance with the attached procedures entitled "Preparation of Uranium for CP-5 Casting Charges, as Revised May 23, 1972" shall be acceptable for casting, except

ATTACHMENT B 1 & 14

that clean, recycle material generated during previous CP-5 fuel tube fabrication programs and returned by ANL for use under this program shall also be acceptable.

3. Uranium and uranium containing charge materials shall be weighed on a metrogram balance which, together with its assortment of standard weights, has been certified by QC within the preceding six months to be accurate within .05 gm for determinations up to 500 gms and within .01% over the range of 500 to 5000 gms.

4. All virgin aluminum used shall be from the 99.99% Al notched ingot segregated in the CP-5 storage area and bearing the stamped Heat No. 40534. Inspect each bundle of ingot as it is withdrawn for charge makeup and use only if the above heat number is clearly discernible. This requirement for the virgin aluminum, however, shall not preclude the use of recycle material containing aluminum from other sources, nor shall it preclude the use of up to 20 gms of aluminum foil of 1100 Al purity or higher in which to wrap unalloyed U fragments included in the charge.

5. All cutting of virgin aluminum to obtain a balanced charge shall be done by sawing without coolant, using a thoroughly pre-cleaned saw.

6. The virgin aluminum before final weighing shall be wiped and/or brushed free of any loose particles with a clean, dry cloth and/or paint brush, then visually inspected without magnification for adherent foreign materials. All adherent foreign materials shall be removed by picking or scarfing with a clean steel tool, be inspected by the project engineer for possible acceptance as normal dross or otherwise relatively harmless inclusions, or cause rejection of the piece to which they adhere.

7. Weighing of the virgin aluminum charge materials shall be done on a balance that has been certified by QC within the preceding twelve months to be accurate within .1 gm for determinations up to 500 gms and within .02% over the range of 500 to 15000 gms.

8. All charge materials for an Al-U casting shall be selected from inventory records by the project engineer and listed on a charge sheet that he shall prepare giving all pertinent

information on the identity of the individual charge items, their weights as carried on the inventory of materials ready for casting, their percentages of uranium as determined or interpolated from chemical analyses, their calculated uranium contents, their enrichments for the uranium they contain, their contents of iron as analyzed or assumed, and the pertinent totals or averages of these values for all materials in the charge. Impurities in the recycle aluminum (primarily Fe, Si and Mg) shall be considered as contributing to the weight of Al for purposes of balancing the charge; however, recycle material shall be limited to the extent that the known or assumed impurity content of this material shall not increase the total of all impurities in the charge beyond 5000 ppm or of iron beyond 1500 ppm.

9. Charge weights shall fall within the following limits:
Type I and II ($23.3^{W}/_{oU}$): $10890^{+}_{-}5$ gms Al and $3308.0^{+}_{-}0.5$ gm U
Type III ($16.4^{W}/_{oU}$): $9614^{+}_{-}5$ gms Al and $1186.0^{+}_{-}0.5$ gm U.
Exceptions to these limits may be made by the project engineer when effective use of recycle material may require slight deviations; however, the charge shall still be balanced to maintain the percentage of uranium as specified above.

10. At the time of charge makeup, Foundry personnel shall reweigh all recycle items on the charge sheet and correct the original weights listed thereon if any are found in final weighing to be invalid. In any event, Foundry shall independently calculate the uranium content of each item and the total weights of aluminum and uranium in the charge, then date and initial the charge sheet with the notation "charge corrected" or "charge confirmed." The original charge sheet shall then be returned to the project engineer.

11. The project engineer shall review any changes on the charge sheet, date and initial his approval and return the sheet to Foundry before melting will be permitted.

B. Equipment Preparation and Maintenance

1. All graphite components and accessories shall conform to the drawings bearing a May 1972 date for the latest revision or approval. Crucibles, skimmer cups and stir rods shall be machined from ATJ grade graphite, if this grade is available

without significant delay to the program. Grade CS shall otherwise be used for all graphite components and accessories.

2. All graphite cores after machining shall be scribed on their bottom face with the number I, II or III to denote core type, and their fit within the mold bottom plate shall be checked and, if needed, adjusted.

3. Certain graphite components and accessories as defined below shall be heated in a vacuum of 20 microns or less at 1700 to 1800°F for 1 to 2 hours before their first use. Included are all crucibles, thermocouple tubes, melt purge tubes, skimmer cups, stir rods, pour cups, hot top sleeves, cores and mold bottom plates. Cool to below 700°F before breaking the vacuum. Vacuum baking will not normally be required for crucible extension sleeves, crucible covers, crucible port caps or the container used for holding such implements as the stir rod.

4. The crucible after vacuum baking shall be cemented in the induction furnace, using Thermolith mortar, and positioned so its upper edge extends 1-3/4 to 2 inches above the top surface of the furnace. Allow a minimum of 24 hours for initial drying, then heat the crucible at 5kw to 600 to 800°F for 3 to 4 hours.

5. The installed crucible shall be kept fully covered at all times when not in use. The normal crucible cover with port caps in place will suffice for short term storage, but a plastic cover should be fastened around the top of the fully cooled crucible during periods of disuse exceeding a few days.

6. The crucible extension sleeve, cover and port caps may remain in place over the crucible without added covering for a few days, but for longer periods these items shall either be covered in place under a plastic bag secured around the bottom of the extension sleeve or else stored in a closed plastic bag on a dry shelf.

7. Long term storage of thermocouple tubes, purge tubes, skimmers, stir rods, pour cups, hot top sleeves, cores and mold bottom plates shall be in closed plastic bags on a dry shelf, with the bag marked "vacuum degassed" or "not degassed" as appropriate. Storage of these items when they will be used within a few days may be done in a clean, closed drying oven operating at 400°F and reserved only for CP-5 use. Note, however, that thermocouple tubes and purge tubes after installation at the

furnace site may be left in position, providing they are encased in a plastic sheath when not in use.

8. The graphite container used to hold the stir rod and skimmer during melting may be left on the floor adjacent to the furnace, but it shall be cleaned on its interior and kept covered between melts.

9. The CP-5 steel mold shall be inspected on its inside surface before each use. Any rust spots shall be abraded clean with 240-grit or finer emery paper, wiped thoroughly with a clean, dry cloth, coated with Aquadag, and burnished smooth after drying. In any event, the entire inside surface shall be thoroughly wiped free of loose soot or other particles, using a clean, dry cloth. Storage between uses shall be in a closed plastic bag on a dry shelf or, for periods of a few days, in the drying oven with the CP-5 graphite components.

C. Melting and Pouring

1. No heating of a charge shall be initiated until these final preparations have been completed:

   (a) Check the thermocouple and temperature recorder to be used for continuous recording of the melt temperature, and write the casting number and date on the recorder chart. The sensing-recording combination shall bear a QC sticker indicating that it has been recalibrated within the past three months to read within 10°F accuracy at 1500°F and at 1640°F. Note that any anomaly occurring in the recorded temperature during melting or any suspicion of malfunction of the unit shall terminate all further melts until recalibration of the unit by QC.

   (b) Preheat the pour cup and hot top sleeve within a closed graphite container in an 1100°F furnace, starting 1-1/4 to 2-1/4 hours before the initiation of heating of the melt charge if the graphite container is initially near furnace temperature, or 2 to 3 hours before if the container is much below furnace temperature.

   (c) Preheat the steel mold and the graphite bottom plate, core, skimmer and stir rod in a 400°F drying oven for a minimum of 1-1/4 hours before heating of the melt charge.

   (d) Provide two argon cylinders, with functional valving and

lines, containing at least 10 cubic feet of argon in the cylinder supplying the melt purge tube and at least 40 cubic feet in the second cylinder. Adjust and appropriately tag the gages for reading a low flow rate (4 cu. ft./hr.) in the line for the melt purge tube, and a high flow rate (20 to 120 cu. ft./hr.) in the line from the second cylinder.

(e) Provide an acetylene torch and cylinder.

(f) Check that the water lines are ready for connection to the mold.

(g) Adjust the mold pedestal to place the mold at the correct position for the start of pouring and at the maximum height still providing clearance with the crucible and furnace.

(h) Thoroughly clean the top of the furnace and crucible cover parts with a suction tube and/or brush.

(i) Have a melting card on hand for recording notes on the progress in melting and all deviations from standard conditio or normal occurrences. Attach the charge sheet to the melting card as a permanent record of the charge being used.

2. Load all of the virgin Al in the crucible. If the virgin Al represents 1/4 or more of the total weight of the charge, delay adding the U-containing materials until the Al is molten; otherwise, load with the Al the first batch of recycle material permitted by the "Safe Handling Limits." Selection of recycle materials for starting the melt should follow the same sequence of preference as additions to the molten pool; ie., flattened fuel tubes first, then hot tops, other solid recycle and, finally, compacted chips.

3. Cover the crucible, complete with port caps. Use the extension sleeve if it is needed to raise the cover above the charge.

4. Start a flow of argon at 20 cubic feet per hour through the port in the crucible cover.

5. Heat at 15kw until the Al starts melting. Periodically remove a port cap and check for melting, starting 20 minutes after the power was turned on if the crucible was cold at the start and

10 minutes after the power was turned on if the crucible was still hot from previous use.

6. As soon as substantial melting has occurred, bring the 400°F stir rod and skimmer to the melting area. Bring the 400°F steel mold and graphite bottom plate to the area, drop the bottom plate in place, thinly coat the complete inside surface of the steel mold with soot from an oxygen-deficient acetylene flame, and position the mold on the pedestal.

7. As melting of the initial charge material nears completion, insert the thermocouple and start the temperature recorder. Insert the purge tube to the bottom of the crucible and flow argon through it at 3 to 4 cubic feet per hour. Maintain the argon flow through the port in the crucible cover at 20 cubic feet per hour.

8. As soon as melting of the initial charge material is complete, sequentially add the remaining charge materials while following the requirements of the "Safe Handling Limits." Move the crucible cover aside no further and for no longer a time than needed to make each addition to the melt.

9. Bring the 400°F core to the area, check the number on the bottom to ensure that it is the correct size, then insert it in the mold bottom plate.

10. Connect the water lines to the steel mold, with the inlet line entering the bottom. Do not start the water flow.

11. Final heating should proceed as follows:

    (a) For the 16.4 $^{W}/_{oU}$ alloy (Type III), maintain heating at 15kw until the melt temperature rises to 1340 to 1360°F, then cut back the power as needed (typically to about 10kw) to bring the rate of temperature rise to approximately 5 to 10°/min. above 1450°F. As the temperature rises to 1440 to 1460°F, skim the melt, then stir thoroughly, probing to the bottom of the crucible with the stir rod to ensure that no uranium chunks remain unmolten after stirring. Replace the crucible cover and continue heating at a rate that will bring the melt to 1500°F a minimum of 5 minutes and preferably no longer than 10 minutes after probing first confirmed that no solid uranium remained in the crucibl

Turn off the power when the melt hits 1500°F and immediately proceed as noted in item (12) below.

(b) For the 23.3^{W}/oU alloy (Types I and II), maintain heating at 15kw until the melt rises to ~~1480 to 1500°F~~ 1540-1570°F, then cut back the power as needed (typically to 10kw) to bring the rate of temperature rise to approximately 5 to 10°/min. above 1590°F. As the temperature rises to 1580 to 1600°F, skim the melt, then stir thoroughly, probing to the bottom of the crucible with the stir rod to ensure that no uranium chunks remain unmolten after stirring. Replace the crucible cover and continue heating at a rate that will bring the melt to 1640°F a minimum of 5 minutes and preferably no longer than 10 minutes after probing first confirmed that no solid uranium remained in the crucible. Turn off the power when the melt hits 1640°F and immediately proceed as noted below.

12. Bring the 1100°F hot top sleeve and pour cup to the area and position them on the mold while the thermocouple and purge tubes and the crucible cover are being removed. Skim the melt well, then stir vigorously throughout the 15-second period while the mold cavity is being purged with argon at 120 cubic feet per hour. Immediately pour, keeping the pour cup 1/2 to 3/4 full. The water for cooling the mold shall be turned on just as the first metal enters the pour cup.

D. Post-pour Operations

1. Immediately after pouring, remove the heavy skull from the crucible and replace the crucible cover and port caps. Restore the argon flow at 20 cubic feet per hour until the crucible has cooled below 800°F. Inspect after cooling and remove any residual skull.

2. Continue water cooling the mold for 15 minutes after the pour before removing the casting.

3. Immediately upon removal from the mold, stamp the casting on its bottom face with its assigned serial number (in the AX series). Subsequent handling shall be done in a manner that maintains thorough cleanliness and precludes embedment of foreign particles in the surfaces of the casting or hot top.

4. Each item of equipment immediately upon sufficient cooling shall be cleaned and stored as indicated in Sec. B, Items 5 through 9, of this document, or if another melt is scheduled for later the same day, cleaned as required and then prepared for reuse as indicated in Sec. C, Item 1. If insufficient time remains in that day to complete the necessary cooling, cleaning and storage, then the equipment shall be provided with suitable protection to maintain cleanliness until the start of the next work day, when completion of the task shall be done.

5. Thorough clean up of equipment and work area is also required at the earliest practical time and, in any event, before the next casting is made in order to recover such uranium-containing materials as the skull, skimmings and drippings. Consign these materials to the inventory of non-recycle uranium and enter their weights on the applicable accountability form.

6. The casting after cooling to near room temperature shall be reheated to 800°F and the core pressed out. Provide a clean, padded container to catch the core and prevent further damage or contamination. Inspect the core and, if it is judged acceptable for reuse, cool it, wipe it with a clean cloth and return it to storage. Weigh the casting after removal of the core, using the same balance used for weighing virgin Al charge materials, then record the weight on the applicable accountability form and complete all other required entries on the form. Store the casting until it has been inspected by the project engineer and approved for processing. Transfer the melt card to the project engineer for his review.

7. The project engineer shall indicate preliminary acceptance or rejection of each casting by his notation and signature on the completed melt card. The Foundry shall retain the final melt card in their permanent files and retain the temperature recorder chart for one year.

PREPARATION OF URANIUM FOR CP-5 CASTING CHARGES

(1) Universal Requirements

Processing of uranium or uranium-containing materials requires strict adherence to the May 22, 1972 edition of "Safe Handling Limits in Fabrication of CP-5 Fuel Elements" and completion of the applicable accountability form for the task being performed. Full precautions and care shall be taken to minimize processing losses, obtain accurate weights and, particularly, to prevent contamination of materials for melting. Final weighing shall be done only when the materials are thoroughly clean and dry, using a QC-approved Metrogram balance and recording weights to the nearest .05 gm.

(2) Unalloyed Uranium

To facilitate alloying, the virgin uranium must be broken to individual pieces below 1/2-inch in at least one dimension. Clean the containment cylinder, the wedge-end piston and the mating Vee block by abrading thoroughly with 240 grit emery paper, wiping with a clean cloth soaked in trichloroethylene, and finally rubbing with a clean dry cloth. Clean the upper and lower platens of the Birdsboro press with a trichlor-soaked cloth followed by rubbing with a clean dry cloth. Cover the lower platen with clean kraft paper upturned and taped at the edges to catch any fines. Place a slide plate or shallow box of trichlor-cleaned stainless steel beneath the containment cylinder. Cover the floor in front of the press with kraft paper to facilitate final cleanup, then set up an exclusion area around the press and bring in one container of uranium. Chill the uranium in a clean, insulated container of liquid nitrogen, then break the cold uranium between the piston and Vee block within the containment cylinder. Fragments too small to effectively bridge the Vee yet still too large to be acceptable can be adequately crushed between flat blocks of hardened steel (e.g., the tooling for compacting CP-5 chips) within a containment cylinder, but such tooling must first be thoroughly cleaned by the procedure noted above for the wedge and Vee block.

Place all clean fragments and all but the most powder-like of clean fines (i.e., all but the finest 1 to 2% of the material) in a pre-weighed

plastic bag, leaving the top of the bag spread open and storing it over a packaged desiccant within the covered storage pail. Delay final weighing of the contents of the bag for at least 16 hours to ensure evaporation of the moisture that originally condensed on the fragments while they were chilled. The most powder-like of the fines will not be used for casting, but should be turned in to the Accountability Representative for disposition at the end of the program. Final cleanup of the equipment and work area after the last container of uranium has been processed should be done as required by Accountability and by Health and Safety.

(3) Hot Tops

Hot tops that have been cut from previous CP-5 Al-U castings and solvent cleaned by the approved pre-storage procedures require no further preparation before remelting. They shall, however, be re-weighed at the time of charge makeup to ensure that they were thoroughly dried of solvent before their original weighing.

(4) Rings and Machined Cores from Primary Extrusions

End croppings and other rejected lengths from the Al-U primary extrusions, including any machined core rings scheduled for remelting, should be adequately clean from their pre-storage processing. However, at the time of charge makeup, inspect all such pieces to ensure they are free from significant extrusion lubricant residues and sizable surface inclusions, and grind out any such contaminants found. Do all grinding with a steel burr, and contain the operation within a clear plastic bag to catch all fines. Any contaminated piece not readily cleanable by grinding should be reported to the project engineer for his selection of alternative cleaning procedures or of transfer of the piece to the inventory of non-recycle material. Re-weigh all final pieces at the time of charge preparation, including those that did not require further conditioning.

(5) Lathe Turnings

The chips recovered as usable recycle material during machining of

the Al-U primary extrusions are temporarily stored while still wet with coolant. These must be thoroughly cleaned and compacted before remelting.

Set up a chip cleaning area under a hood, covering the work surface with clean kraft paper. Wash the stainless steel mesh chip cleaning basket and the inside and cover of three new 5-gallon pails with trichloroethylene, then fill two pails with trichlor to approximately 1 inch below the rim of the basket when the basket is resting on the bottom of the pail. Rinse the third pail with acetone, then fill with acetone to the same level as the trichlor in the other pails. Cut several 30 x 30-inch squares of kraft paper upon which to spread the chips while drying.

A single batch of chips (i.e., the contents of one storage pail) is transferred to the wire mesh basket and processed as follows:

(a) agitated, soaked, then again agitated in the first pail of trichlor for a total of 3 minutes.
(b) drained over the first pail for 1 minute.
(c) agitated in the second pail of trichlor for 1 minute.
(d) drained over the second pail for 1 minute.
(e) agitated in the pail of acetone for 1 minute.
(f) drained over the acetone for 1 minute.
(g) spread over clean kraft paper bearing the batch identification number (i.e., the same number as the primary extrusion length from which this batch of chips was machined).
(h) allowed to dry thoroughly (minimum of 30 minutes if under moderate heat from infrared lamps; otherwise 1 hour).
(i) transferred to a clean, pre-weighed 1 gallon pail bearing the batch identification number.
(j) weighed for net chip weight prior to compacting or return to storage.

Safe handling limitations require that only a single batch of chips shall be allowed in one exclusion area at any one time. However, fines passing through the chip cleaning basket may be allowed to accumulate in the pails of solvent while up to ten successive batches of chips are cleaned, providing an accumulation of 20 grams of fines is assumed for each batch

already processed, and that the total assumed accumulation plus the weight of the incoming batch of chips does not exceed 925 grams for the 23.3^{W}/o U alloy or 1310 grams for the 16.4^{W}/o U alloy. In any event, no more than 10 successive batches of chips may be processed before cleaning the accumulated fines from the first two pails. Removal of fines from the first two pails and a superficial cleanup of the work area will also be required when processing is being switched from one nominal composition to the other (i.e., 23.3% vs. 16.4%). Final cleanup of the equipment and work area should be done as required by Accountability and by Health and Safety, and the alloy fines and all chips that did not go through the full cleaning cycle should be consigned to the inventory of non-recycle material.

Compacting of the cleaned and thoroughly dried chips should be done in the Birdsboro press after cleaning and preparing the press, the containment cyclinder (with its split inner sleeve of stainless steel), the flat-end tools and the work area as described above under item (2) for breaking of unalloyed uranium. Make a separate compact of each batch of chips, then place the compact and the few clean loose chips that may not adhere to the compact in a pre-weighed plastic bag, obtain the net weight of the alloy, and return to storage, retaining the separate identity of each batch of chips and its final compact. Clean up as required by Accountability and Health and Safety.

Compacted chips shall be re-weighed at the time of charge makeup.

(6) Rejected Fuel Tubes

Certain coextruded fuel tubes, but only as individually designated by the project engineer, shall be flattened and folded in preparation for recycling. If these tubes have not already advanced through the normal post-extrusion cleaning and cropping processes, they shall be so cleaned then fluoroscoped and cropped approximately 1 inch outside of the extreme tips of the Al-U core material. All tubes designated for recycle shall be prominently Vibratooled with their identification number on the outside surface near one end. Rub the tubes down with a clean, acetone-soaked cloth just before flattening. Flatten and fold each tube to a total length

not exceeding 8 inches, retaining the Vibratooled identification number in an exposed location on the outside of the folded tube. Use the Birdsboro press to flatten the tubes and to hold one end while hand folding the balance of the flattened tube. Before doing so, however, clean the upper and lower platens of the press with trichlor followed by rubbing with a clean dry cloth, and do the actual flattening between thoroughly deburred stainless steel plates that have been thoroughly washed with trichlor and rubbed down with a clean dry cloth or between hardened steel blocks that have been abraded clean and similarly washed. Each tube should be inspected immediately after folding to ensure that its identification number is fully visible and easily readable, and its weight should be determined and recorded before it is placed in storage.

Exclusion Area	Material	Safe Handling Limit Per Exclusion Area
3. Heating Furnace	Completed castings	2 castings
4. Graphite core press	Completed castings	2 castings
5. Hacksaw	1) Castings and hot tops	1 complete casting plus 1 hot top or 1 cropped casting plus 2 hot tops
	2) Hot tops	3 hot tops
	3) Hot top halves	6 halves
	4) Saw chips	Saw to be rough cleaned before 200 grams* contained U-235 accumulates; package in 1 gallon can.
6. Heating furnace	Machined castings	2 castings
7. Extrusion press	Castings and/or primary extrusions	2 castings, or 2 extrusions or one of each.
8. Primary extrusion pickling pipe	Primary	1 primary. Perform pickling in containers less than 5 inches inside diameter. Analyze solution when record of cumulative removal indica approach to 200 grams U-235 in the solution; do not exceed 200 grams U-235 in a given solution**,
9. Hacksaw	Primary	4 lengths (plus cropped ends) from same primary. Saw to be rough cleaned before 200 gram contained U-235 accumulates; package in 1 gallon cans.

*As on page 1

**All solutions to be assayed for uranium. Discard if no uranium present. If uranium content is sufficient to warrant recovery, evaporate solution to dryness. Ship residue in 5 inch diameter cans fitting in birdcages. Not more than 200 grams contained U-235 per batch of solution to be processed at one time.

ATTACHMENT C 1 of 4

Exclusion Area	Material	Safe Handling Limit Per Exclusion Area
10. Lathe	Cut length of primary, rings, and turnings	1 length in lathe area plus rings and turnings from that length. 200 grams* of contained U-235 in turnings per 1 gallon pail. Rough clean lathe after machining <u>each</u> length.
11. Chip cleaning area	Lathe turnings and chips	200 grams* of contained U-235 maximum. See MBA form for chip cleaning for description of process and control over weights.
12. Compacting Press	Lathe turnings and chips, after cleaning	Individual 200 gram (U-235) batches are brought singly to area and compacted to buttons to fit inside 1 gallon pails. Any number of buttons containing no more than 200 gram (U-235) each may be stored together but only in a 1 gallon pail containing a sealed 1 pint friction lid can to limit volume to 3.6 liters.
13. Coextrusion billet, preparation & assembly (2 exclusion areas)	Machined rings	24 rings for dry operations. 2 rings for immersed operations. Spot check solutions for uranium before discarding.**
14. Coextrusion billet operations (2 exclusion areas)	Assembled billets	6 billets for welding, leak testing, heating. Only 1 of the 6 billets immersed in extrusion lubricant at any one time.
15. Extrusion press	Coextrusion billets and/or extrusions	6 billets or tubes or a combination
16. Extruded duplex tube operations (several exclusion areas)	Duplex tubes	6 tubes for dry operations. 3 tubes for immersed operations.**

ATTACHMENT TO 2 of 4

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* As page 1

** As page 2

Exclusion Area	Material	Safe Handling Limit Per Exclusion Area
17. Radiography	Duplex tubes, single tubes and U-235 step wedge	2 tubes plus wedge
18. Finished single tube operations	Single tubes	8 tubes for dry operations, 1 tube for immersed operations (up to 7 other tubes nearby in same area).
19. Final packing	Single tubes	8 tubes. 3 tubes, one of each size, nested in schedule 40 pipe of shipping container (Model 2823).
20. Storage for shipping containers.		
(a) In process bldg.	Packed containers	11 containers
(b) In Butler Bldg.	" "	Not to exceed 100 maximum units, including all other storage of special nuclear material.
21. Security enclosure behind Building A (Metallography)	Packed containers	23 containers
22. Shipments	Packed containers	11 containers per shipment; transport index of 4.2 to be assigned to each package (DOT Special Permit No. 4969).
23. Miscellaneous areas. These require prior approval of Criticality Officer	Any form	Less than 350 grams of U-235
24. Material being transported between Butler Bldg. and exclusion areas	Any of above	Such material must be considered to be in a moving exclusion area. The above limits for each type of material apply.

ATTACHMENT 2 of 4

REVISED COPY - Destroy copies dated 4/18/72

MEMORANDUM

May 22, 1972

To: R. F. Huber/P. Zagarella
From: L. Clark, Jr.
Subject: Safe Handling Limits in Fabrication of CP-5 Fuel Elements (JOB NO. 3506)

Exclusion Area	Material	Safe Handling Limit Per Exclusion Area
1. Button breaking press	Enriched uranium buttons for flattening and breaking	3,200 gms uranium. Containers of water, oil or other liquids larger than 3.6 liters are not allowed in area. Confine the uranium to a single 1 gallon pail containing a sealed 1 pint friction lid can to limit volume to 3.6 liters. If smaller quantities are handled, even though total is less than 3200 grams, limit to 3.6 liters per pail, as above, and transport individually from storage rack to area and back again.
2. Casting furnace	1) Virgin castings	The quantity needed for 1 casting -- 3308 grams uranium for inner and intermediate castings, 1886 grams for outer castings, confined to a single 3.6 liter pail, or to 2 or more 3.6 liter pails if transported separately, as above.
	2) Recycle castings	Melt pure aluminum first. Add and dissolve hot tops, then bring compacted turnings to exclusion area, add and dissolve compacted turnings; then bring virgin enriched uranium to exclusion area, add and dissolve. Safe batches are transported one at a time, and each must be added and dissolved before another batch may be brought up. Batches exceeding 200 grams must be confined to 3.6 liter pails; batches of 200 grams or less may be transported in 1 gallon pails.
	3) Skull and fines from casting	200 grams* contained U-235 per 1 gallon can

*200 grams of contained U-235 is equivalent to 925 grams of the 23.3% alloy or 1330 grams of the 16.4% alloy.

ATTACHMENT 2 Page 4 of 4

cc: RH/PZ/LC ✓

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 4969
FIFTH REVISION
(REINSTATEMENT)

Pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended, and on the basis of the March 29, 1972, petition by the Whittaker Corporation, West Concord, Massachusetts:

Special Permit No. 4969 is hereby reinstated and amended by adding a new paragraph (10a) and by revising paragraph (14) to read as follows:

"10a. For shipments by air, a copy of this permit, kept current, must be carried aboard each aircraft transporting radioactive material under these terms.

"14. This permit expires on April 30, 1974."

All other terms of this permit, as revised, remain unchanged. The complete permit currently in effect consists of the Fourth and Fifth Revisions.

Issued at Washington, D.C.:

for B.D. Milstead — 9 MAY 1972
W.R. Fiste (DATE)
For the Administrator
Federal Highway Administration

for William G. Black — 11 May 1972
Mac E. Rogers (DATE)
For the Administrator
Federal Railroad Administration

Ellis C. Langford — 15 May 1972
Ellis C. Langford (DATE)
For the Administrator
Federal Aviation Administration

Address all inquiries to: Secretary, Hazardous Materials Regulations Board, U.S. Department of Transportation, Washington, D.C. 20590. Attention: Special Permits.

Dist: a, c, d, e, h, i
Argonne National Laboratory, Argonne, Illinois

ATTACHMENT D