INCOMING TELEGRAM

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DOCKET NO. 70-134

For Div of Inspect

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U.S. ATOMIC ENERGY COMM.
TWX UNIT

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WUX PLAINVILLE MASS AUG 3 1226PME

CHARLES P MCCALLUM, LICENSE BRANCH

USAEC GERMANTOWN MD

RE SNM 185 PLEASE AMEND FEASIBILITY REPORT DEM5 LIMITS OF URANIUM CONTENT IN PICKLING SOLUTIONS PAGE 6 PARA C LINE 7 CHANGE LIMIT FROM 350 TO 50 GRAMS U235 PAGE 9 PARA H LINE 7 350 TO 50 GRAMS U235 PAGE 15 PARA O LINE 7 FROM 350 TO 25 GRAMS OF U235 COMPUTED BY METHODS PREVIOUSLY OUTLINED IN MAY 28 AND JUNE 3 1959 SUPPLEMENTARY LETTERS WHERE CLADDING IS CONSIDERED AS ALLOY REQUEST SAME AMENDMENT APPLY ALSO TO FEASIBILITY REPORT DEM6 REFERENCES PAGE 4 PARA C PAGE 5 PARA H PAGE 8 PARA 9 CONFIRMING LETTER OF THIS DATE FOLLOWS

ENGELHARD INDUSTRIES D E MAKEPEACE DIVN J H DURANT

130PME

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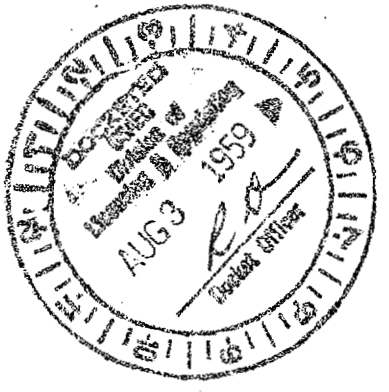

INCOMING TELEGRAM

DOCKET NO. 70-139
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INCOMING TELEGRAM

1958 MAR 30 PM 4 39

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WUX PLAINVILLE MASS MAR 30 VIA HAGERSTOWN MD

ATOMIC ENERGY COMMISSION, ATTN CHARLES MCCALLUM

LICENSE BRANCH

UNDER OUR CONTRACT TO PRODUCE CORE SUBASSEMBLIES FOR ENRICO FERMI REACTOR WE ARE SCHEDULED TO BEGIN APRIL FIRST THIS IS COVERED IN DEM FEASIBILITY REPORT 5 SUBMITTED JANUARY 30TH REQUEST YOU GRANT APPROVAL ON SECTION 1 COVERING RECEIVING AND STORAGE REQUEST EARLIER BY OUR LETTER OF JANUARY 13TH HOPE TO RECEIVE INTERIM LICENSE BY APRIL 1ST

ENGELHARD INDUSTRIES D E MAKEPEACE DIVN J H DURANT

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INCOMING TELEGRAM

DOCKET NO. 70-139

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ENGELHARD INDUSTRIES, INC.

D. E. MAKEPEACE DIVISION
PINE & DUNHAM STREETS
ATTLEBORO, MASS.
ATTLEBORO 1-0080

March 3, 1959

Mr, Lyall Johnson
Chief, Licensing Branch
Division of Civilian Application
United States Atomic Energy Commission
Washington 25, D. C.

Dear Mr. Johnson: Subject: Feasibility report DEM-6

The D. E. Makepeace Division of Engelhard Industries, Inc., hereby submits 5 copies of its feasibility report on the fabrication of 164 (10%) fuel pins for the SRE test program.

The task of fabrication is the subject of a joint purchase order between Power Reactor Development Corporation and its agents, Commonwealth Associates Inc., and co-contractors Nuclear Metals, Inc., and Engelhard Industries, Inc. The scope of the report transmitted herewith is confined to that portion of the work which will be performed by Makepeace. The Nuclear Metals' feasibility report will be submitted shortly covering the balance of the work of the contract to be performed at N.M.I. plant in Concord, Mass.

The D. E. Makepeace Division operates its fuel fabricating plant under special nuclear license #185 which expires on September 30, 1962.

We would like to call to your attention our letter of January 30th covering the presentation of the feasibility report on the construction of a core and blanket sub-assembly for the Enrico Fermi fast breeder reactor. Several of the references made in the subject report of this letter are contained in the earlier report, since the work involved is nearly identical to that of the core fabrication task.

U. S. Atomic Energy Commission March 3, 1959

In the event that further information and clarification of the supporting documentation is required, please advise us.

Very truly yours,

D. E. MAKEPEACE DIVISION

John H. Durant
Business Representative

JHD/ms
Enclosures:

Feasibility report DEM-6 - 5 copies
DEM drawing E-1038 - 5 copies
COO, AEC, Lemont, Ill.
NYOO, AEC, 70 Columbus Ave., New York, N. Y.
R. Rateick, PRDC W. C. Arnold, PRDC
A. White, N. M. I. Philip Thompson, N. M. I.
W. F. Mittendorf, D. E. M. G. H. Barney, D. E. M.
C. A. Canham, D. E. M. N. Weiss, D. E. M.
J. M. Young, A. I. M. J. H. Durant, D. E. M.

ENGELHARD INDUSTRIES, INC.

D. E. MAKEPEACE DIVISION

FEASIBILITY REPORT DEM-5

Fabrication of Core Subassemblies for the Enrico Fermi Fast Breeder Reactor.

Written by: N. Weiss

Date: January 30, 1959

PRDC FEASIBILITY REPORT DEM-5

* Section I - "Receipt and Storage of Raw Material"

1. Work to be Performed.

DEM in conjunction with Nuclear Metals, Incorporated, intends to fabricate, test, inspect, and deliver 100 core subassemblies to the Power Reactor Development Corporation, Detroit, Michigan. These are to be used in the Enrico Fermi Fast Breeder Power Reactor.

Each core subassembly will consist of a core section composed of pin-type fuel elements and an axial blanket section on either end of the core containing depleted uranium - moly elements. Core sections will contain 144 - 30 1/2" long pins each. These fuel pins will be fabricated from a 10% Mo, 90% U (25.6% enr.) alloy and clad with .004" of zirconium. Each pin will have a zirconium end cap on either end.

In addition to the core subassemblies, DEM proposes to fabricate 300 outer radial blanket subassemblies. These will be fabricated from a 2.75% Mo, 97.25% depleted uranium alloy which will be sodium bonded to stainless steel tubing.

Drawings of the fuel pins and core and blanket subassemblies are attached to facilitate a better understanding. **

The schedule of shipments to PRDC will be as follows:

Core Subassemblies	Blanket Subassemblies	Date
4	12	6/1/59
5	15	7/1/59
6	18	8/1/59

Core SubAssemblies	Blanket SubAssemblies	Date
7	21	9/1/59
8	24	10/1/59
8	24	11/1/59
8	24	12/1/59
8	24	1/1/60
8	24	2/1/60
8	24	3/1/60
8	24	4/1/60
8	24	5/1/60
7	21	6/1/60
7	21	7/1/60

** 6XN-1723 - APDA Radial Blanket Assembly.
6XN-1716 - Core Sub Assembly
5XN-1722 - Fuel Pin Detail

2. Material to be Supplied.

PRDC will supply 4,835 pounds of 25.6 enriched uranium in the form of pickled derbies approximately 5" in diameter and weighing approximately 11 pounds (5 Kg.) each. The material will be shipped from Davison Chemical Company, Erwin, Tennessee, in birdcages containing 55 lbs. each of uranium (6.4 Kg. U-235). A maximum of 390 lbs. (45.4 Kg. U-235) will

be sent in any one shipment according to the following schedule:

Date	Pounds Uranium	Kg. U-235 (25.6% enr.)
3/1/59	240	28.0
4/1/59	240	28.0
5/1/59	245	28.6
6/1/59	340	39.6
7/1/59	390	45.4
8/1/59	390	45.4
9/1/59	390	45.4
10/1/59	385	44.8
11/1/59	385	44.8
12/1/59	385	44.8
1/1/60	385	44.8
2/1/60	385	44.8
3/1/60	340	39.6
4/1/60	335	39.0

We estimate that the maximum amount of U-235 on hand at any one time at DEM will be approximately 170 Kg.

In addition to the enriched material, we will receive 58,540 lbs. depleted uranium from Davison Chemical Company, in the form of 12" dia. derbies cut into 3 slices each. This depleted material will be shipped at a maximum rate of 15,000 lbs. per month and will be used for blanket material.

3. Receiving and Storage.

Birdcages, containing enriched uranium derbies will be received at DEM plant, Plainville, Mass. A maximum of 7 birdcages will be received at any one time. Each birdcage

will contain 5 derbies weighing 5 Kg. each. The maximum amount of U-235 per birdcage will be 6.4 Kg. The total amount of U-235 for 7 birdcages will be approximately 45 Kg.

Birdcages will be stored in our enriched vault until ready for production. This vault is constructed of 12" thick concrete and is 7' 11" wide x 13' 0" long x 7' 11" high with a Mosler combination safe door.

The birdcages will be unbolted one at a time, under the direction of the Criticality Officer, and the derbies weighe to verify the accuracy of the shipper's weights. The five derbies will be replaced in the original birdcage if they are to be melted within a month after receipt. This is necessary due to the fact that birdcages must be returned to Davison Chemical Company one month after delivery.

Those derbies which are to remain in storage for a peri longer than one month will be placed in metal cubicles in th vault. We anticipate building 10 such cubicles, each capabl of holding 5 derbies (6.4 Kg. total contained U-235). If more space is necessary, we can add additional cubicles to hold in excess of 300 Kg. U-235 in a safe configuration at this enrichment level.

Cubicles will be of all welded construction using 1/8" steel plate as material. They will be 6 1/2" x 6 1/2" x 6" deep with a hinged door containing a rubber gasket and a latch. The cubicles will be lagged to the concrete wall wit two steel bolts each. There will be a 2 foot spacing in all directions between cubicles.

Additional cubicles may be added as required by extendi the wall sections upward and by building additional center

sections in angle iron framework maintaining the same spacing requirements. A drawing (#1033-1)of 10 such wall cubicles is enclosed for reference.

In addition to vault storage for enriched derbies, we intend to store enriched scrap (chips, cropped ends, etc.) in the locked caged area surrounding the vault. Containers to be used will be covered steel 1 gal. and 5 gal. containers. They will be stored in vertical and horizontal arrays on unistrut sections with bucket clamps to fasten the containers in position thus assuring the maintenance of spacing requirements. The individual containe and types of scrap will be discussed in the body of the report under fabrication procedure.

Another concrete vault 8 ft. wide x 12'3" long x 8 ft. high on the opposite side of the mfg. area will be used for storage of finished pins prior to assembly. In addition, it will be used to store analytical and metallographic samples.

Other enriched material which may be processed concurrently with the PRDC material will be stored in this vault also. We estimate that this will amount to approximately 15 Kg. U-235 in the form of a 26% U-Al alloy to be used for making tubular fuel elements for the Argonne CP-5 reactor. A copy of our feasibility report DEM-4 will serve to describe this fabrication and storage procedure.

In-process PRDC material will be stored in a locked cage of dimensions 19 1/2 ft. long x 15 ft. wide adjoining the aforementioned vault. A third cage surrounds the vault and at this time is being held in reserve for such storage as may be necessary.

Fabrication Procedures:

The enriched fuel pins will be fabricated from a 90% Uranium (25.6% enriched) - 10% Moly. alloy which will be coextruded with Zirconium tubing to provide the clad layer. A complete flow chart of the fabrication procedures is attached for reference.

All material movement will be cleared through the Criticality Officer or his representative at all times. No enriched material will be moved without specific approval being granted. In addition, material movement must be accompanied by the Criticality Officer or his representative. Enriched derby and scrap storage areas will be under the direct supervision of Criticality representatives. No one will be permitted in the locked storage areas unless accompanied by the Criticality Officer or his designate.

The project engineers working on the different phases of manufacturing will be responsible for carrying out the provisions of this feasibility report with the assistance of criticality, health-safety, and accountability representatives.

Fabrication will proceed through the following stages:

A. Charge Preparation and Melting of U-Mo Ingot.

The uranium to be used for melting will be removed from the birdcage or vault cubicle and issued to production by the criticality representative in a tared, covered, 5 gallon steel bucket in the vault. The bucket will be moved to the furnace area on a dolly. One half of the charge will be issued at a time. A melting

charge will consist of 10 derbies weighing 5 Kg. each and 2 Kg. of smaller pieces which have previously been prepared in the following manner:

Approx. 20 derbies will be broken into a number of small pieces in lots of 5 derbies (6.4 Kg. U-235). Each derby will be immersed in liquid nitrogen for a short period and then broken on an enclosed hydraulic press. The small pieces generated will be collected and placed in metal containers for storage until needed for melting. The metal containers to be used will be one gallon covered steel pails 6 13/16" high x 6 13/16" mean inside diameter. A maximum of 1.6 Kg. U-235 will be placed in any container at which time it will be placed in the enriched storage area on 15" centers.

The moly. which is to be melted will be in the form of rods 1/2" in dia. x approx. 3/8" high. The maximum charge to be melted will be as follows:

Weight Uranium (25.6% enr.)	= 52.0 Kg.	(13.3 Kg. U-235)
Weight Moly.	= 5.8 Kg.	
TOTAL CHARGE	57.8 Kg.	

The crucible to be used for melting will be 1/2" thick graphite, 8" in dia. and 12 1/2" high. The mold will be 1" thick graphite, 3.95" in dia. and 16" high. Ingots will be melted in a Kinney vacuum induction furnace and bottom poured into the mold. We expect to melt approx. 50 ingots. Hoses which maintain the flow of cooling water through the coils will be uncoupled while charging the

crucible and replaced when charging has been completed, to prevent accidental flooding.

The crucible will be charged with one-half of the uranium on the bottom, the moly. in the middle, and the balance of the uranium on top. All work which is done inside the furnace will be done while wearing respirators. Crucibles and molds will be weighed prior to charging for accountability purposes.

When the charge has been melted, it will be bottom-poured into the mold and allowed to cool for at least 2 hours.

Whenever sufficient scrap has been generated in the course of fabrication, a certain amount will be recycled into each melt along with the derbies. The maximum amounts of cleaned scrap to be used per melting charge will be as follows:

1.	Lathe turnings (compacted)	1.0 Kg. U-235
2.	Primary Extrusion Croppings (1.5" dia.)	0.75 Kg. U-235
3.	Incomplete Slugs (1.445" dia.)	0.70 Kg. U-235
4.	Secondary Extrusion Croppings (.310" dia.)	0.85 Kg. U-235
5.	Rejected Pins (.158" dia.)	0.35 Kg. U-235

These figures represent maximum quantities which may be used and in most instances will be cut down considerably. The scrap to be used for remelting will

be prepared in the following manner:

1. Turnings - ultrasonic cleaning, max. 350 gm. U-235 per batch. - Compacted on a hydraulic press.

2. Cropped Ends - pickled in nitric acid, a max. of 350 gm. U-235 per batch - pieces to be weighed before and after pickling to determine amount of U-235 in solution-solution to be transferred to 13 gal. polyethylene containers whenever 350 gm. U-235 has gone into solution.

3. Rejected Pins - ultrasonic cleaning - max. 350 gm. U-235 per batch.

B. Removal of Ingot from Mold and Crucible from Furnace.

After the ingot has cooled sufficiently, the mold container will be dropped and the mold removed. A tared cover will be placed over the top of the mold to prevent oxide from escaping. The covered mold will then be weighed and sent to a hood for ingot removal. The ingot will be removed in the hood and vacuumed to remove loose oxide. It will then be steel stamped for identification and placed in a tared covered bucket to be weighed to .05% accuracy. After weighing, the ingot will be inserted into a birdcage container to be used for both transportatio and storage. The birdcage will be of angle iron construction supporting a 5" dia. pipe which is capped at both ends and cut in the middle to support the ingot in a vertical position. The two halves of the pipe will be threaded in order that they may be sealed after the ingot has been inserted. The ingot will be fixed in position such that there is a 12" spacing between it and the outer edge allowing it to adjoin

a similar container and still maintain a 2 ft. separation between the two ingots. The birdcage will be provided with casters for ease of movement.

* A drawing of the container is enclosed for reference.

The crucible will be covered and removed from the furnace via a hoist. It will then be weighed to determine the weight of oxide and skull. After weighing, it will be transported to a hood where both crucible and mold will have the dross mechanically removed. Large pieces of skull will be placed in 5 gal. covered steel buckets for storage, a max. of 1.5 Kg. (.35 Kg. U-235) per bucket. Scrap buckets will be removed to the enriched scrap storage area where they will be stored in arrays with a 12" edge-edge separation between adjacent containers.

The hood will then be vacuumed to remove small particles of oxide, and the mold and crucible wiped thoroughly with damp cloths before being removed from the hood. Vacuum cleaner filters will be removed and placed in covered metal containers for reclamation.

C. Pickling Enriched U-Mo Ingot.

The ingot in the birdcage will be moved to the enriched pickling area. The ingot will be removed from the birdcage and placed in a plastic tray. Concentrated hydrochloric acid will be poured over the ingot to remove oxide. Water will be added to dilute the acid, and the ingot scrubbed with a steel

brush while in the acid solution. The ingot will then be removed from the tray and dried. After drying, the ingot will be reweighed and replaced in the birdcage. The difference in ingot weight before and after pickling will show the amount of U-235 which has gone into solution. Whenever the amount of U-235 in solution reaches 350 grams, the solution will be transferred to a 13 gal. polyethylene container and sent to the scrap storage area to be stored in wire racks at 18" separation from similar containers.

The pickled ingot will be transported to the vacuum annealing area.

D. Vacuum Annealing Enriched Ingots.

A maximum of two ingots (26.6 Kg. U-235), each in a birdcage, will be allowed in the vacuum annealing area at any time. The furnace to be used for annealing is a Westinghouse vertical pit type with a 14" diameter hot zone, 10 ft. long. The fixture to be used for holding the ingots will hold two ingots end to end in a vertical position, with a 24" spacing between them.

Annealing temp. will be 1025° C for 24 hours in a vacuum of less than 1 micron. The furnace will then be cooled to 200° C, the retort removed, and each ingot removed from the fixture and replaced in its birdcage.

One birdcage will then be moved to the canning area and the other to the in-process storage area. Movement will be controlled by the criticality representative. A drawing of the annealing fixture is enclosed for reference.

E. Canning, Welding, and Evacuation of Enriched Billets.

Each ingot (11.8 Kg. U-235) will be removed from the birdcage and inserted into a clean copper can on a roller table. Copper - nickel extrusion components (nose plug, cut-off slug, end caps, and evacuation tube) will be inserted into the copper can and heli-arc welded together. After welding, the canned billet will be evacuated to one micron and leak tested. If leaks are found, the canned billet will be returned to the welder for reworking. If no leaks are apparent, the evacuation tube will be sealed and the billet placed in the birdcage for shipment to NMI.

F. Shipment of Canned Billets to NMI for Primary Extrusion.

The canned billets will be shipped to NMI in sealed birdcages via DEM truck. A maximum of 2 billets (23.6 Kg. U-235) will be shipped at any time. Birdcages will be fastened in position on the truck to avoid accidental movement in transit. All shipments will be inspected by the criticality officer before being allowed to proceed. The driver will be briefed on possible hazards to be avoided.

G. Receipt of Copper Clad Secondary Billets From NMI.

The extruded copper clad rods, 1.525" dia. will be received from NMI in max. lots of 4. The rods will be approx. 9 ft. long and weigh approx. 51 Kg. (11.8 Kg. U-235) each. They will be shipped in individual containers. Each container will be constructed of welded angle iron with a channel fixed in position to hold a rod in a covered tray and an outer cover which will be bolted in place for shipping. The birdcage type construction will assure a 15" spacing between adjacent containers.

* A drawing of the container is enclosed for reference.

Containers will be transported to the in-process cage for storage. When needed for production, the material will be issued by the criticality representative in lots of one rod (11.8 Kg. U-235).

H. Removal of Copper from Extruded Secondary Billets.

Each rod will be sent to the hacksaw where it will be cut into two sections, each approx. 4 1/2 ft. long. The two pieces will then be replaced in the original birdcage and sent to the pickling area where they will be weighed and then pickled in a nitric acid solution to remove copper. Saw chips will be placed in one gal. steel pails (max. .35 Kg. U-235/pail) and stored in the enriched scrap area.

* 1033-3 & 4

When the removal of copper is complete, the rods will be placed in a rinse tank and rinsed thoroughly with cold tap water. They will then be removed and dried. Pickled rods will be weighed to .05% accuracy and replaced in the birdcage for transportation to the hacksaw.

Pickle solutions will be transferred to 13 gal. polyethylene containers whenever 350 gm. U-235 is in solution as determined by before and after weighings. The polyethylene containers will be stored in the enriched scrap area in wire racks at 18" separation. Pickling solutions will also be analyzed for uranium content to insure that the max. quantity of U-235 has not been exceeded.

I. Sawing Extruded Secondary Billets.

Each rod will be cut into slugs 4.187" long on a mechanical hacksaw. Approx. 25 slugs will be cut from the two rods combined. A maximum lot for processing will consist of 15 slugs (6.6 Kg. U-235). Each lot of slugs will be placed in its own birdcage for transportation and storage. The birdcage will be the same as the basic unit which was used for the extruded rods with the exception that it will have an 8 ft. instead of a 10 ft. long metal tray. After sawing has been completed, one birdcage will be moved to the machining area and the other to the in-process storage area.

Saw chips will be stored in one gal. steel pails, a max. of 1.5 Kg. alloy (.35 Kg. U-235) per pail. Pails will be stored in arrays at 12" edge-edge separation in the enriched scrap storage area.

J. Machining Slugs.

The cut slugs will be machined on a lathe to 4.163" in length and 1.443" in diameter. Slug ends will also be shaped to a convex at the rear end and a concave at the front end. A carbide cutting tool will be used and a water soluble wax as lubricant. The lathe will be hooded to prevent vapors from escaping.

Turnings will not be allowed to accumulate in the lathe bed but will be scooped up and placed in tared, one gal. steel pails with small holes drilled in the bottom for drainage. A max. of 1.5 Kg. chips (.35 Kg. U-235) will be allowed in any one pail. When this amount has been reached, the pail will be rinsed with acetone to remove the major portion of the lubricant. The turnings will then be cleaned ultra-sonically and sent to the press to be compacted. The maximum amount of chips to be compacted will be 4.5 Kg. (1.0 Kg. U-235). Compacted chips will be placed in one gal. steel pails and stored at 12" edge-edge spacing in the enriched scrap area prior to remelting.

After each lot of slugs has been machined, they will be replaced in the birdcage and moved to the cleaning area under the direction of the criticality representative.

K. Cleaning Machined Slugs.

Slugs will be cleaned ultra-sonically. The slugs will be inserted into the ultrasonic tank in batches of two slugs (0.88 Kg. U-235) each.

The cleaned slugs will be weighed on a metrogram balance to the nearest 0.1 gm. After weighing, the slugs will be replaced in the birdcage and moved to the canning area.

L. Canning, Welding, and Evacuation of Slugs.

Each slug will be canned according to the following procedure:

Copper - nickel extrusion components will be placed on either end of the slug and a zirconium sleeve fitted over the assembly. A steel can with an end cap will then be placed over the entire assembly and welded in a fixture. The canned billet is then connected to a leak tester and checked for leaks. If a leak is found, the billet will be marked and re-welded. If no leak is found, the billet will be attached to a vacuum pump and pumped down for 30 - 45 min. Near the end of the period the billet will be heated to 800° F with a torch. The evacuation tube will also be heated and then welded shut to seal off the billet. Excess evacuation tubing will be cut off with a torch, and the sealed billet placed in a metal container for shipment to NMI. A maximum of 15 canned billets (6.6 Kg. U-235) will be placed in one shipping container.

M. Shipment of Canned Slugs to NMI.

Shipping containers for canned slugs will be of angle iron construction and hold 15 slugs at an 18" distance from a similar container. The slugs will be placed in a steel tray end to end to form a rod approx. 7 1/2 ft. long. The tray will be covered and bolted in place to assure that the slugs will not be disturbed in transit.

* A drawing of the tray in which the slugs are to be inserted is enclosed. A maximum of 30 slugs (13.2 Kg. U-235) in two separate containers will be shipped to NMI via DEM truck. Containers will be fastened in the truck to prevent accidental movement. All shipments will be inspected by the criticality officer or his representative before departure. In addition to the slugs, two primary billets in birdcages may be transported at the same time.

* 1033-4

N. Receipt of Coextruded Rods from NMI.

Coextruded rods .310" in dia. x approx. 10 ft. long will be received from NMI in lots of 30 (13.2 Kg. U-235). The rods will be packed in shipping containers each containing 15 rods closely packed together. The 15 rods will be banded together with tape and placed in a metal tray 10 ft. long. The tray will have a cover which is bolted in place and have holes in the bottom for drainage. The covered tray will then be set in the steel channel which will then be covered and bolted. The channel will also have holes for drainage. The entire unit will be suspended in an angle iron framework assuring a minimum spacing of 18" between adjacent containers.

* A drawing of the tray which will be used in conjunction with the basic unit is enclosed.

Upon receipt of the rods at DEM, the shipping containers will be moved to the in-process storage area. When ready for processing, a lot of 15 rods (6.6 Kg. U-235) will be issued by the criticality representative and sent to the pickling area in the shipping container.

* 1053-4

O. Pickling and Shearing of Coextruded Rods.

A maximum of 3 rods (1.1 Kg. U-235) will be weighed and placed in a pickle tank containing an aqueous nitric acid solution. The rods will be pickled for 30 min. and then rinsed.

The pickled rods will be moved to the alligator shear where the ends will be cropped. End croppings will be cut into 1 1/2" lengths and sorted into four categories:

a.) Pieces containing U - Mo only.

b.) Pieces containing U - Mo with Zr cladding.

c.) Pieces having some Cu - Ni on the surface.

d.) Pieces containing primarily Cu - Ni.

Categories a.) and b.) will be placed in one gal. steel pails (max. .35 Kg. U-235 each) and sent to the scrap storage area. Category c.) will be pickled to remove Cu - Ni and then sent to the scrap storage area for storage prior to recycle melting. A max. quantity of .35 Kg. U-235 will be adhered to in pickling cropped ends. Category d.) material will be placed in metal containers for storage.

Cropped rods will undergo a second pickling where necessary to remove small spots of steel which may remain after the rough pickle. The ends of the rods will be capped with rubber "policemen" to prevent the U - Mo from going into solution. The pickle solution will be a mixture of nitric and hydrochloric acids at 110° F.

Rods will be pickled until such time as all steel is removed (max. quantity of 1.1 Kg. U-235 in solution at any time) after which they will be rinsed, weighed, and placed in the shipping container.

All pickle solutions will be transferred to 13 gal. polyethylene containers whenever it is determined that 550 gm. U-235 has gone into solution both from before and after weighings and an actual analysis of the pickle solutions. Polyethylene containers will be stored in wire racks at an 18" distance from similar containers in the enriched scrap storage area.

P. Swaging, Cutting, and Pointing Pickled Rods.

A maximum of 15 - 6 1/2 ft. rods (5.5 Kg. U-235) will be allowed in the swaging area. Each rod will be swaged to .158" dia. x approx. 26 ft. long. Swaged rods will then be placed on a rolling table and moved to an alligator shear. Each rod will be inserted into a die and cut to 30 1/2" lengths. Approx. 10 of these pins will be cut from each rod. Test specimens 1/2" long will be cut from each end and the middle of every other rod for metallographic examination.

After being inspected for proper length, the pins will be placed in trays in a metal cabinet for internal transportation and storage. Each cabinet will hold 150 pins (5.25 Kg. U-235) in 15 trays of 10 pins each. The pins will be fastened in position to maintain identity.

* A drawing of the metal cabinet is enclosed.

* 1033-5

The three test specimens from every sampled rod will also be placed in the proper tray. Subsequently, three specimens, each properly identified, will be placed in a glass, screw cap bottle and sent to the quality control section for examination in max. lots of 100 samples (64 gm. U-235).

Scrap ends generated will be placed in one gal. covered steel pails (max. 350 gm. U-235/pail) and sent to the enriched scrap area for storage in arrays.

When the cutting has been completed, each lot of pins will be moved to a two die swaging mach. within the area for pointing. The ends of each pin will be pointed to a 30° angle and inspected. When all points have been swaged, the pins will be replaced in the cabinet and moved to the cleaning area.

Q. Cleaning Pointed Pins After Swaging.

The swaged pins will be removed from the cabinet in lots of 20 pins (700 gm. U-235). This will be the maximum quantity to be allowed in the cleaning tank at any time. The 20 pins will be placed in a stainless steel rack and inserted into the ultrasonic tank for cleaning. Cleaning time will be approx. 5 min. per batch. After cleaning, the pins will be removed from the rack and inserted into a graphite vacuum annealing fixture which may hold a max. of 165 pins (5.8 Kg. U-235) A drawing of the annealing fixture is enclosed. When the fixture has been loaded with the cleaned pins, it will be moved to the vacuum annealing area on a dolly.

R. Vacuum Annealing Finished Pins.

The fixture containing a max. of 165 pins will be loaded into the retort of the vacuum annealing furnace. Two such fixtures (11.6 Kg. U-235) separated by a minimum of 2 ft. will be the maximum permissible loading of the furnace. A graphite spacer ring between the two fixtures will assure that the spacing will be maintained in case holding wires give away.

After the retort has been loaded, the furnace will be pumped down to less than 1 micron and then heated to 800°C where it will be held at temp. for one hour. The furnace will then be cooled to 375° C in less than four hours, and then from 375° to 150° C.

The retort will be removed from the furnace and the two fixtures removed from the retort. The pins will then be removed from the fixtures and replaced in the storage cabinet. One cabinet will be sent to the testing area and the other to the in-process storage area. The entire annealing cycle will take approx. 18 hours.

S. Fluorescent Penetrant Inspection of Pins and Cleaning.

The pins will be tested using a fluorescent penetrant dye for surface defects. Maximum lot size for testing will be 20 pins (700 gm. U-235). When testing has been completed, acceptable pins will be ultrasonically cleaned, again in lots of 20. The cleaned pins will then be replaced in the cabinet. Rejected pins will be cut into approx. 5" - 6" lengths and placed in one gal. steel pails for recycling. A max. of 1.5 Kg. (350 gm.

U-235) will be placed in any pail which will then be stored in arrays in the enriched scrap area. When the entire lot of 150 pins has been tested and cleaned, it will be sent to the weighing area in the metal cabinet. Pins will be weighed individually to 0.1 gm., replaced in the cabinet, and sent to the swaging area.

T. Swaging End Caps on Finished Pins Straightening and Cleaning.

Zirconium end caps will be swaged onto both ends of the pins. They will then be straightened in a two die swaging machine. After straightening, each pin will be replaced in its tray. When the entire lot of pins has been swaged, it will be moved to the cleaning area and cleaned ultrasonically in batches of 20 pins (700 gm. U-235). After cleaning, the pins will be replaced in the cabinet and sent to the inspection area for final inspection.

U. Inspection of Finished Pins.

Finished pins will be removed from the cabinet and inspected for straightness, length, and diameter, in addition to a complete visual examination. Acceptable pins will be replaced in the cabinet while rejects will be cut into 5" - 6" long pieces and placed in one gal. steel pails in the enriched scrap area (max. 350 gm. U-235/pail). A maximum of 10 pins (350 gm. U-235) will be on any inspection bench at any time. When inspection has been completed, the metal cabinet containing the acceptable pins will be sent to the vault for storage prior to assembly.

V. Insertion of Pins into Stainless Steel Birdcage.

When ready for assembly, a lot of 144 pins (5.0 Kg. U-235) will be issued in the metal cabinet to the primary assembly area. The pins will be individually inserted into a stainless steel birdcage * (print enclosed) which will be sent to the final assembly area located in a clean area separated from the fabrication area by a wall. Only one lot of 144 pins will be in the assembly area at any time.

W. Final Assembly of Pins into Core Subassembly.

The birdcage containing the enriched fuel pins will have the locking plates and anchor bars inserted and welded. The birdcage will then be inserted into a stainless steel tube 2.464 x 2.464 x 73" long, with only the locking end being exposed. The lower blanket grid assembly containing 16 depleted U - Mo axial blanket rods will be welded to the birdcage in a welding fixture. The entire unit will then be slipped further into the tube until only the blanket rod end caps are exposed. A grid will be placed over the end caps and welded to the lower orientation cam. The lower subassembly will then be joined to the upper subassembly in a fixture, the concentricity checked, and the two welded together to button up the complete assembly. Localized cleaning will be done where necessary with acetone. The entire finished subassembly will be inserted into a polyethylene liner containing an indicating desiccant and heat sealed prior to insertion into the shipping container.

* ANL-4718

Finished core subassemblies will be stored in the assembly area on wall racks maintaining a 2 Ft. separation between each unit while awaiting shipment.

K. Shipment of Core Subassemblies to PHDC.

At this time the design of the shipping containers and the method of transportation to be used have not been firmly established. We are presently working on these problems and expect to finalize our plans shortly. It is our intention to provide this additional informati in the form of a supplement to our license application when ready.

III. Accountability and Health-Safety.

An Outline of our program with respect to Health-Safety, procedures has been previously submitted with our original license application docket No. 70-139 and will be adhered to in the performance of this contract. Copies of our accountability manual are enclosed.

The accountability representative will maintain and control all records pertaining to the issuance and storage of special nuclear materials. He will issue a material control card with each lot of material which will remain with that lot through all stages of fabrication. In addition, he will keep a master control record containing weights of all material in-process and in store

All weighings of enriched material will be performed to .05% accuracy.

The main features of our health-safety program have already been described in our manual which has been previously submitted.

All operations involving the possibility of loose oxide escaping into the air will be performed in adequately ventilated hoods. Audible monitoring equipment capable of detecting gamma radiation has been purchased and is expected to be installed by April. All enriched fabrication will take place in our exclusion or "hot" area. Final assembly and cleaning will take place in a 65 x 85 ft. area separated by a glazed tile wall from the "hot" area. This assembly area will be maintained as a clean area since all material entering it will have previously been clad. Adequate precautions and checks will be maintained by means of air sampling and smear testing to assure that contamination does not spread from the "hot" area into the clean area.