ESTABLISHED 1867

MALLINCKRODT CHEMICAL WORKS

MANUFACTURERS OF
FINE CHEMICALS FOR MEDICINAL, PHOTOGRAPHIC
ANALYTICAL AND INDUSTRIAL PURPOSES

FACTORIES ST. LOUIS, JERSEY CITY, MONTREAL
SALES OFFICES: ST. LOUIS, NEW YORK, CHICAGO, CINCINNATI, CLEVELAND
LOS ANGELES, PHILADELPHIA, SAN FRANCISCO, MONTREAL, TORONTO

CABLE ADDRESSES
MALLINCKRODT ST. LOUIS
DESABRIDO NEW YORK
CODES
A B C FIFTH ED.
A B C SIXTH ED.
BENTLEY'S COMPLETE PHRASE
BENTLEY'S SECOND PHRASE

SECOND AND MALLINCKRODT STS. ST. LOUIS 7, MO.

Mallinckrodt FINE CHEMICALS Standard Since 1867

June 18, 1956

70 36

Mr. Lyall Johnson
Licensing Division
U. S. Atomic Energy Commission
1901 Constitution Avenue
Washington 25, D. C.

Dear Mr. Johnson:

Reference is made to our application for a special nuclear material license covering our plant at Hematite, Missouri, transmitted with our letter of May 15, 1956. Since this time, there have been several changes in our plans which make it necessary for us to request amendments to the original application.

We now have requirements for processing highly enriched UF_6 to oxide beginning about September 1, 1956. In processing this material, we plan to use, as in the case of the other enrichments, "always safe" batch sizes as well as equipment of "always safe" geometry. A description of our process and equipment is attached as Appendix I.

We also have a requirement for producing a small quantity of 20% enriched oxide by September 1, 1956. Since this order amounts to only about 1 kg. of contained U^{235} and since other commitments prevent our producing it in the Hematite plant, we would like to process this material in our pilot plant located in St. Louis. This single order is the only enriched material we propose to process in our St. Louis facilities. Our plans for the conversion of the 5½ kg. approximately (U content) to UO_2 are described in Appendix II.

We have been advised of the necessity of having adequate storage facilities for special nuclear material before a license may be issued. Our new storage facilities at Hematite are scheduled for completion early in August. Although we have no plans to receive any special nuclear material until after completion of these facilities, we would like to know that our license is in order as soon as possible so that final production plans can be made. We propose, therefore, that a concrete floored, hollow-tile walled building now available on our Hematite property be designated as a temporary storage facility in order that the storage requirement can be met immediately. A description of this building is attached as Appendix III. You will note that the criticality problem is handled in storage by maintaining all stored material in "bird cages".

L&R File Copy

E-16

FORM 82

MALLINCKRODT CHEMICAL WORKS

ST. LOUIS.

In view of the information contained in the above paragraphs, we request that our application for a special nuclear material license for our Hematite facility be amended to:

(1) cover processing of UF_6 of all enrichments to UO_2. (See also Appendix IV which outlines proposed methods.)

(2) designate the former dairy barn described in Appendix III as a temporary storage facility.

We also request that we be granted a "one shot" special nuclear material license to permit us to process UF_6 containing approximately 1 kilogram of U^{235} to UO_2 in our pilot plant facilities at Mallinckrodt's main plant located at 3600 North Second Street, St. Louis, Missouri. Processing of this material is desired during the month of August, 1956, and would be under the direct supervision of qualified technical personnel named in our basic application of May 15, 1956.

Should you require additional information in order to permit your action on the items mentioned above, we shall attempt to supply it immediately upon notification from you.

Very truly yours,

Frederick M. Belmore

Frederick M. Belmore
Special Asst. to the President

FMB/cak

City of St. Louis
State of Missouri

Subscribed and sworn to before me this 18th day of June, 1956.

Marie A Ranger
Notary Public

My commission expires December 10, 1958.

L7791

Appendix I

PROCESS DESCRIPTION AND FLOW DIAGRAM - CONVERSION OF

URANIUM HEXAFLUORIDE TO URANIUM DIOXIDE AT THE HEMATITE, MISSOURI PLANT

The hexafluoride will be received in "always safe" cylinders as specified by the AEC. These cylinders will be transported in bird cages which will maintain "always safe" spacing between adjacent cylinders. At Hematite, concrete block vaults will be used for storage of the cylinders of uranium hexafluoride still in bird cages prior to use. A cylinder in the bird cage will be moved by dolly from storage to the hydrolysis hood. At this point the cylinder will be removed from the bird cage, placed on a scale and connected to a 1/4" line leading to the hydrolysis equipment. As indicated on the attached flow sheet, the hydrolysis operation will be carried out in an "always safe" geometry cylindrical tank, 5" in diameter and 4' deep. As an added precaution, processing will be done in "always safe" sized batches of 0.7 pounds uranium. The solution in the tank will be pumped through the aspirator to create suction on the cylinder. The entire operation will be carried out in the hood which will be curbed for a depth of 4", and the curbed area will have sufficient capacity to hold the entire contents of the hydrolysis system in case a break in the line should occur. Following hydrolysis the material will be transferred to cylindrical tanks of similar dimension for settling. After the settling operation, a supernate liquid will be air lifted to a nutsche filter 4" deep X 12" diameter to maintain "always safe" geometry in the filtration equipment. Following filtration the product will be removed from the filter in batches containing 0.7 pounds uranium each and placed in drying trays which are half of a 5" diameter cylinder. These trays containing the moist filter cake will be placed in a forced air drying oven. The exit gas will be filtered through MSA Dust Foe space filters. Subsequent operations in the process will be carried out on 0.7 pound batches in dry boxes. Trays of dried ammonium diuranate are removed from the drying oven and transferred to a high temperature furnace with an inside diameter of 5". In this step of the process, ammonium diuranate is thermally decomposed to U_3O_8. The exhaust gases from this step of the process are also filtered.

Trays of U_3O_8 are transferred to a dry box where the material is loaded into similar sized trays for the reduction step. These trays, having a depth of about 4" and a width of 5" are heated in a hydrogen atmosphere in a tube furnace. Cooled UO_2 is removed from the reduction furnace and transferred to a dry box for grinding. Grinding is done in a 1" tray using a rolling pin type grinder. Material from the grinding tray is transferred to sieves which are stacked to make a 5" cylinder. Sieves are kept and used at a distance greater than 2' from the grinding tray. After sieving, UO_2 is poured through the bottom of the dry box into a 5" shipping container which is positioned below the floor of the dry box. The UO_2 for recycle from this step of the process is loaded back into the reduction trays and returned to the reduction furnace for recycle.

Three bottles of UO_2 product will be placed in a bird cage designed to maintain safe spacing. The center of the bird cage will consist of a steel pipe in which the polyethylene bottles are firmly positioned. It

should be recognized, however, that this mode of shipment is subject to agreement with our customers. In all cases of storage and shipment it is our intention to maintain a single layer of bird cages on trucks or in storage vaults. It should also be pointed out that in handling high enrichment uranium our design provides for all dusty type operations to be carried out in dry boxes to eliminate the potential hazard from the alpha radiation of uranium

Appendix II

CONVERSION OF 20% ENRICHED UF_6 CONTAINING 1 kg U^{235} TO UO_2

It is proposed that this material be processed from UF_6 to UO_2 in our present pilot plant at 3600 N. Second Street in St. Louis. It would be our intention to receive a single cylinder of UF_6 from Oak Ridge. This would be the "always safe" cylinder which is standard for use by the Atomic Energy Commission. If shipped by common carrier this cylinder would be conveyed in an "always safe" bird cage. If the cylinder were transported in a private vehicle, it is possible that it might be more expedient to handle it without a bird cage. A walk-in safe protected by a burglar alarm system (Potter Signal System) is available for storage of the UF_6 prior to putting it in the process. The first phase of the process is hydrolysis and precipitation to prepare ammonium diuranate. To accomplish this, the single cylinder of product would be connected directly to a line which in turn will discharge into an "always safe" geometry slab tank 4" thick, 5' high and 4' long. Following hydrolysis and precipitation of the entire contents of the cylinder, the slurry would be transferred to an "always safe" type settling tank 4" thick, 5' high and 4' long. Following a suitable settling period the slurry would be filtered through "always safe" nutsche filters, 4" deep X 12" diameter. The product at this point, while still moist, will be loaded into 2" deep trays and dried, one tray to an oven. In this manner it is expected the entire batch can be handled as one "always safe" geometry batch.

Following the drying, the product will be ground and transferred to smaller trays where the depth will not exceed 1". This "always safe" geometry is maintained throughout thermal decomposition and reduction operations. The finished product will be packaged in "always safe" geometry polyethylene bottles of 5" diameter and transported to the customer in bird cages designed to accept these polyethylene bottles and maintain "always safe" geometry even in case of a bottle rupture. It should be pointed out that these bottles have been chosen for shipment of enriched uranium dioxide only after a 24 hour immersion test has indicated they are water proof. Pending actual usage or shipment, this one lot of 20% assay uranium material would be stored in the safe described above.

Appendix III

DESCRIPTION OF TEMPORARY STORAGE VAULT AT HEMATITE FOR WEAPONS GRADE URANIUM HEXAFLUORIDE

The proposed production facility at Hematite, Missouri now has on the property a dairy barn. It is proposed that this dairy barn be designated a temporary storage facility for special nuclear material pending completion of special storage vaults immediately adjacent to the production building. The barn is built on a concrete main floor. The walls are of hollow tile construction to an elevation of approximately 12' above the concrete slab. The roof is a corrugated sheet metal. The floor space available is 45' wide by 100' long. We are proposing that one end of this building will be chained off to act as a temporary storage facility, until the storage vaults for the plant are completed in August. It is our intention and agreement with Union Carbide Nuclear Corporation in Oak Ridge, Tennessee that the shipping containers for the transportation of UF_6 will remain with the bird cages at all times. We would, therefore, receive a truck shipment of cylinders contained in "always safe" bird cages, remove the cylinder and the bird cage as a unit and place them in our storage facility. When the product is ready for use, the bird cage and the cylinder would be transported as a unit to the production plant. We have also agreed with our customer for uranium dioxide that the shipping bottles and the bird cages will be maintained as a unit through shipment and storage both at our plant and at the customer's plant. The bird cages and the bottles would be transported as a unit to the production facility for filling and the filled containers so labeled would then be returned to the storage vault awaiting a truck shipment to our customers. Bird cages of product and raw material will be stored in a single layer in this storage area.

.43 g/l

.2 g/l

$\frac{1000g}{.2g/l} = 5000l.$

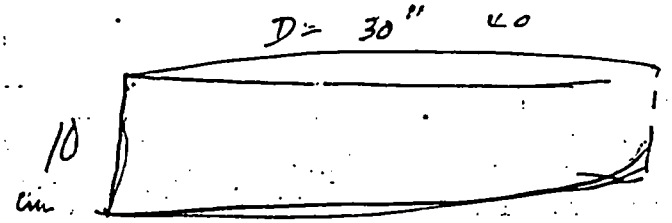
$V = \pi r^2 h = 3 \cdot (15)^2 10$

$= 2250 = 6250$

$= 7\ l$

$\cdot 9 = 6.3$

$1\ kg =$



$\frac{1}{7} = .143$

$V = \pi r^2 h = 3(15)^2(10) = 7000$

$= 3(12)^2 \cdot 10 = 12\ l$ $\frac{1}{12} = .68$