THE **CARBORUNDUM** COMPANY

THE CARBORUNDUM METALS COMPANY DIVISION

P. O. BOX 39 · AKRON, NEW YORK

November 27, 1959

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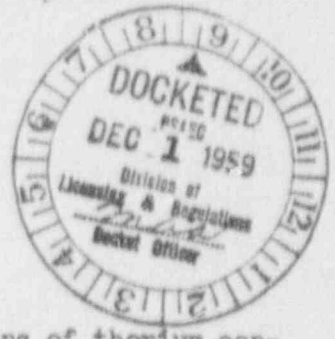

Nuclear Materials Section
Licensing Branch
Division of Licensing and Regulations
U. S. Atomic Energy Commission
1901 Constitution Avenue
Washington 25, D. C.

Attention: Mr. Doulos

Gentlemen:

Attached are the completed AEC-2 forms required for the processing of thorium containing source material.

In order to supply as much pertinent information as feasible with regard to the process, facilities and plan of action, the following information is being supplied:

The Parkersburg plant of CMC is located at Washington, West Virginia in a rather remote, lightly populated area. Two large chemical plants (Marbon and DuPont) are located one to two miles away in a northerly direction. The nearest residence is located approximately a half mile away in an easterly direction from the plant. The plant property is adjacent to the Ohio River and includes appreciable river frontage. The entire water supply for the plant is obtained from wells.

CMC interest in processing Nigerian zircon is based on the hafnium content of this ore. The Hf/Hf + Zr ratio of most readily available ores is close to 0.02; in the Nigerian zircon, this ratio varies between 0.05 and 0.08 so that, on the average, three times as much hafnium is present in these ores. Associated with the higher hafnium content are appreciable amounts of thorium which vary between 3-6% thorium oxide (based on the ore). Zircon ores are silicate ores; therefore, the zirconium, hafnium and thorium all are present as silicates of the type $MSiO_4$. Thorium as the silicate is called thorite. The silicates of thorium, zirconium and hafnium are very stable and are, therefore, not easily opened by normally accepted procedures. The two methods used commercially to open such ores are (1) caustic fusion of the ore, and (2) carbide formation conducted in the electric arc furnace. This latter method is employed by CMC at its Parkersburg plant. In this operation, zircon and coke are first blended (with an oil binder) in appropriate ratios; the resulting mix is fed into a carbon arc. Under these conditions, the silicates react with the carbon in the following manner:

$$MSiO_4 + C \xrightarrow[(>3500^{\circ}C)]{\Delta} SiO\uparrow + CO\uparrow + MC\ (MCN)$$

The furnace employed at Parkersburg to carry out this process utilizes approximately 50T of zircon in a 30 hour run yielding approximately 25,000-30,000 pounds of carbide. This furnace operates at approximately 150 V and 2500 KW.

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40,000 cfm of ventilation are provided for this furnace. The off gases are led to appropriate cyclones where fines down to <20 microns are removed and recycled back to the furnace. The gaseous product from the cyclone is conducted to a 36" diameter stack which is 120 feet high.

The carbide furnacing will effectively remove all daughter products from the natural thorium as off gases so that succeeding operations will involve only thorium as a prime contaminant which remains with the hafnium and zirconium carbides.

The carbide is then exothermically chlorinated. It is estimated that 30% of the thorium will go along with the zirconium and hafnium tetrachloride as thorium tetrachloride. Thorium tetrachloride is comparatively non-volatile so that its presence in the zirconium and hafnium tetrachlorides can only be accounted for by a carryover mechanism. The vapor pressure of thorium tetrachloride is nil below 650° C. whereas zirconium tetrachloride and hafnium tetrachloride are both sublimed at temperatures in the range of 330° C. The chlorinator residues will, therefore, contain approximately 70% of the original thorium as unreacted carbide, tetrachloride and probably some thorium oxide. It is our intention to barrel these residues and sell them as thorium concentrates. The thorium content should run to between 10 and 20% on a metal basis.

The zirconium and hafnium tetrachloride portion (containing some thorium) will be processed through a crystallization process which has been found to effectively separate out the thorium. The thorium along with all of the other impurities stay in the mother liquor which is 6N with respect to HCl. The HCl is recovered in this operation via a distillation step leaving behind all of the impurities including the thorium. This "still bottom" fraction will be neutralized and barreled for sale as a thorium concentrate. The amount of thorium in this concentrate may run in the same range as the chlorinator residue. The zirconium and hafnium are now free of contamination and may be further processed by normally accepted procedures free of internal or external radiation problems.

There will at no time be a liquid discharge of any waste from this process, i.e. containing thorium.

The carbide resulting from the initial operation, although containing thorium, does not exhibit gamma radiation. Here, only an internal radiation problem (from alpha and beta) exists.

The carbide building and the Nigerian ore storage area will be classified as restricted radiation areas. This area will be off limits for all workers not classified as "radiation area" workers. Any unauthorized worker reported in this area will be subject to a layoff of a varying length of time, depending on the nature and number of times of violation.

Prior to operation of the carbide facilities on this ore, CMC will engage consultants who are experts in the field of running radiological surveys and who meet the highest standards recommended by the AEC for this work. We will follow their recommendations for the entire survey program.

If further information is required, please let us know. We are anxious to make one or two preliminary carbide runs of this ore so that complete radiation surveys

can be conducted in order to ascertain the full nature of any problems not already apparent. Therefore, your earliest action will be appreciated.

Very truly yours,

THE CARBORUNDUM METALS COMPANY

D.R. Spink

D. R. Spink, Assistant to Manager
Technical Branch

DRS:mc

Attachments

DOCKET NO. 40-5001

FORM (4-61) AEC-2

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Form approved.
Budget Bureau No. 38-R002.4.

APPLICATION FOR AEC LICENSE TO TRANSFER, DELIVER, EXPORT, OR RECEIVE URANIUM OR THORIUM SOURCE MATERIAL

Pursuant to Code of Federal Regulations, Title 10—Atomic Energy, Part 40—Control of Source Material

2. PREVIOUS AEC LICENSE NUMBER, IF ANY.

TO: U. S. Atomic Energy Commission,
1901 Constitution Ave. NW.,
Washington 25, D. C.

INSTRUCTIONS

File 3 copies of this application with the U. S. Atomic Energy Commission, 1901 Constitution Ave. NW., Washington 25, D. C. This application may be used for an original license or for the renewal of a license. In the case of a renewal, this application should be received by the Commission on or before 30 days before the expiration of the previous license. Complete blocks 1, 2, 3, 9, and if you combine two or more of the activities of Producer, Processor, Distributor, Exporter, or Consumer, complete each of the applicable blocks numbered 4 through 8.

1. NAME AND ADDRESS OF APPLICANT (Street, city, zone, state)

The Carborundum Metals Company
P. O. Box 32
Akron, New York

3. **INVENTORY.** INVENTORY OF SOURCE MATERIAL, RAW AND REFINED, AS OF November 16, 1959 500 T
(Specify date of last inventory)

INSTRUCTION.—Include all source material in your possession or under your control, regardless of location. Include any source material you have possession of but which is owned by others, whether or not they are licensees of the Commission. Please specify that part of your inventory which is owned by other persons, listing the names, addresses, and quantities owned by each. Do not include in this inventory any raw source material not yet removed from its place of deposit in nature.

(a) Raw Source Material

DESCRIPTION OF MATERIAL	ESTIMATED PERCENT URANIUM OR THORIUM	QUANTITY IN INVENTORY (Gross tons)	NAME AND ADDRESS OF OWNER, IF DIFFERENT FROM THAT IN BLOCK 1 ABOVE
Nigerian Zircon	3-6% ThO_2	500	

(b) Refined Source Material

DESCRIPTION OF MATERIAL	GRADE (Comm., CP, USP, etc.)	PERCENT OF URANIUM OR THORIUM	QUANTITY (Lb.)	NAME AND ADDRESS OF OWNER, IF DIFFERENT FROM THAT IN BLOCK 1 ABOVE

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USAEC
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Division of
Licensing & Regulation
Docket Officer