

UNITED STATES GOVERNMENT

Memorandum

TO : Lyall Johnson, Chief
 Licensing Branch
 Division of Licensing and Regulation

FROM : *D. H. Rogers*
 Dexter R. Rogers, Chief
 Radiation Safety Branch
 Division of Licensing and Regulation

SUBJECT: THE CARBORUNDUM COMPANY, DOCKET NO. 40-5001

DATE: AUG 5 1960

Conclusion: It is suggested that the license for the subject company be extended for three months in order for Dr. Whipple and his staff, who are consultants to the licensee, to complete their survey and furnish the Commission with a description of the routine radiation safety program which will be carried out by this company.

It appears, from the surveys conducted, that during the trial run this company has taken adequate safety precautions and is making satisfactory progress in defining radiation problem areas and taking corrective action. However, it appears that there are additional areas that need attention insofar as dust control is concerned. The company seems to take its responsibilities for compliance seriously and seems to be willing to make any necessary equipment modifications.

1. Radiation Safety Progress

The subject company's application of November 27, 1960 for a trial run of 900,000 lbs. of Nigerian ore containing thorium was granted so that the consultants could make complete radiation surveys to ascertain any problem areas which were not apparent.

The process will involve the carbide formation in an electric arc furnace. Zircon and coke ore blended (with an oil binder) into appropriate ratios and the mixture fed into an arc furnace. $MZiO_2 + C \xrightarrow[>3500^\circ C]{\Delta} SiO_2 + CO + MC (MCN)$. The

furnace to be used utilizes approximately 30,000 lbs. of carbide. 40,000 CFM are provided for this furnace. The off gases are fed into cyclones where particles less than 20 microns are removed and recycled back to the furnace. The gaseous product from the cyclone is fed into a 36" diameter stack which is 120 feet high.

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The carbide furnacing is stated to 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. An estimated 30% of the thorium will go along with the zirconium and hafnium tetrachloride. The chlorinator residues will contain approximately 70% of the thorium as unreacted carbide, tetrachloride and thorium oxide. These residues containing 10-20% thorium will be barreled and sold as thorium concentrates.

The zirconium and hafnium tetrachloride (containing source thorium) will be passed through a crystallization process which has been found to effectively separate out the thorium. The thorium along with all of the other impurities stays 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 impurities including thorium. This "still bottom" fraction will be neutralized and barreled for sale as thorium concentrate. The zirconium and hafnium are then free from thorium contamination.

It should be noted that there will be no liquid discharge from this process which contains thorium.

The licensee hired G. Hoyt Whipple of the University of Michigan as the consultant. It is stated that his recommendations will be followed for the entire survey program.

2. Description of the Site

The plant is located on the Ohio River at Washington, West Virginia. Two large chemical plants are located in the north at distances from 1-2 miles. The nearest residence is approximately 1/2 mile to the east. All water for the plant is obtained from wells.

3. Summary of Results of Surveys from:

a. The Carbide Run

Hoyt Whipple's radiation survey, as contained in his March 10, 1960 memo, gives information on the air samples taken, sampling and counting procedures and data summary. Information is provided on water samples, urinalysis, film badge results, gamma measurements, respirators, occupancy factors and recommendations. Table 3, page 11 of the report gives a summary of the air sampling results.

The air samples which average greater than MPC are (1) the car pulling operation, (2) the catwalk with furnace on, (3) the ore and coke hole with the furnace off and (4) off site with the furnace on. The conclusions and recommendations for these problem areas are found on pages 19-21.

b. The Chlorination Process

The April 20, 1960 memo of Hoyt Whipple contains the survey report of the chlorination process with the exception of the "bed residue pulling operation". Table 1, page 4 gives a summary of the air samples taken. The only areas in which the average concentration exceeded the MPC was the (1) feeding chlorinator operation and (2) the Zr Cl₄ drum pulling operation. The use of occupancy factors, however, reduces the average concentration to less than MPC. The average of six samples taken of the plant effluent to the river is less than MPC.

Pages 8-9 of Whipple's April 20 report give his conclusions and recommendations for the sampling program.

Radiation surveys and film badge results of both of the above operations indicates that there are no gamma radiation problems.

4. Modifications Made

The May 3, 1960 letter from the licensee indicated that corrective measures were being taken to reduce dust concentrations at the furnace and the car pulling operations. Photographs were furnished showing the visible effect of the modifications. No new survey data was given. This letter indicated that Dr. Whipple will establish the final radiation survey program when the second carbide run is completed. Mr. Spink states that they will follow the program until further data indicates that changes should be made. The routine changes which will be introduced in the chlorination process will further reduce the contamination in all areas. These changes will include better ventilation in critical areas, the use of closed hoppers for carbide feed to the chlorinators and the use of larger size receivers which will be opened only once every two or three shifts.

The letter of July 13, 1960 requests an additional extension. On the basis of their past progress it is suggested that it be granted for a three month period.

It appears that the consultant has defined the problem areas by means of survey results and that he has made valid recommendations to reduce the dust concentrations. Our only recommendation concerns the plant gaseous effluent. Some means should be taken to reduce the concentration of the gaseous discharge. In this regard, the licensee should be requested to furnish a drawing of the plant and surrounding area indicating location of sampling points.

5. Items Needed to Complete Review

In order to complete the review of the Carborundum Company's routine processing of the ore and to determine whether or not a full term license should be granted, the following information is requested:

- X a. A detailed description of the organization, including authority and responsibility of each level of management and/or supervision in regard to development, approval and adherence to operating procedures.

If Dr. Whipple or other consultants are to be retained to carry out certain parts of the radiation safety program and advise on radiation safety problems, information should also be submitted concerning the arrangement made between the consultant and the licensee, the consultants responsibility and the authority given to the consultant by the licensee to prescribe procedural, operational and equipment modifications.

b. The qualifications and experience of the personnel in your organization assigned the responsibility for developing, conducting and administering the radiation safety program for the plant.

c. A description of the method for restricting the plant from unauthorized entry.

d. A description of the routine liquid effluent survey program including the number, location and frequency of check samples and a step-by-step procedure for sample analysis for thorium content. A description of the equipment used to remove solid radioactive material prior to discharge of the liquid effluent from the plant area.

e. A flow diagram of the plant production operation and a diagram of plant area layout, indicating areas and points where dust is generated.

f. A description of ventilation and dust collection equipment that will be utilized when the plant will be running routinely.

g. A description of the survey program which will be followed to determine concentrations of airborne radioactivity within the mill, including the step-by-step procedures for sample analysis.

h. In the description of your air sampling program, please include:

i. a description of the sampling location in respect to operating personnel,

ii. a description of the sampling location in respect to the process operation,

iii. the approximate number of sampling locations in each area.

i. If respirators are to be used as a temporary protective measure, a description of your program for using respiratory protective equipment including type, methods for assuring adequate mask to face seal, procedures for maintenance and cleaning the areas of use and management enforcement of the program.

j. A description of the plant discharge stacks including stack heights and types of effluent to be discharged, methods for controlling release of radioactive material and methods for determining the concentrations of radioactive material released to the environs.

k. A copy of the written radiological safety operating instructions to be supplied to employees. These instructions should include provisions for personal hygiene, including washing prior to eating or leaving the plant.