

MR 68-5

Remarks by Mr. J. S. Brown
President - Industrial Chemicals Division
ALLIED CHEMICAL CORPORATION

Before

Governor's Uranium Conference
Ramada Inn
Casper, Wyoming
November 1, 1968

Governor Hathaway, Mr. Curry, Mr. Hill, and associates:

It is a pleasure to represent Allied Chemical Corporation at this important conference this afternoon.

I am intrigued by this morning's discussions of uranium exploration. Although Allied Chemical has not participated in uranium mining in Wyoming, we have been mining and milling fluorspar in nearby Colorado for many years and have more recently engaged in mining natural trona near Green River here in Wyoming. Our new mill for producing soda ash from trona together with an associated Church & Dwight sodium bicarbonate plant have both started operations this week. Initial shipment of soda ash was also made this week.

Let us turn, now, however to uranium processing. Unlike the mining and milling of uranium which have always been essentially in the private business sector, the refining of uranium beyond concentrates was carried out exclusively by the Atomic Energy Commission and its predecessor, the Manhattan District until 1959. In that year, Allied's Metropolis refinery went into operation to process AEC owned concentrates, and was shut down 5 years later - a rather gloomy beginning for the first private effort in the refining part of the nuclear cycle.

Now, four years, later, with the rapidly increasing growth of nuclear power and private ownership of uranium becoming a reality next year, a rapidly increasing demand for uranium has developed and with it a non-governmental demand for uranium refining. Present day power reactors of both boiling and pressurized water types require uranium enriched to 2-4% U-235 content, and natural uranium as it comes from the ground, unfortunately combine only 0.7% U-235 isotope. To obtain the necessary enrichment of U-235 to permit economic usage of uranium in reactors required processing through the AEC's gaseous diffusion plants, and, as the name implies, the uranium must be in gaseous form. To achieve such a form, uranium furnished to the AEC must first be refined from the concentrates form to ultra-high purity uranium hexafluoride (UF_6), a solid under normal conditions, but happily a gas when slightly warmed. The diffusion process for enrichment involved the passage of gaseous UF_6 through many porous barriers which are easily fouled and hence the need for very high purity material.

with the exception of some 32,000 tons of UF_6 produced by Allied for the AEC, in the period 1959 to 1964, and somewhat over 1000 tons of foreign-owned material earlier this year, all UF_6 produced to date has been processed in AEC owned plants.

The process employed by AEC involved the dissolution of impure uranium concentrates in nitric acid and the recovery of high purity uranyl nitrate solution via solvent extraction. The uranyl nitrate solution was then evaporated and calcined to uranium trioxide which was reduced with hydrogen to uranium dioxide, treated with HF to produce uranium tetrafluoride (or green salt) and finally fluorination with elemental fluorine to produce UF_6 . Upon passage of the 1954 amendment to the Atomic Energy Act, not only private use of enriched uranium under leasing arrangements became possible, but industry participation in the hitherto exclusive government nuclear processing operations was permitted. AEC solicited competitive proposals from industry to convert \$500,000,000 worth of uranium concentrates to specification UF_6 over a five year period beginning in 1959. Allied Chemical won the award with its proposal to develop a dry fluoride volatility process and also to construct and operate with its own funds a plant of warranted performance.

The Allied process was conceived by scientists at Argonne National Laboratory and was demonstrated on a small scale at Allied's Baton Rouge Louisiana Development Center. The commercial plant was then built on the Ohio River at Metropolis, Illinois, not far from the AEC diffusion plant at Paducah, Kentucky.

The Allied process eliminated the acid dissolution and solvent extraction steps. Following initial physical feed preparation, uranium is reacted in a series of fluid beds. Concentrates are reduced to UO_2 , hydrofluorinated to UF_4 and then fluorinated with elemental fluorine to crude UF_6 . The crude UF_6 is refined to AEC specification by fractional distillation. The Allied plant performed as warranted and, after a three-month extension of the original five-year contract was shut down on June 30, 1964, concurrent with the shutdown of AEC's UF_6 plants, because of a decline in AEC needs.

The demand for toll-enrichment services, which AEC will provide commencing in January and which is a direct outgrowth of the boom in nuclear power, led Allied to expand and reopen its plant to meet the private demand for refining uranium concentrates and chemically converting the uranium to the hexafluoride form in accordance with AEC specifications. Allied anticipates completing the last step of the presently authorized expansion of the Metropolis plant to 10,000 NT of uranium annual capacity during 1969 to meet

anticipated requirements. The partially expanded Metropolis refinery is now being operated to pre-produce UF_6 for both domestic and foreign customers to meet the requirement for enriched uranium in the early months of AEC toll enrichment.

The Atomic Energy Commission purchases its uranium in the form of concentrates, the end product of many privately-owned and operated uranium mills which are located here in Wyoming. AEC takes title to concentrates at its sampling plant at Grand Junction, Colorado after weighing, sampling, analyzing. Concentrates are shipped to Grand Junction in lots of 20,000 to 100,000 lbs., packaged in sealed nonreturnable, open-head 55-gallon steel drums each of which holds 700 to 900 lbs. of material. All drums making up a lot of concentrates are weighed and discharged into the sampling plant which employs the falling stream method. Seven or more samples are taken for analysis and assay. Two are furnished to the seller, three or more are retained by AEC, and two are set aside for possible umpire use in the event of disagreement between the seller and AEC, the buyer. After sampling, concentrates are repackaged in the same drums and stored pending completion of analytical work and agreement on total uranium content, which is the basis for payment.

Through its operating contractor, Lucius Pitkin, Inc., AEC is providing sampling services at cost to its toll-enrichment customers on an interim basis until such sampling services are available from industry.

Allied, convinced that control of gross uranium quality is more economically affected in uranium mill than in a refinery, established a standard uranium concentrates specification and a schedule of surcharges reflecting its cost for removing impurities exceeding such standard. In the meantime, many mills modified their circuits to improve recovery. The net result has been a radical improvement in concentrate quality. For the several thousand tons of concentrates delivered to Allied's Metropolis plant, billings for surcharges will average under one percent of the base conversion charge.

Allied has constructed, to Lucius Pitkin's specifications, a falling stream sampling plant contiguous to its Metropolis uranium refinery. Lucius Pitkin has leased the plant and is independently providing sampling services similar to those of AEC's at Grand Junction.

Following the precedent set in its earlier contract with the AEC, Allied warrants to its private customers that it will convert 99.5% of the uranium contained in accepted concentrates to uranium in the form of UF_6 which meets the AEC specification.

Allied and the concentrate supplier analyze and assay samples furnished by Lucius Pitkin and agree on uranium content of each lot as well as impurity content, etc., which form the basis for payment and title transfer between the concentrate supplier and the buyer. The buyer's concentrates are then transferred to Allied's plant.

Because the AEC cannot accept material for toll-enrichment services prior to January 1, 1969, Allied has been forced to require receipt of concentrates six months prior to delivery of UF_6 . After 1969, Allied is prepared to deliver UF_6 within ninety days of receipt of concentrates.

Allied acts as the owner's agent in arranging for transportation of UF_6 to the diffusion plant designated by AEC. Allied furnishes, as a part of its service, the shipping containers, steel cylinders of 14 tons capacity meeting AEC specifications, and all UF_6 sampling and analytical services as required to assure AEC acceptance.

Although no other privately-owned plants are yet in operation, Dean McGee's company has commenced construction of a uranium refinery in eastern Oklahoma; and Eldorado Mining, the Canadian Crown Corporation, will install UF_6 facilities at an early date at their Port Hope, Ontario, plant. Others are known to be considering similar moves.

Additional uranium refining capacity will obviously be required in a relatively few years, and a Wyoming refinery would appear to have but one drawback, that of lack of supply of hydrofluoric acid, the source of fluorine in UF_6 . Colorado fluor spar and locally available sulfuric acid are the basic raw materials for hydrofluoric acid manufacture, however, so that a Wyoming HF plant could easily rectify this situation, provided a refinery of sufficient size were built.

A modern uranium refinery and its associated auxiliaries represents an investment of approximately \$25,000,000 and employs 300 or more people for its operation.

Earlier I commented on the fact that AEC alone operates uranium-enrichment plants, the feed for which is natural uranium in the form of hexafluoride. Consideration is now being given to arrangements for turning over one or more of the three AEC diffusion plants located at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio, to private industry. In cooperation with AEC, a committee from the Atomic Industrial Forum recently submitted a report on this subject and recommended that all three

plants be taken over by industry at the earliest practical time, calculated to be early 1973. Although at least two members of the committee, Dean McGee and Ken Osborn, are present at this conference and can cover this subject in greater depth, it seems appropriate for me to comment further. The present AEC plants, each of which cost approximately 3/4 billion dollars, are planned to be expanded, but even so, will not have sufficient capacity to handle projected needs of ten or so years from now. Additional plants will be required, by some estimates, at the rate of one each year.

The enrichment of uranium by gaseous diffusion required not only large capital expenditures, but also large blocks of electrical power and large quantities of cooling water. Each of the present plants consume 2,000,000 kw of electric power. With the use of nuclear power reactors, it is now possible for Wyoming to produce low-cost electrical power. The relatively low population density and the availability of inexpensive land make Wyoming an attractive area for such a venture. Water requirements would probably limit the siting possibilities to a few selected areas of the State, such as that near the Flaming Gorge Reservoir on the Green River or the Jackson Hole area on the Snake River.

Within the past week or two, the Atomic Energy Commission has advised that Oak Ridge has recently completed the first of several diffusion plant conceptual design and cost studies directed toward alleviating the anticipated uranium enrichment capability deficiency in ten years or so. This study involves a single plant of capacity almost equaling that of the three existing plants at an estimated cost of approximately \$2,000,000,000. Electric power requirements would exceed 5,000,000 kw., presumed to be supplied by new nuclear generating plants. For the purpose of this study, a Minnesota site on the shore of Lake Superior was selected.

Wyoming has established itself as one of the principal sources of uranium the raw material for nuclear power. I hope my comments on uranium refining and enrichment will shed some light on the enormous future potential for Wyoming to contribute in a healthy and profitable manner to the upgrading of its raw material upon which the nuclear industry is based. Thank you.

#