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Attention: Miss Margaret L. Pflueger

Dear Miss Pflueger:

Subject: CF 57-4-54 (Unclassified)

Enclosed are seven copies of the subject document which we feel is of interest to the Pennsylvania Advanced Reactor Project. We will appreciate your making it available to them. This document may also be made available to the Civilian Application Program if considered applicable.

Very truly yours,

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A handwritten signature in dark ink, appearing to read "N. T. Bray".

N. T. Bray, Supervisor
Laboratory Records Department
Information and Reports Division

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*3 to West 429
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CENTRAL FILES NUMBER

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COPY NO. 54

DATE: April 22, 1957

SUBJECT: Discussion of Slurry Problems
with Dr. W. O. Milligan

TO: Distribution

FROM: C. S. Morgan

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DISCUSSION OF SLURRY PROBLEMS WITH DR. W. O. MILLIGANON MARCH 18, AND MARCH 20, 1957

Slurry problems, with emphasis on the ThO_2 caking problem and sphere formation phenomenon, were discussed by REED personnel with Dr. W. O. Milligan of the Rice Institute on March 18 and March 20. Data on cake and sphere formation were reviewed by D. G. Thomas, S. A. Reed and C. S. Morgan.

Dr. Milligan expressed, as interpreted by C. S. Morgan, the views summarized below. In addition he gave information and expressed opinions on related material and details which were discussed.

1. Spheres and cakes must be formed by (1) true solubility, or (2) coagulation of fines. He thought that minute solubility changes affected by fluctuating temperature could influence start or formation of spheres or cakes but considered coagulation of fines to be the dominant factor. He felt that cakes are formed in a manner similar to spheres except that deposits are on a nucleus on the wall instead of a moving aggregate in the slurry stream. He expressed the opinion that van der Waals forces would be sufficient to hold the ThO_2 particles together and thought that chemical bonding was negligible or absent.

2. High temperature firing will reduce the rate of peptization of oxide particles in the loop. He suggests that spherical ThO_2 particles, made either in a loop or by other means, be sized, fired at the highest temperature suitable and subjected to circulation tests. In the petroleum industry it has been found that corrosion in fluidized catalyst beds is reduced if catalyst particles are spherical.

3. Oxalate is a poor compound to thermally decompose to ThO_2 . It tends to become superheated and to decompose irregularly, making it impossible to obtain reproducible results in ThO_2 preparation. This could account for ir-

regular behavior in the loop observed for similarly prepared oxides. He suggests use of the hydroxide or nitrate. (Use of the formate has also been suggested.)

4. It would be wise to determine zeta potential as a function of pH and compare the zeta potentials of different oxides on this basis. Comparison of zeta potentials determined as a function of pH would provide a truer comparison of differences in the oxides as variations due to the extreme sensitivity of the zeta potential to pH would be avoided.

5. Small quantities of electrolytes will probably not prevent caking. The surface condition of the ThO_2 would not be stable as adsorbed ions would tend to migrate into the particle or to be desorbed completely under high temperature, circulating conditions.

6. The literature on oolites^a may contain information of interest with respect to the sphere formation phenomenon. Oolite consisting of discrete spherical particles with a calcareous base is found on the Florida coast.

7. Determination of the pore size distribution may yield useful information for characterizing oxides both before and after pumping. Pore size distribution can be determined by obtaining the desorption isotherm, preferably with water vapor, as it has a smaller molecular size than nitrogen. High temperature water adsorption studies could be made on the same equipment as that used for the pore size measurement.

^a Oolites are small rounded grains which often consist of calcareous deposits built upon a nucleus of sand or minute organism. Silicious oolites as well as oolites containing iron are common. The belief that oolites were formed by coagulation of colloidal material was advanced early. [W. H. Bucher, J. Geology 26, 593-609 (1918)]

8. Small angle X-ray scattering studies may be useful in the evaluation of ThO_2 samples. Small angle scattering of X-rays is a function of inhomogeneities in the sample and depends primarily on particle size and pore size.

9. It may be possible to determine orientation of tiny aggregates in very small spheres ($\leq 0.5\mu$) by electron diffraction methods.