STANDARD FORM NO. 64

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Office Memorandum • UNITED STATES GOVERNMENT

TO : Roy C. Hageman, Chief, Operations Division, Richland, Washington

DATE: October 23, 1947

FROM : Wendell K. Crane, Ass't. Chief, Research Branch, Richland, Washington

SUBJECT: R.D.T.M. NUMBER FOUR - OCTOBER 20, 1947

SYMBOL: HDPRE

Box 000313

PA Thurman 5-1-91
JJ Stroge 5-1-91

IN-8

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BY WA Snyder DATE 5-1-91
PNL Class Asst.

Notes prepared by A. J. O'Donnell.

Those attending the meeting were: R. C. Hageman, D. G. Sturges, W. K. Crane, J. T. Christy, H. R. Freitag, P. G. Holsted, A. J. O'Donnell, H. E. Parker, R. E. L. Stanford, V. L. Pelich.

I. **SEPARATIONS PROCESSES - H. E. Parker:**

A. An ideal separations process should fulfill the following requirements:

1. The materials should be separated into three (3) fractions - decontaminated plutonium, decontaminated uranium, and fission products.

2. The equipment should be simple in design, operation, and should provide for remote maintenance.

3. The equipment should be designed so as to provide flexibility to allow for incorporation of process improvements.

4. The quantity of active waste solution to be stored should be small.

5. The quantity of chemicals should not be excessive or difficult to obtain.

B. The processes that have been studied to date by the Manhattan Engineer District and the Atomic Energy Commission contractors are as follows:

1. Precipitation - The precipitation processes are based upon the principle that plutonium is preferentially carried on a precipitate of bismuth phosphate or lanthanum fluoride in the reduced state, whereas the uranium and fission products are preferentially carried in the oxidized state. Using sodium uranyl acetate the preference is reduced: i.e., plutonium is carried in oxidized state and uranium and fission products in the reduced state.

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(a) Bismuth phosphate - this method is unfavorable because of the large amount of waste material involved.

(b) Lanthanum fluoride - disadvantages include excessive corrosion due to fluorine and fluorides and difficulty of handling fine precipitate.

(c) Combination of bismuth phosphate and lanthanum fluoride methods.

(d) Sodium uranyl acetate - this method involves large quantities of chemicals, concentrated solutions and provides poor decontamination.

C. The precipitation methods in general are unfavorable when considered from the requirements for an ideal separations process as listed above.

1. <u>Dry Fluoride</u> - the dry fluoride process is based upon the principle that the fluorides of uranium, plutonium and fission products have sufficient difference in volatility to be separated by distillation and sublimation. This process meets the above requirements but involves a holdup of activity which is undesirable.

2. <u>Adsorption</u> - the adsorption processes are based upon the principle of selective adsorption of plutonium and fission products on resins (Amberlite IR-1). One process uses adsorption only for extraction and sodium uranyl acetate for decontamination, while others pass sodium bisulphate and oxalic acid solutions of irradiated uranium through adsorption columns. These processes are undesirable in that they involve a retention of fission activity in adsorption columns and desired decontamination was never achieved.

3. <u>Solvent Extraction</u> - The solvent extraction processes should most nearly fulfill the requirements for an ideal process. The so-called redox takes advantage of the selective solubility of plutonium, uranium and fission products in oxidized and reduced states in hexone and aqueous nitrate and nitric acid solutions. Oxidized uranium and plutonium are soluble in hexone. Reduced plutonium is soluble in hexone while reduced urandum is not. The waste reduction is about 40%. The uranium is recoverable.

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The chelate process is an adaptation involving the extraction of the plutonium chelate into a non-polar solvent and then re-extracting it into the polar phase. The chelate is defined as a complex compound involving a weak hydrogen bond. The yields for 3½ cycles in semi-works studies using 1½ liters of starting solution were 98.7% for either solvent. The decontamination factor for betas is greater than 10^7 in benzene and greater than 10^6 in toluene; for soft gammas 10^6 in benzene and 10^4 in toluene. The chelate process will require the solvent extraction method in addition for the separation of uranium. The chelate process has been developed theoretically to a more advanced degree than the redox process.

D. The solvent extraction method has been applied to many problems throughout the project. The following uses are now under study. The separation of plutonium, uranium and fission products as in progress at Hanford Works. Clinton Laboratories is studying the separation of U-235 used in enriched piles and U-233 in breeder piles. The separation of Americium from plutonium is in progress at Chicago. Los Alamos is studying the use of columns for separations of plutonium from wastes (i.e. gloves, shoes, and small buildings). The possibility of Thorium purification and rare earths is under study at Ames, Iowa. Berkeley is continuing work on the chelate process. This emphasis of the solvent extraction methods indicates them to be the "White Hope" of the project.

E. Preliminary data obtained on the two and three inch Demonstration Columns using each column as a single stage, rather than two stages (extraction and stripping) as outlined in the Redox flow sheet, indicates H.E.T.S. values of about 1.09 feet for the extraction of nitric acid from the aqueous to the hexone phase. There is no data as yet which will permit extrapolation of this data to uranium solutions under flow sheet conditions.

Work at Mallinckrodt indicates the H.E.T.S. values of four to five feet are obtained in their ether extractions process for the purification of uranium using columns of 16 - 18 inch diameter.

II. <u>TECHNICAL INFORMATION LIBRARY RECOMMENDATIONS</u> - A. J. O'Donnell:

During a recent visit of Mr. B. M. Fry of the Washington Technical Information Library the subject of reorganization for both the Atomic

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Energy Commission Classified Files and the General Electric Company Central Files was discussed. The recommendations would involve separation of classified reports from classified correspondence. This practice is not at present followed in either of the above named files.

The problem of locating reports in the Atomic Energy Commission Classified Files is one resulting from inadequate indexing systems. The same problem to a lesser degree exists in the General Electric Company Central Files.

To facilitate handling of reports and to insure adequate accountability a recommendation was presented for the establishment of a Technical Information Library under the Research Branch of the Atomic Energy Commission at Hanford.

A committee composed of W. K. Crane, chairman, R. E. Stanford, H. E. Parker, and A. J. O'Donnell was appointed for the purpose of studying the present filing systems and recommending changes in them. Those recommendations will be presented at the next meeting.

III. <u>BREEDER PILES - P. G. Holsted</u>:

In view of the limited supply of fissionable materials the need for a breeder pile was realized at the beginning of this project but the need for plutonium was far more urgent. The estimated world supply of uranium in the earth's crust is 10^{14} tons, of which only 10^{5} are in known deposits (reference: "One World Or None", chapter 4, by Gale Young). In order to make available fissionable materials such as U-233 and Pu-239 breeder piles have been discussed for some time and several are now in the design stage. A breeder pile is defined as one in which the yield of a fissionable isotope exceeds the destruction of that isotope so that a reserve is built up. The same species of isotope is produced as is destroyed (e.g. neutrons from fissioning U-233 can be made to react with Th 232 to produce U-233. In contrast to the breeder pile a converter is one in which the yield of a fissionable isotope is less than the amount destroyed; the new species is different from the original. For example fast neutrons from U-235 upon reacting with U-238 yields Pu-239.

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In a breeder pile there is always more than one atom of fertile material produced for each atom destroyed so that eventually all U-238 or Th-232 should be used up. The number of fissionable atoms produced per fissionable atoms destroyed is known as the "breeder gain". A Pu-239 breeder should be a fast neutron pile since the number of neutrons per fission of one atom of Pu-239 is 3.0 when bombarded with fast neutrons compared with a figure of 1.9 for bombardment with thermal neutrons. However, a U-233 breeder can be either a thermal or fast pile since the number of neutrons evolved per fission under bombardment by thermal and fast neutrons increases only from 2.52 to 2.55. Breeder piles may be divided into two classes. The first class, known as stationary, includes those piles in which the active material is not circulated through the pile. Heat removal is a major problem with this type of pile. The second type, known as the circulating type, includes those in which the active material passes through the pile and is out of the pile for a relatively long period so that there is considerable loss of neutrons, and inefficient utilization of fissionable materials.

Wendell K. Crane

Wendell K. Crane
Ass't. Chief, Research Branch

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TO : R. C. Hageman DATE: October 23, 1947

FROM : W. K. Crane

SUBJECT: R.D.T.M. NUMBER FIVE - OCTOBER 28, 1947

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AGENDA

I. SLUG BLISTERING - R. E. Stanford

II. SEGMENTAL PUSHING - P. G. Holsted

III. ALPHA PHASE EXTRUSION - R. E. Stanford

IV. REDOX - H. E. Parker

V. GRAPHITE EXPANSION - P. G. Holsted

VI. CRIBBING OF WASTES - D. G. Sturges

VII. WASTE LINE CORROSION - D. G. Sturges

Wendell K. Crane

Wendell K. Crane
Ass't. Chief, Research Branch

Distribution:
cy 1 - Mr. Shugg, Mr. Shaw, Mr. Hageman
2 - Mr. Stanford
3 - Mr. Christy
4 - Operations Files

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