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SUBJECT: Eurochemic Assistance Program: Comments by FMPC, dated
July 6, 1959, on Eurochemic Technical Documents

TO: E. M. Shank

FROM: F. L. Cuthbert, FMPC

Acknowledgment

The attached comments were given by
FMPC personnel on Eurochemic technical docu-
ments distributed to them for review.

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Report No. 2, "General Safety Factors for a Nuclear Fuel Reprocessing Plant"

The nuclear safety portion of this report is inclined to ignore the factors by which safety limits can be increased. It makes no mention of the control that can be exercised by limiting the assay of the U-235 being processed in the plant. From some of the previous reports, it is apparent that this plant is not anticipating processing U-235 of assay greater than approximately 20%. At this value, many of the numbers that are presented in the tables could be increased markedly. Rough examination indicates that these values all refer to top product U-235. The general discussion is, however, excellent. The references apparently used are those unclassified references with which we are all familiar and think highly of. We would recommend the inclusion of TID-7016.

Radiation shielding does not seem to be adequately treated but this may be subject to later detailed work and design. The safety problems in chemical handlings are lightly covered and emphasize the nitric acid and nitrate oxidizing potentials as regards to explosion hazards.

Report No. 4, "Tail-End Treatments for Uranium and Plutonium Concentration and Purification"

The section on uranyl nitrate conversion is too brief. No evaluation of existing processes has been attempted as was done for other phases of the tail-end treatment. For example, will denitration be accomplished in pot, fluid bed, or stirred bed equipment?

Report No. 5, "Preliminary Draft of Studies on Pilot Plant Extraction"

The solvent washing process to be used is inadequate according to current Hanford experience. Recent unpublished work by J. C. Duckworth indicates that it is necessary to use a carbonate-permanganate scrub followed by a nitric acid wash and another carbonate scrub.

Report No. 8, "Head End Process"

No mention of nuclear safety was noted in the entire discussion. This is certainly a vital part of any such system, even for normal uranium processing if there is any place where plutonium could separate out and accumulate.

Fumeless dissolving should be considerably easier in a continuous system than in a batch system because the gas rates can be held constant in the former. Also, continuous dissolving is better adapted to fuel elements of large surface area in that better control of reaction is achieved, and the hazard of a run-away reaction is greatly reduced.

Sulfuric acid decladding also has the great advantage that materials of construction are more available than for the HF, HCl, and aqua regia system proposed. Also, decladding and dissolution of the core can probably be done in the same tank, and the same tank can also be used for removing zircaloy and stainless-steel cladding.

Sulfuric acid removal of stainless-steel cladding is not limited to UO_2 cores; it will work quite well with U metal cores.

Carbon monoxide may be evolved in the oxalic acid-sodium fluoride removal of zircaloy decladding.

The solid cladding pieces left after dissolving out the uranium could be dissolved instead of being removed mechanically.

There is undoubtedly no real economic incentive for nitric acid recovery on even the largest scale that can be predicted for this type of operation, strictly from the standpoint of purchasing acid. It is undoubtedly desirable to recover the waste acid for other reasons.

Report No. 9, "Cost Estimation for the Extraction Pilot Plant"

The total equipment cost of the extraction pilot plant appears reasonable (\$225,700) and the list of equipment seems to be rather complete. The capacity of the unit appears to be about 2 tons of uranium feed per 7-day week, and the column size would probably permit increasing this by addition of more dissolvers (or continuous dissolution in the existing dissolver) and larger pumps. This "pilot plant" could probably handle the output of two or three low-enrichment-fueled power reactors of economical size.

Report No. 16, "Analytical Procedures for the Eurochemic Reprocessing Plant"

Referring to Procedure 8.1, we doubt that the extraction of uranium could be made without losing micro quantities of contaminants. Rather than to extract the uranium, we prefer to convert the uranyl nitrate solution to U_3O_8 and perform spectrochemical analyses on the U_3O_8 matrix, employing the carrier distillation method of H. R. Mullins and B. F. Scribner, Journal of Research, National Bureau of Standards, 37, 379 (1946). This method is also reported in TID-7003. For the determination of alkali we have found the flame-photometric method, in which no separation of uranium is required, to be very satisfactory. This latter method is reported in NLC0-685, page 181, Technical Summary Report for the Period April 1 to June 30, 1957.

Report No. 21, "Basic Considerations on Instrumentation"

It is hard to understand details of this report; therefore, only general comments can be made.

Some of the sensing elements being installed are similar to those which have given us trouble under similar conditions. Orifice meters for measuring slurry flow rates have never been even reasonably accurate due to erosion of orifices by the slurry. Magnetic induction flowmeters are believed to be highly preferable. Hydrostatic (dip tube) measurement of density in our pulsed extraction columns has not been satisfactory. Gamma ray absorption techniques can be applied quite nicely in this situation.

Close control of the system as designed is contingent upon a very uniform feed with no upsets occurring in the system. Inclusion of computer control will be a step toward solution of this problem, but it is not believed that the sensing elements installed will provide sufficient or fast enough information to achieve tight computer control.

It is felt that continuous recording in analog form of certain variables is desirable so that trends can easily be detected. Whether such provision is included in the final system cannot be determined.

We are working on computer simulation of this process and would like to obtain any information they have on the mathematics of the process.

Report No. 24, "Health Physics Program"

This report presents a well-thought-out program of the administration of Health Physics.

Report No. 25, "Design of Plant for Treating Irradiated Nuclear Fuels - Preliminary Operating Flowsheets"

Nitric Acid Recovery, pp. 12-14, Fig. B-4: Why not use a vapor feed to the fractionator (C-3), thus eliminating all the equipment between C-2 and C-3, also reducing the steam load on E-8?

Report No. 27, "Use of Air Lifts as Metering Apparatus for Radioactive Materials"

Theory and data are taken directly from report by G. W. T. Kearsley (ORNL-2175). This leaves only the test project to

be commented upon. It would seem that it is a logical follow-up to the original project and, without close checking, the equipment appears to be satisfactory.

The following Eurochemic documents were reviewed without comment:

Technical Report Nos. 3, 6, 7, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 22, 29, 30, 31, 32, 33, 34, and Document No. B and ED-C.

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