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Dr. R. A. Staniforth

Trip Report of Dr. R. A. Staniforth and Dr. E. Orban to HRE and ANP Projects at Oak Ridge National Laboratory

Earlier reports this fiscal year have indicated that there would not be a renewal of funds for the Homogeneous Reactor work at Mound Laboratory, but a recent Budget Assumption allowed for $50,000 for 1955. In order to clarify the status of this work and to be brought up to date on the latest developments in the HRE and ANP programs, Dr. R. A. Staniforth and Dr. E. Orban traveled to Oak Ridge to visit the following people from both programs: Dr. J. A. Swartout, Dr. C. H. Secoy, Dr. Arthur Miller, Dr. W. H. Jordan, and Mr. Warren Grimes.

The Homogeneous Reactor Project has made its most radical change in planning as a result of a change in objective of the Atomic Energy Commission. The experimental reactor has been operated to the satisfaction of its directors and is now being dismantled for inspection of its components. A five-year Homogeneous Reactor Development Program was presented to the Atomic Energy Commission during the summer months as document (CF-53-10-222). It consisted of three major phases, the construction of a 5-megawatt reactor (HRT) by July 1955, second, the construction of a 65-megawatt power-breeder pilot plant (TBR) including a chemical processing plant in 5 years; and third, the construction of a full scale 450-megawatt power-breeder reactor (K-23) to feed 140 megawatts of electrical power into the TVA system in eight years. This plan along with budget increases from 4.5×10^6 for F-54 to 6.1×10^6 for F-55 and 7.2×10^6 for F-56 have been approved by the Commission.

New developments in the Weapons Program have increased the interest in low g/T plutonium (low grams of Pu-240 per ton plutonium). Low g/T plutonium is required for low predetonation in thermonuclear weapons. Last month ORNL made an alternate proposal (KA-328) for the development of a $\$48 \times 10^6$ low g/T plutonium producer-power reactor (K-49). The plan calls also for a HRT reactor, but instead of the TBR and K-23 reactors, it would call for a reactor producing 450 megowatts heat and 400 grams per day of 35-50 g/T plutonium. Detailed design would begin in January 1955, construction in January 1956 and operation in January 1958. The cost of 35 g/T of plutonium by this method is estimated to be eventually $20/g while Hanford costs would run as high as $500/g for less pure material.

The latest design of the Homogeneous Reactors calls for the uranyl sulfate fuel solution containing 1.5 g to 5.0 g of uranium per liter of D_2O to be pumped through a central spherical core fabricated of zirconium. The temperature of operation is 300°C at the concentrations mentioned. Surrounding the core will be a blanket layer containing either thorium [probably $Th(NO_3)_4$] dissolved in D_2O (K-23) or 300 grams of uranyl sulfate in D_2O (K-49).

Some of the problems to be solved are, first, the construction of the core from zirconium and a study of the hydrogen embrittlement. Second, could the blanket system be constructed completely of titanium. Estimates for titanium construction run as high as $100/lb. metal installed. Third, what would be the radiation effects on these metals. Fourth, could large components (heat exchangers, pumps, etc.) be designed from these metals, and finally, how would the plutonium be separated continuously from the fuel solution. It appears offhand that the solubility of the PuO_2 produced in the reactor will be low enough to enable the removal of plutonium by either centrifugation or filtration. These methods failing, coprecipitation and adsorption methods will be tried.

The role of Mound Laboratory will be played in one of the three following problems: We will study the high temperature chemistry of the uranium - neptunium - plutonium system (K-49) under the condition of the reactor; or we will make the same study on the thorium - protoactinium - uranium system (K-23); or we will study the solubilities of the fission products at high temperatures. In addition, we may make measurements on the physical properties of high concentrations of uranyl sulfate solutions in heavy water.

At present the most interest exists in the low g/T plutonium reactor, and it is most likely that we will be asked to participate in this portion of the program.

A quarterly visit was made to the ANP group where a discussion was held with Miller, Jordan and Grimes. In Briant's absence it appears that Jordan is moving into the Acting Director's position closely pursued by Miller. Grimes gave a detailed report on the latest thinking indicating a shift back to the $LiF-BeF_2-UF_4$ fuel system from the stand he had last month on the LiF - NaF - KF - UF_4 system. Reasons for this shift were discussed. The ANP Project also submitted a 5-year program for approval by the Atomic Energy Commission. Under this schedule, two years from now the prototype power reactor design will be fixed as will the fuel system. Grimes fears that this program may be accelerated so that he would not have time to investigate thoroughly his fuel system. They hope that at the end of two years we will know the LiF - BeF_2 - UF_4 ternary well enough for them to make some decisions on this fuel. Their current interest is in the solution of UF_3 in fused salts because UF_3 gives a good corrosion picture.

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