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For The Atomic Energy Commission

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Chief, Declassification Branch

Distribution

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HRR FUEL ENRICHMENT

An initial fuel enrichment of about 8% will be necessary if the HRR is to go critical with a fuel concentration of 10 gm/liter at an operating temperature of 250°C and 10% poisons. This corresponds to a U-235 concentration of 0.8 gm/liter. Under the same conditions, but with a fuel concentration of 5 gm/liter, a U-235 concentration of 0.77 gm/liter and a fuel enrichment of about 15.4% would be required. With fully enriched uranium, and the above temperature and poison conditions, a U-235 concentration of only 0.645 gm/liter would be needed.

On the basis of a fuel enrichment of 8%, the required U-235 concentration for criticality at 20°C, 100°C, and 200°C with 10% poisons is about 0.36 gm/liter, 0.46 gm/liter, and 0.633 gm/liter, respectively. The total uranium concentration would be 4.55 gm/liter at 20°C; 5.8 gm/liter at 100°C; and 7.9 gm/liter at 200°C. If the fuel solution at 250°C is cooled to these temperatures without dilution, U-235 concentrations of about 0.99 gm/liter at 20°C; 0.96 gm/liter at 100°C; and 0.86 gm/liter at 200°C would result.

Use of 8% enriched uranium, as compared to fully enriched uranium, reduces the thermal flux by about 20%. The addition of a compound such as lithium sulfate, however, may suppress uranium precipitation at low uranium concentrations. A study of this effect is to be made this summer* using Li_2SO_4 and BeSO_4 as additives. Increasing the fuel enrichment would reduce the amount of U-235 required and hence increase the thermal neutron flux.

With a fuel enrichment of 8% an initial conversion ratio of about 0.25 may be expected. The plutonium thus formed would tend to increase the thermal flux if it could be retained in solution.

* H. F. McDuffie - personal communication

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