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TITLE: Description and Performance of Uranium Beams Used to Generate Tritium-Deuterium at the Tritium Systems Test Assembly*

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Description and Performance of Uranium Beds Used to Getter
Tritium-Deuterium at the Tritium Systems Test Assembly*

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The Tritium Systems Test Assembly, (TSTA), a full size simulation of the fuel loop for a fusion reactor, will circulate 360 g mol/day (1800 g) of DT and will have an inventory of 150 g of tritium. During shutdown, a safe storage system for hydrogen isotopes, primarily DT, is needed. Uranium reacts readily with hydrogen, deuterium or tritium at room temperatures to form $U(H,D,T)_3$ having a dissociation pressure of approximately 10^{-4} torr. Upon heating to 720 K, the isotopes will desorb at pressures of one to two atmospheres. Uranium beds were selected as the means for long-term storage of the fuel loop inventory.

To design uranium beds for tritium use, several goals were established. The containment must be high integrity and redundant; capacity and rate must be sufficient for convenient off-loading and heaters, controllers and other components must fail in a safe mode. Figure 1 shows the primary container, full diameter filters and the egg crate inserts (used to maintain uniform distribution). Stainless steel was selected for the primary container and was subjected to multiple thermal/leak check cycles prior to hydriding. A vacuum jacket encloses the primary container providing thermal insulation as well as secondary containment. Uranium content of the five beds used at TSTA is sufficient to pump the entire fuel loop inventory at 40% stoichiometry. Forty

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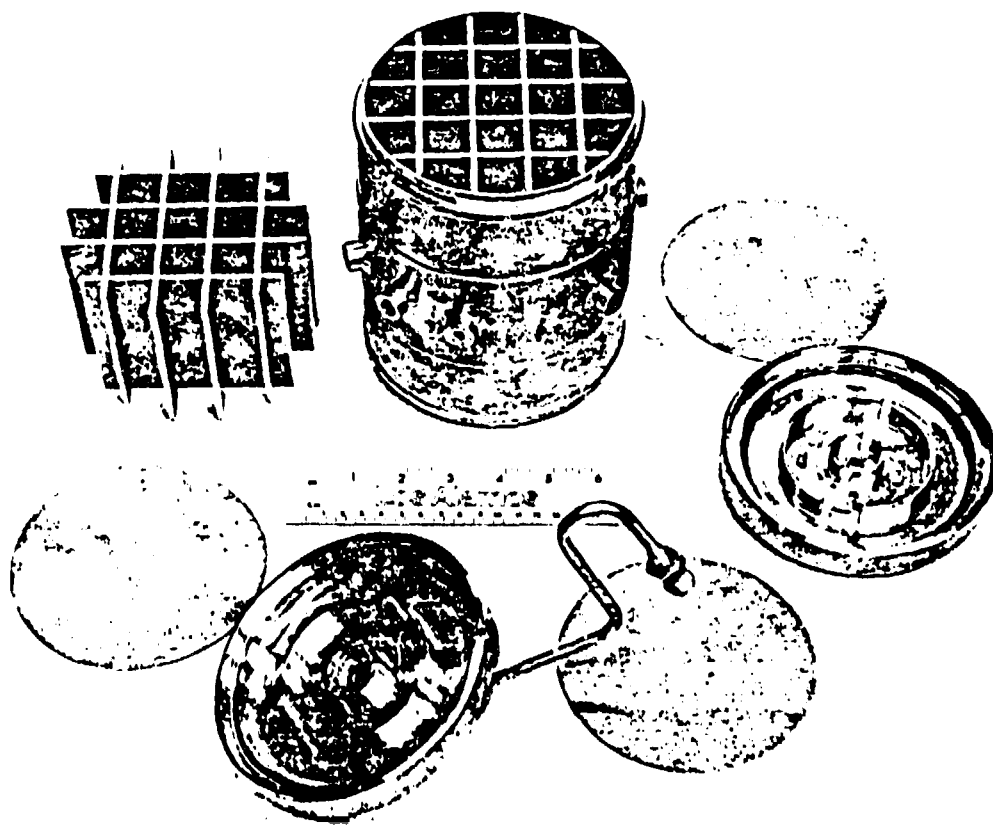


Fig. 1. Primary Container Components.

percent represents a compromise between minimizing bed weight and maximizing pumping speed; a compromise which is satisfactory for TSTA purposes as described below. Failure of any of the control components of the uranium bed storage system will not result in an unsafe condition. This is due the sizing of the dehydrating heater which, at full line voltage, is only capable of heating the bed to 770 K. Valve, temperature transducer or controller malfunction can, at worst, cause dissociation pressures of three atmospheres in the primary container. Failure of the vacuum system will result in increased heat loss and lower temperatures and pressures.

The first of five uranium beds was assembled and hydrided in June 1983. Figure 2 shows the pumping speed for the second thru fifth hydridings. The first hydration was accomplished by heating the bed to dehydration temperature and allowing the bed to cool passively for several days while the uranium was opened to a deuterium-filled tank. The second hydration was performed with the bed initially at room temperature and the vacuum jacket pressurized with helium. The uranium bed emptied the 265 liter supply tank several times starting at approximately 930 torr and being refilled when the pressure dropped to about 200 torr. Runs 3 and 4 were similar except that the supply tank volume was doubled, allowing the bed to be loaded fully without interruption. Run 5 was the same as runs 3 and 4 except that the vac jacket was evacuated.

These data indicate that the TSTA can be off-loaded into safe long-term storage in approximately ten minutes. Dehydrating the beds, starting at room temperature, requires 8-10 hours with the present heater size.

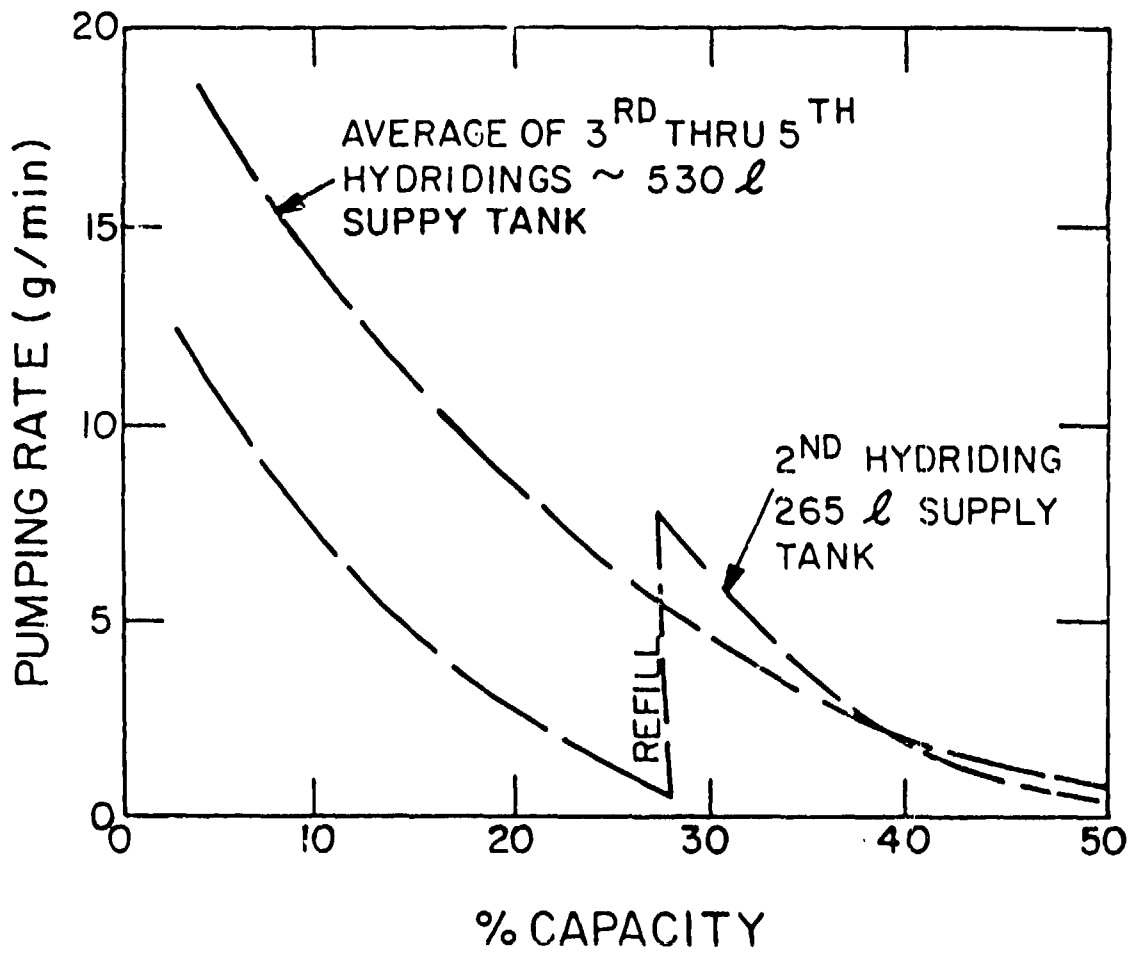


Fig. 2. Speed vs Percent Capacity