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P4.187 Tritium operations at the Laboratory for Laser Energetics

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The Laboratory for Laser Energetics (LLE) at the University of Rochester supports a 35 kJ, direct-drive, laser to compress DT ice to study inertial confinement fusion physics. One millimeter diameter, hollow, 6 to 10 micron-thick wall, plastic spheres are charged with deuterium-tritium (DT) gas mixtures up to several hundred atmospheres. These targets are cooled to cryogenic temperatures in a controlled manner to form single-crystal DT ice layers on the inner surface of the spheres. The DT targets are compressed under vacuum and cryogenic conditions by direct, uniform illumination with 60 beams of 351 nm laser light to achieve pressures in the several tens of gigabar range.

Filling the targets is a multistep process. Tritium is released from uranium storage bed and assayed to verify the working inventory. The gas is then compressed cryogenically and passed through a palladium purifier to remove decay helium-3 and tritium-beta generated impurities arising from tritium interaction with the stainless steel process lines. The purified gas is collected and compressed first cryogenically once again to approximately 100 bar and then mechanically to several hundreds of bar before the cooling process is initiated. The targets are filled by permeation through the thin wall spheres so the mechanical compression to the final pressure is slow to ensure the targets are not crushed in the process. Unused tritium is returned to the uranium storage beds.

The tritium inventory at LLE is limited to 1.5 g by New York State regulators. Emissions to the environment can not exceed 260 GBq annually. Several tritium capture technologies are deployed to intercept any tritium that has leaked or outgassed from the process systems. This presentation will outline the target filling process and discuss the technologies that are used to prevent tritium from being released to the environment.

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