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Construction, Startup and Initial Operation of Ignition Fusion Target Tritium Fill Systems at LLNL

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A specialized tritium handling capability has been constructed in Building 331 at LLNL (the LLNL Tritium Facility) to assist with the preparation of targets for the National Ignition Facility (NIF). This capability is provided primarily through the operation of three major new work stations, the Tritium Science Station (TSS), the Tritium Processing Station (TPS) and a High Resolution Mass Spectrometer. This paper briefly describes the design philosophy, regulatory environment and construction and startup processes for each of these stations before moving on to current operations and long term NIF support.

The NIF is a large laser facility sited at LLNL and designed to achieve fusion ignition in 2010. NIF ignition targets contain high purity deuterium-tritium (DT) ice. Demanding purity requirements for very low protium (H), He-3 and other contaminants are challenging to achieve and accurately measure. A similar challenge is presented by non-ignition tritium targets; the majority of which contain a tritium heavy mix of tritium, protium and deuterium. A typical gas mixture for these intentionally low yield "THD" targets is in the ratio 74/24/2 for T/H/D. For THD targets, the primary emphasis is on accurately characterizing the deuterium component as this directly affects a shot's maximum neutron yield.

For TSS and TPS, tritium and standard mixes of protium/tritium or deuterium/tritium are stored on uranium beds for chemical purification and delivered from palladium beds, which act to remove ^{3}He and generate pressure. Demand for non-standard mixes is common and is achieved by direct pressure/volume additions to a specially designed "mix manifold," described in a companion paper at this conference.

Accurate isotopic and chemical analysis is critical and is achieved through use of a dedicated Finnegan's (Thermo Fisher Scientific) MAT- 271 Mass Spectrometer, equipped with modern electronics and improved through selective automation of routine, repetitive tasks. These features are described in the context of current performance.

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