Contribution ID: **21** Type: **Oral**

Radiation Safety Design for the North Pole Neutron Time-of-Flight System at the NIF

Monday 5 June 2017 12:20 (20 minutes)

The National Ignition Facility (NIF) at Lawrence Livermore National Laboratory is the world's largest and most powerful laser system for inertial confinement fusion. During the ignition campaign, the NIF is expected to generate shots with varying fusion yield (up to 20 MJ or 7.1e18 neutrons per shot). Neutron time of flight (nTOF) detectors are fielded in the NIF to measure neutron yield, ion temperature, and downscattering in the cold fuel for D-T implosions. A collimated nTOF line-of-sight (LOS) has been fielded near the Target Chamber (TC) North Pole to examine any possible anisotropy in the cold fuel. A fast scintillator is placed inside a diagnostics hut located above the roof of the Target Bay (TB). The scintillator is located at 21.6 m from the Target Chamber Center (TCC). The line-of-sight passes through the TC, the 60.96-cm-thick concrete 69'9"TB floor and the 76.2-cm-thick concrete TB roof. Radiation streaming through the LOS represented a potential radiation hazard if personnel were accidentally present on the 69'9"floor or on the top of the TB roof. The potential hazard at these two locations is caused by radiation streaming through a 30.48-cm-diameter hole in the 69'9"concrete floor and the TB roof. Additional potential hazard to personnel present on the roof during a shot is caused by radiation scattering off the scintillator. The un-scattered radiation is eventually intercepted by a beam dump made of 45.72-cm-thick iron followed by 30.48-cm-thick concrete. The front surface of the beam dump is located at 23.85 m from TCC. The beam dump is designed to fully intercept the radiation and eliminate skyshine hazard due to neutrons passing through the LOS and interacting with the surrounding air. A detailed MCNP model of the TB is used to estimate dose values at the previously identified locations of concern during shots. Before adding the new LOS, the area above the 69'9"floor wasn't normally accessed or swept before low yield shots (< 1e16 neutrons) due to expected low dose values. The MCNP simulation indicated that adding the LOS will result in a maximum effective dose of 2 mSv on the 69'9"floor during 1e16 shot. Following construction of the LOS, the 69'9"TB floor is routinely swept and no access is allowed during all shots. Similar analysis showed that radiation scattering off the scintillator resulted in higher dose values inside the diagnostics hut. A maximum effective dose value of 3 mSv is expected outside the hut during a 20 MJ shot. Currently, no access is allowed inside the hut during all shots, and access control of the TB roof is required for shots with yield above 1e16 neutrons. Finally, in addition to reducing the skyshine dose, the beam dump effectively eliminated any potential hazard to planes flying over the facility. In conclusion, contribution of the new North Pole nTOF system to dose outside the facility and near the site boundary is negligible.

*This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Eligible for student paper award?

No

Author: Dr KHATER, Hesham (Lawrence Livermore National Laboratory)

Presenter: Dr KHATER, Hesham (Lawrence Livermore National Laboratory)

Session Classification: M.OA3: Inertial Fusion Engineering and Alternate Concepts

Track Classification: Safety and environment