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NEUTRON SKYSHINE CONSIDERATIONS FOR THE NIF SHIELDING DESIGN*

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A series of coupled neutron-photon transport Monte-Carlo calculations was performed to estimate the roof shielding required to limit the skyshine dose to less than 1 mrem/y at the site boundary when conducting DT experiments with annual fusion yields up to 1200 MJ (4.2E20 neutrons/y). The NIF shielding design consists of many different components. The basic components include 10-cm-thick Al chamber with 40-cm-thick target chamber gunite shield having multiple penetrations, 1.83-m-thick concrete Target Bay walls, 1.37-m-thick concrete roof, and multiple concrete floors with numerous penetrations. Under this shielding configuration, the skyshine dose at the nearest site-boundary was calculated to be less than 0.2 mrem/y for all possible target illumination configurations. The potential dose at the site boundary would be about one-tenth of the cosmic neutron dose that we measured with bubble neutron detectors on board a commercial roundtrip flight from SF to Rochester. This incremental dose increase is well within the normal fluctuations (noise) of the natural background radiation in the Livermore area. The skyshine dose has no impact on the public. The skyshine dose trends at ground and elevated levels are plotted as a function of distance from 20 m to 1000 m from the center of the target bay. The differential neutron and photon energy flux emerging from the NIF roof and at several locations on the ground is plotted to show how it shifts with distance. The results of this study are compared with the neutron skyshine studies done at high-energy accelerators by R. H. Thomas. *(This work was performed under the auspices of the U. S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.)

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