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Fast Neutron Beam Line at The Ohio State University Research Reactor

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The Ohio State University Research Reactor (OSURR) is a pool type, light water moderated, uranium silicide fueled research reactor licensed for steady-state operating powers up to 500kWth. It provides a variety of functional testing facilities including near-core and in-core irradiation locations. A thermal neutron beam facility is available at OSURR, providing a small neutron beam (30 mm diameter) to a working bench where various device testing can be set up for neutron radiograph, tomography, or device evaluation. The size of the neutron beam can be refined to mm level with neutron apertures, which enables electrical characterization and functional testing of devices during spatially controlled neutron irradiation. Although it is designed as a thermal beam, the residual 1-MeV fast neutron flux is still at 104 cm-2s-1, which has been used to evaluate fast neutron scintillators developed by Lawrence Livermore National Lab. To meet the increasing demands for fast neutron imaging applications, we have built a dedicated fast neutron beam line that consist of two collimators for shaping the neutron beam, a beam shutter for switching the beam on/off, and a beam-stop for reducing the dose rate in the environment. The 58" (147.3 cm) long collimation features a 6" (15.24 cm) thick graphite block with an aperture of 40 mm and a 4" (10.16 mm) thick solid polycrystalline bismuth, which are positioned near the core for slowing down neutrons and filtering gamma-rays, respectively. A cylindrically shaped beam shutter located between the two collimators utilizes high-density polyethylene and lead to attenuate fast neutrons and gamma rays, respectively. The collimators accommodate several lead, borated aluminum and borated polyethylene blocks with same aperture size but varying thicknesses to shape the 40-mm diameter beam. An MCNP simulation executed with 2.0 MeV neutrons with the beam shutter open, estimated a neutron flux of ~1.8×108 neutrons/cm2s at the exit of the collimator. Furthermore, calculations revealed that the gamma ray content in the beam is reduced to less than 0.01 % of its near core value. The project is at the final testing stage and the fast neuron energy spectrum is being measured with foils activation method, unfolded by STAYSL code and a Bonner sphere neutron spectrometer.

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