Comparison between the source terms used in SHIELD11 and the source terms calculated by FLUKA

X. S. Mao (650-926-4317), W. R. Nelson and A. A. Prinz
Stanford Linear Accelerator Center
2575 Sand Hill Road, Menlo Park, CA 94025, USA

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SHIELD11 is an analytical code for performing shielding calculations used at SLAC. It uses simple analytic expressions for the production and attenuation of photons and neutrons resulting from electron beams striking thick targets. SHIELD11 code is based on five-component model: Direct Gamma, Indirect Gamma, Giant-Resonance Neutron (GRN), Mid-Energy Neutron (20 MeV - 100 MeV), High-Energy Neutron (> 100 MeV). FLUKA Monte Carlo code was used to study direct gamma and three neutron components used in SHIELD11.

Photon absorbed dose rate from a thick iron target was measured by D. A. G. Neet at SLAC in 1965. In Neet's experiment, a 990-MeV and 10-Watt beam hit an iron target with radius of 3" and length of 15". The dose was measured using an air ionization chamber with thin aluminum walls (ZEUS). We simulated the energy deposition on the air ionization chamber using FLUKA. The energy deposition was converted to absorbed dose. The measurements and FLUKA calculations agree within ± 30%. The measurements and SHIELD11 calculations agree within ± 50%, except in the 0-degree direction. SHIELD11 underestimates the dose rate in the 0-degree direction by 60%.

FLUKA was used to score the neutron yields using a 10-GeV electron beam to hit thick targets (Al, Fe, Sb, Pb). Total neutron yields produced from the targets were divided into two energy ranges: from 20 MeV to 100 MeV and greater than 100 MeV. SHIELD11 overestimated the GRN, Mid, and High neutron yield by a factor of three, six and two respectively. The neutron yields per steradian produced from the iron target as a function of the angle were presented. The high-energy neutron yield per steradian in lateral direction agreed within ± 10% between the SHIELD11 and FLUKA calculations.

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* W. R. Nelson - Department Associate in the Radiation Physics Group (retired)