IRPA9
1996 International Congress on Radiation Protection
April 14-19,1996
Vienna, Austria

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PAPER TITLE Multisphere Neutron Spectrometry Measurements In A High Energy Neutron Beam

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MAJOR SCIENTIFIC TOPIC NUMBER 5.5 ..... (see page 7)

ABSTRACT (See instructions overleaf)

The multisphere neutron spectrometer detectors (commonly referred to as Bonner Spheres), augmented with threshold neutron detectors, were exposed to well characterized beams of neutrons generated by striking either a thick tungsten target with a beam of 800 MeV protons or a thin lithium target with 800 MeV protons at the Los Alamos Weapons Neutron Research facility. The experiments were performed in the 15° flight path from the tungsten target and in the 0° flight path from the lithium target. The purpose of these experiments was to compare the neutron energy spectra determined from unfolding the sphere and threshold detector data with the energy spectra determined by time of flight measurements for the neutron beam. The Bonner sphere set, including 5.08cm, 7.62cm, 12.70cm, 20.32cm, 25.40cm, 30.48cm, and 45.72cm diameter moderators, plus a Bare and a Cd covered detector was augmented with a $^{12}C(n,2n)^{11}$ threshold detector and a Bismuth fission counter to provide data for the energy regions above 20 and 50 MeV respectively. Paired sets of ^{6}LiF and ^{7}LiF TLD chips were used as the neutron sensitive elements at the center of the moderator spheres. Several different average energy neutron beams were obtained from the tungsten target by inserting various thickness of polyethylene filters in the beam upstream of the detector location. The integrated beam intensity during each exposure was monitored by a small plastic scintillation counter inserted in the beam, which provided a count proportional to the dose equivalent, calculated for each filter thickness. The average energies for the beam spectra from the tungsten target ranged up to approximately 400 MeV, and peaked near 800 MeV from the lithium target. The data from the detectors larger than the beam diameter were corrected using Monte Carlo calculations. The corrected data were analyzed using four different spectrum unfolding computer codes to determine which technique would give the best results, ie. the best match with the time of flight measurements. The results indicated that all of the unfolding codes were reasonably good in determining the gross neutron field parameters of dose, dose equivalent, and average energy. The conclusion can be made that the multi-detector neutron spectrometer will give sufficiently accurate spectral information for neutron energies up to 800 MeV for dosimetry and shielding evaluation purposes.