Dose distribution in a human phantom onboard aircraft

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The exposure of aircrew personnel to cosmic radiation has been considered as occupational exposure in the European Union since the European Council Directive 96/29/EURATOM became effective on May 13, 1996. In Germany the corresponding safety standards for aircrew, which include dose assessment among other things, are regulated by the German Radiation Protection Ordinance, which implemented the European law and was amended in 2001. The radiation exposure of most German aircrew is calculated by the DLR, Institute of Aerospace Medicine in Cologne, applying the calculation program EPCARD in the framework of the aircrew dose determination system CALVADOS (CALculated and Verified Aviation DOSimetry).

Beside the operational dose calculations DLR performs measuring flights applying active (e.g. TEPC, DOSTEL, etc.) and passive (TLDs, bubble detectors) radiation detectors to verify the calculation codes. Within these activities the project BODO (BOdy DOsimetry) comprised a long term exposure of a RANDO© anthropomorphic phantom to measure for the first time the skin and the depth dose distribution inside a simulated human torso at aviation altitudes. The torso was flown for three months from mid of July to mid of October 2004 onboard a Lufthansa Cargo aircraft. This torso made up of 27 polyurethane slices with different densities – simulating tissue and organs – was equipped with passive thermoluminescence detectors TLDs of different types, namely TLD 600 (^{6}LiF:Mg, Ti), TLD 700 (^{7}LiF: Mg, Ti) and TLD 700H (^{7}LiF: Mg, Cu, P). The over 800 TLDs were positioned in 3 of the 27 slices, in the head, the thorax and the abdomen of the torso. In addition dosemeter packages were distributed on the surface of the torso to measure the skin dose. First results indicate a high contribution of thermal and epithermal neutrons – derived by the so called pair method using TLD 600 and TLD 700 – as well as a statistically significant dose gradient in the slices due to the installation of the phantom (lying on its back) in a Cargo compartment.