Estimation of biological protection parameters of electron-beam vacuum furnace

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The All-Russia Electrotechnical Institute (VEI, the RFNC-VNIITF branch) has developed electron-beam vacuum furnaces for ultra-clean metal remelting, including refractory metals such as tungsten, niobium, and molybdenum. In these facilities an electron beam with energy of more than 10 keV is used to heat an object by energy release of electrons directly within the heated object bypassing crucibles and other devices. Such approach ensures a number of advantages such as the absence of contamination and metal oxidation in vacuum, ease of control and process automation, and a wide range of effects on the object being processed. However, the interaction of electron beam with such energies is accompanied by the release of x-rays from the irradiated material, which imposes additional requirements to the facility operation, i.e., the use of x-ray protective shields is required.

In accordance with radiation safety standards NRB-99, radiation safety justification is required when preparing design documentation for such facilities. It is necessary to use the first class of standards containing the values of the basic dose limits for man-made radiation under controlled conditions excluding doses from natural and medical sources.

In the present work, the PRIZMA code is used to estimate the x-ray radiation yield from a tungsten target imitating a smelted ingot. Also this code is used to estimate the attenuation of x-ray radiation in different materials depending on their thickness.