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Low Energy Electron Beam as a Gateway to Machine Sources of Irradiation to Reduce Reliance on Isotope-Based Radiation Technologies

While Cobalt-60 and Cesium-137 have typically been used to irradiate materials for both research and industrial sterilization, the Office of Radiological Security (ORS) and its partners are investigating the viability of electron beam for various applications to reduce this radio isotopic footprint and improve global radiological security. Advantages of electron beam irradiation include lower capital costs than isotope-based technologies, , the ability to turn on and off the machined source, the ability to deliver highly customized doses for specific applications, and the possibility of harnessing various e-beam energies for different applications. Currently, electron beam systems greater than 1 MeV require customized shielding and capital expenditure greater than $ 1 million for turnkey systems. Low energy e-beam systems (80 keV –300 keV) allow for shelf-shielding and the possibility of in-line use in industrial processing. Today, low energy e-beam systems are in commercial use for polymer crosslinking, grafting, curing of printing inks, sterilization of aseptic food packaging, surface disinfection of eggs and seeds, and spice disinfection, etc. Greater availability of low energy e-beam technologies will catalyze research and development in the adoption of low-energy e-beam technology. Increased familiarity with low-energy e-beam technology can lead to greater interest and possible adoption of medium (1 MeV –5 MeV) and high energy (7 MeV –10MeV) e-beam technology. There is an expanding interest in polymer modifications and other surface treatment processes in many regions of the world especially in the emerging markets in Latin America and Asia. Low energy e-beam technology is ideally suited for these applications. Presently, government programs provide cesium-137 irradiation users a financial incentive to switch to x-ray technology. The underlying hypothesis is that easy access to low energy electron beam technology by researchers can stimulate research and development programs in emerging countries in electron beam technology that in turn, can accelerate the transition away from cobalt-60 or cesium-137 technologies. This transition to machined sources such as electron beam will ultimately facilitate reduction of the risk while still maintaining current and in some enhances enhanced irradiation capabilities.

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