

New version of PUFFIn software that allows quick beam quality and biological specimen dose distribution information for cabinet irradiators

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For decades, radiation biology researchers have utilized Cesium-137 based irradiators for irradiation of their biological specimens. Due to stricter regulations and increasing costs associated with radionuclide irradiators within the last decade, many institutions are transitioning from these Cs-137 irradiators to X-ray based irradiators. For many of the applications within the radiation biology research community, the best alternative to the Cs-137 irradiators are the cabinet X-ray irradiators providing orthovoltage-level energies (maximum energies ranging from approximately 160-320 keV).

The main complications or issues new users experience with these X-ray irradiators are the differences between their old Cs-137 irradiator and the new X-ray irradiator in terms of 1) The dose distribution within specimens for a given calibrated Gy/min in air, and 2) the difference in biological response for specimens for a given delivered Gy. Many of these researchers are finding that their new X-ray irradiator allows them to perform studies that are very difficult using Cs-137 irradiators.

The difference in specimen dose distribution between Cs-137 and X-ray irradiators can either be measured (by placing small format dosimeters within these specimens or adequate surrogates) or calculated (using Monte Carlo dose simulation software tools). However, many of these facilities or institutions do not have the required dosimetry or software tools, nor the expertise to use them. Pacific Northwest National Laboratory (PNNL) has identified that a significant tool gap within the radiation biology research community is a dose distribution software tool that is simple to use, ultra-fast processing times, can be run on a regular laptop, and novices can learn and use with minimal training. Therefore, with funding from the Office of Radiological Security (ORS) within the National Nuclear Security Administration (NNSA), PNNL researchers are developing such a software tool, which is a revision of the existing PUFFIn dose distribution software tool currently used in the radiation processing industry for sterilized medical devices and agricultural products.

This presentation will describe and demonstrate the prototype PUFFIn-X software for the simulation of the X-ray spectrum within these commercial X-ray irradiators, and the dose distribution within typical specimens involved with radiation biology research.