

Development of educational courses on basic dosimetry and proper irradiation protocols for users and calibrators of x-ray cabinet irradiators

Mark Murphy¹, Maddison Rex¹, Larry DeWerd², Keith Kunugi², Randy Kimple²,
Colin Hill³, Yannick Poirier⁴, Julian Down⁵

¹*Pacific Northwest National Laboratory, Richland, WA, 99354*

²*University of Wisconsin, Madison, WI, 53705*

³*University of Southern California, Los Angeles, CA, 90033*

⁴*University of Maryland, Baltimore, MD, 21201*

⁵*Massachusetts Institute of Technology, Cambridge, MA, 02139*

Radiation biology studies often depend on establishing the relationship between delivered radiation absorbed dose and the magnitude of particular radiation-induced biological endpoint(s). This requires standardization of irradiation protocols and biological measurement aspects to ensure reproducible studies whose conclusions have a high degree of confidence. Published studies, including a 2014 Nature article authored by the Director and Deputy Director of the NIH, indicate that for decades a significant percentage of biology research studies have been poorly conducted and/or reported, leading to a significant lack of reproducibility. The poor quality of radiation biology studies can be attributed to a lack of standardization in the collection and analysis of dosimetric and biological data, and insufficient detail in the following publications exacerbates the issue. This lack of standardization negatively impacts radiobiology research and subsequent clinical studies in terms of increased costs and clinical translation. A study of recent dosimetry intercomparisons among radiation biology research institutions indicate errors in dose delivery to specimens commonly range from 10% to 20%, and can even reach 25%. These dose delivery errors have multiple causes, most notably insufficient education in basic dosimetry for users of X-ray and gamma-ray irradiators, incorrect measurements or inaccurate information, and the absence of proper irradiation protocols. As increasing numbers of researchers transition from Cs-137 to more complex X-ray irradiators, these reproducibility challenges are expected to increase. In early FY24, the Office of Radiological Security (ORS) within the National Nuclear Security Administration (NNSA) funded a team of subject matter experts to identify the issues or gaps contributing to this lack of standardization. The team concluded that the most critical gap is inadequate education in basic dosimetry and proper irradiation protocols for users of self-shielded (cabinet) X-ray irradiators, prompting them to form a Working Group to develop educational courses in these areas. This presentation will describe the scope of the course content, the target audiences, and the strategy for ensuring effective implementation.