Refurbishment of Co-60 Source in Penn State Gamma Irradiator

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ABSTRACT:

The Pennsylvania State University Radiation Science and Engineering Laboratory is the home of a gamma irradiation facility consisting of cobalt-60 pins in a large pool of deionized water. The irradiator has been extensively used for a variety of projects for the past forty years, but the source material has decayed through many half-lives, reducing the dose rate delivered to the samples by a factor of approximately four hundred. The objective of this project is to procure and install a quantity of ^{60}Co sufficient to allow irradiation dose rates up to 2 Mrads / hour (quantity of ^{60}Co withheld for safeguards purposes), or >100 krad/ hour at the end of an additional twenty years of use. The new cobalt pencils will be loaded into the source holder, which has already been characterized and used for past irradiations. This irradiator will then be usable to deliver doses of up to hundreds of megarads over a several day-long irradiation. The depleted pencils will be transferred to a secondary, low-dose irradiator in order to facilitate lower-dose irradiations (hundreds of rads to hundreds of kilorads) for which the upgraded source activity is too strong. The radiation dose delivered in the irradiation chamber of each irradiator will be confirmed via dosimetry. Two new capabilities will be enabled by the stronger source. Beam port radiography using a single pin, especially a pin oriented coaxially with the beam port, will provide for greatly improved gamma radiographs, which is a specific capability requested by an on-campus researcher. The stronger source pencils will also allow for the development of new source-sample geometries. For example, a planar source geometry with a movable rotating sample holder would allow for a customizable dose rate for samples that are sensitive to dose rate as well as total dose.