Differences in Efficiencies for I-125 and I-129

by Dru Carson, 22 October 2010

Ludlum Measurements, Inc. uses I-129 to ensure that our low energy gamma scintillators detect low gamma energies in accordance with our specifications. We chose I-129 because it has a long half-life of 15.7 million years while I-125 has a relatively short half-life of 60 days. In the medical physics market, I-125 is a radioisotope of iodine which has uses in biological assays, nuclear medicine imaging, and in radiation therapy as brachytherapy to treat prostate cancer and brain tumors.

Using I-129 to determine the optimum high voltage setting is acceptable because the energies of I-125 and I-129 are very similar. There is a misconception that the stated efficiency for I-129 is the same as the efficiency for I-125. There are important differences why this should not be done.

The numbers of photons emitted per nuclear transformation from the two isotopes are different. Below is a chart of the energy and probability of an emission of a photon with a specific energy with each transformation (i.e. disintegration).

Photon Emission Products: I-125		**Photon Emission Products: I-129**	
Energy(keV)	Fraction	Energy(keV)	Fraction
3.770	15.4%	4.110	8.2%
27.202	39.2%	29.458	20%
27.472	73.2%	29.779	37%
31.000	25.4%	33.600	13.2%
35.492	6.4%	39.581	7.5%

We can ignore the 3.77 keV from I-125 and 4.11 keV from I-129 because they are so weak that they are essentially undetectable. So, you end up with about 86% more photons per transformation with I-125 than I-129. Therefore, the efficiency for I-129 can be multiplied by 1.86 to approximate the efficiency of I-125:

Model 44-3 I-125 efficiency is 33% based on I-129 efficiency of 18%
Model 44-17 I-125 efficiency is 38% based on I-129 efficiency of 22%

Ludlum Measurements acquired an I-125 source and obtained the following data that seems to confirm this correction factor:

Predicted vs. Actual 4 pi Efficiencies

Detector Model No	I-125 Predicted Efficiency	I-125 Actual Efficiency
44-3	33.5%	34.5%
44-17	41%	40%