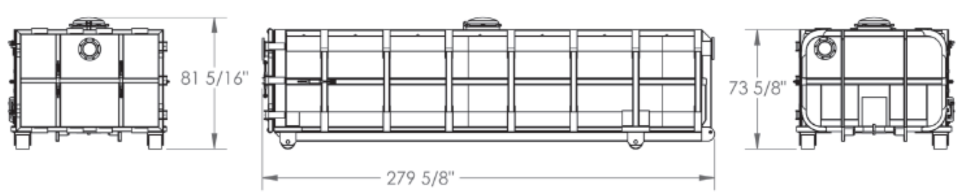
Application Review

Customer: Kevin Kosko
Company: Austin Master Services
Application : TENORM in the oilfield sludge

[Disclaimer: All results discussed here are for consideration of relative performance between different detectors, and the actual count times may vary depending on the final detector/sample configuration and actual background conditions. The results should not be considered as guaranteed performance specifications.]

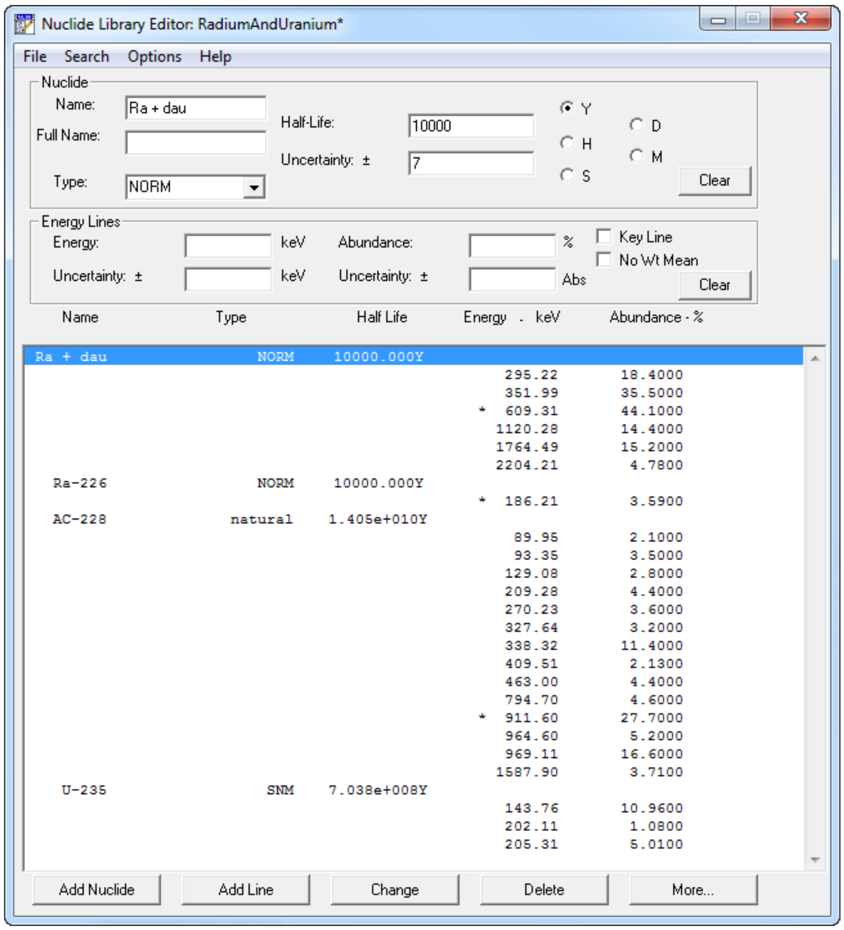
Assumptions

- Detector = BE5030 with ISOCS Cart/Shield
- Sample Data (as measured)
  - Oilfield sludge
    - Density = 1.6 g/cc
- Measurement Geometries Under Consideration
  - M1. 25 yard vacuum Box
    - 7 gauge Steel top (0.1793")
    - .25" steel bottom



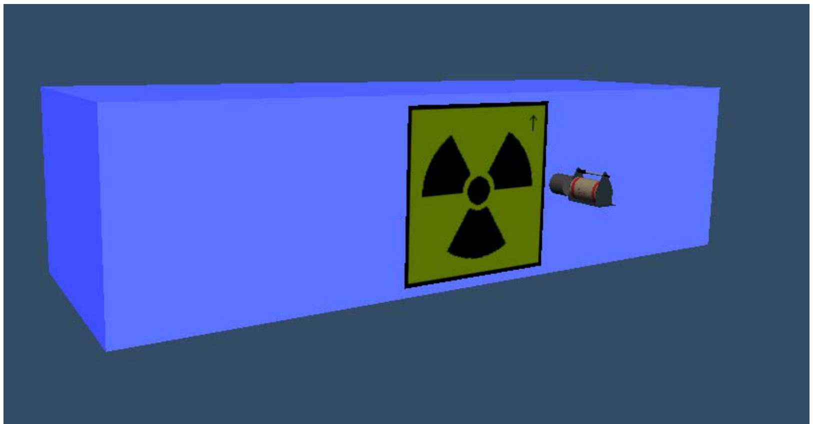
  - M2. 500 g 4" bottle in ISOCS Shield

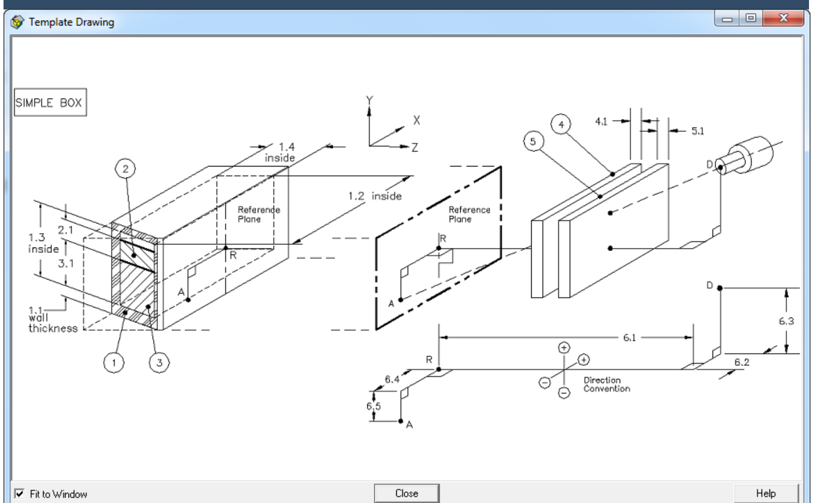
- Radionuclides of interest (analysis library below)
  - o Ra-226 + daughters in equilibrium
  - o Ra-226 directly from the 186 keV gamma line (assuming no U-235)
  - o Ra-226 directly from the 186 keV gamma line with interference correction of U-235.
  - o Ra-228 indirectly determined from Ac-228 911 keV gamma line.

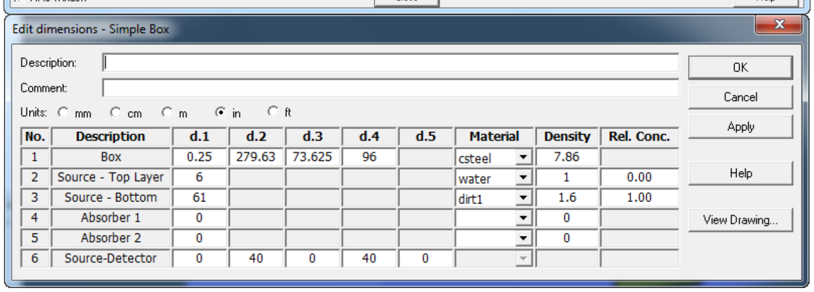


Application

Create efficiency calibration data estimates for one detector (BE5030) in two measurement geometries. The efficiency estimates are calculated with CANBERRA's ISOCS software using the cylinder template for the 0.5L bottle and the simple box template for the 25 yard container. While the 0.5L bottle is very straight forward, a number of assumptions were made in modeling the container. The container was modeled with uniform soil at 1.6 g/cc. This was followed by a 6" layer of water and finally a 6" air gap at the top of the container. The wall of the container was 0.25" carbon steel.







Edit dimensions - Simple Box

Description:

Comment:

Units: mm cm m in ft

No.	Description	d.1	d.2	d.3	d.4	d.5	Material	Density	Rel. Conc.
1	Box	0.25	279.63	73.625	96		csteel	7.86	
2	Source - Top Layer	6					water	1	0.00
3	Source - Bottom	61					dirt1	1.6	1.00
4	Absorber 1	0						0	
5	Absorber 2	0						0	
6	Source-Detector	0	40	0	40	0			

OK

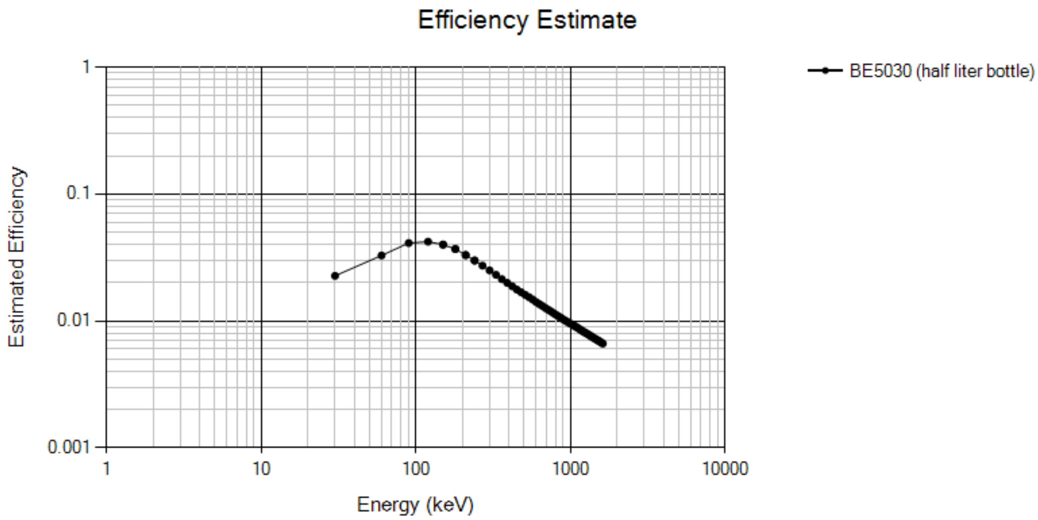
Cancel

Apply

Help

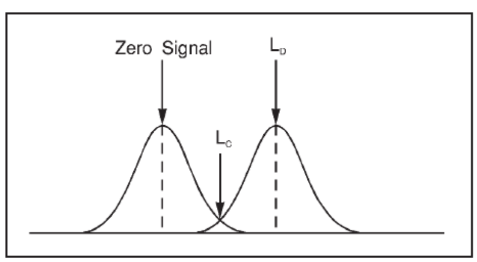
View Drawing...

Efficiency Estimates



MDA Estimates

The minimum detectable activity is computed via the Currie formula (shown below). Currie's method is based on two important concepts: a Critical Level, L_C, below which a net signal cannot reliably be detected, and a Detection Limit, L_D, the smallest net signal that can reliably be quantified.

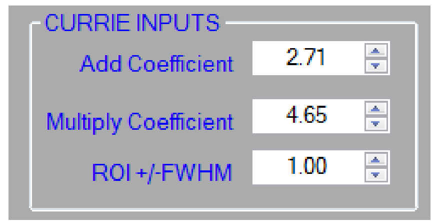


Illustrating the L_C and L_D Concepts

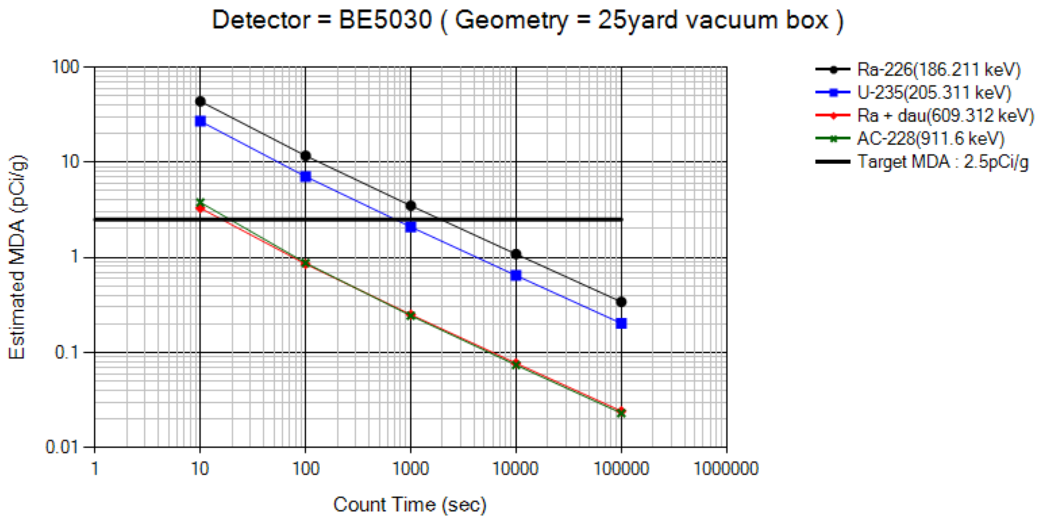
For gamma spectroscopy applications with no interfering gamma lines, the Curie formula can be approximated by the following equation.

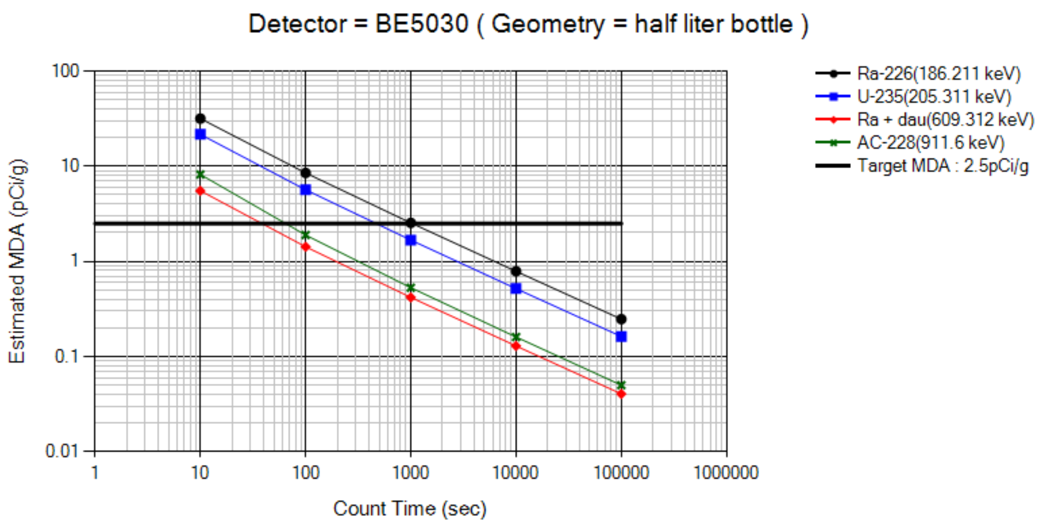
$$MDA(Bq) = \frac{k^2 + 2k\sqrt{2\dot{B}T}}{\varepsilon YT}$$

Where k=1.645 (95% confidence level), B is the background rate, T is the measuring time, Y if the gamma ray yield and ε is the efficiency. Therefore the MDA is proportional to the square root of the background rate and inversely dependent on the efficiency of the measurement. For this type of calculation the gamma ray yield and the count time are known well. The measurement efficiency is also known fairly well from the ISOCS/LabSOCS modeling software. The background rate estimations are taken from previous measurements on detectors of similar construction. However, the background rates are more difficult to predict and subject to local radiation background conditions. Increased background levels from stray radiation fields will increase the background rate and therefore negatively affect the MDA estimate. The data used in this modeling was taken from a similar model detector and shield configuration. This background is dominated by natural radioactivity and is similar to the spectra outdoor in a typical environmental background. The MDA values for this analysis were derived using the Curie method. The following graphs detail the estimated MDA levels in pC/g for each nuclides of interest in each of the measurement geometries. The background count rates assumed for the measurement ROI are as follows.



Radionuclide	Energy (keV)	Backround count Rate (CPS)
AC-228	911.6	0.0805
Ra + dau	295.22	0.2787
Ra + dau	351.99	0.3275
Ra + dau	609.312	0.2516
Ra-226	186.211	0.4211
U-235	143.76	0.5080
U-235	205.311	0.3055





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Thanks, Kevin Carmichael