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**Availability of Large Area NaI based Reference
Standard for the Calibration of
ISO 8769-2 Photon Emission Rate Standards**

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Reference Standard Information

ISO 8769-2 Reference sources for the calibration of surface contamination monitors - Part 2: Electrons of energy less than 0.15 MeV & photons of energy less than 1.5 MeV.

The specified sources consist of a combination of an extended area radionuclide source and a nuclide specific filter.

INTERNATIONAL METROLOGY

UK Primary Standard is held at AWE Aldermaston under contract to DTI

Development History

First realised 16 to 124 keV 1994

Extended low energy to ^{55}Fe through windowed proportional counter 1996

Extended high energy range to ^{137}Cs and ^{60}Co 1998

Other qualities measured on NaI detector

- high detector efficiency

- uniformity of response

- stability

- low background noise

Reference Source Standards

ISO 8769-2 Source Specification

Mean Energy keV	Nuclide	Filter	
5.9	⁵⁵ Fe	None	
16	²³⁸ Pu	Zirconium	32.5 mg.cm ⁻²
32	¹²⁹ I	Aluminium	81 mg.cm ⁻²
60	²⁴¹ Am	Stainless Steel	200 mg.cm ⁻²
124	⁵⁷ Co	Stainless Steel	200 mg.cm ⁻²
600	¹³⁷ Cs	Stainless Steel	800 mg.cm ⁻²
1200	⁶⁰ Co	Aluminium	81 mg.cm ⁻²

Active Area
Backing Material

10x10cm
3mm Aluminium extending 2.5cm beyond active area

Reference Source Standards

The effects of the filter:-

- The removal of internal conversion electrons, auger electrons, beta emissions & low energy photons.
- Some angular collimation of photon emission occurs.
- This produces mono-energetic photon emission rate standards, not sources of given radionuclide

Nal Transfer Reference Standard



Real World Radiological Protection Problems ?

What Are We Monitoring ?

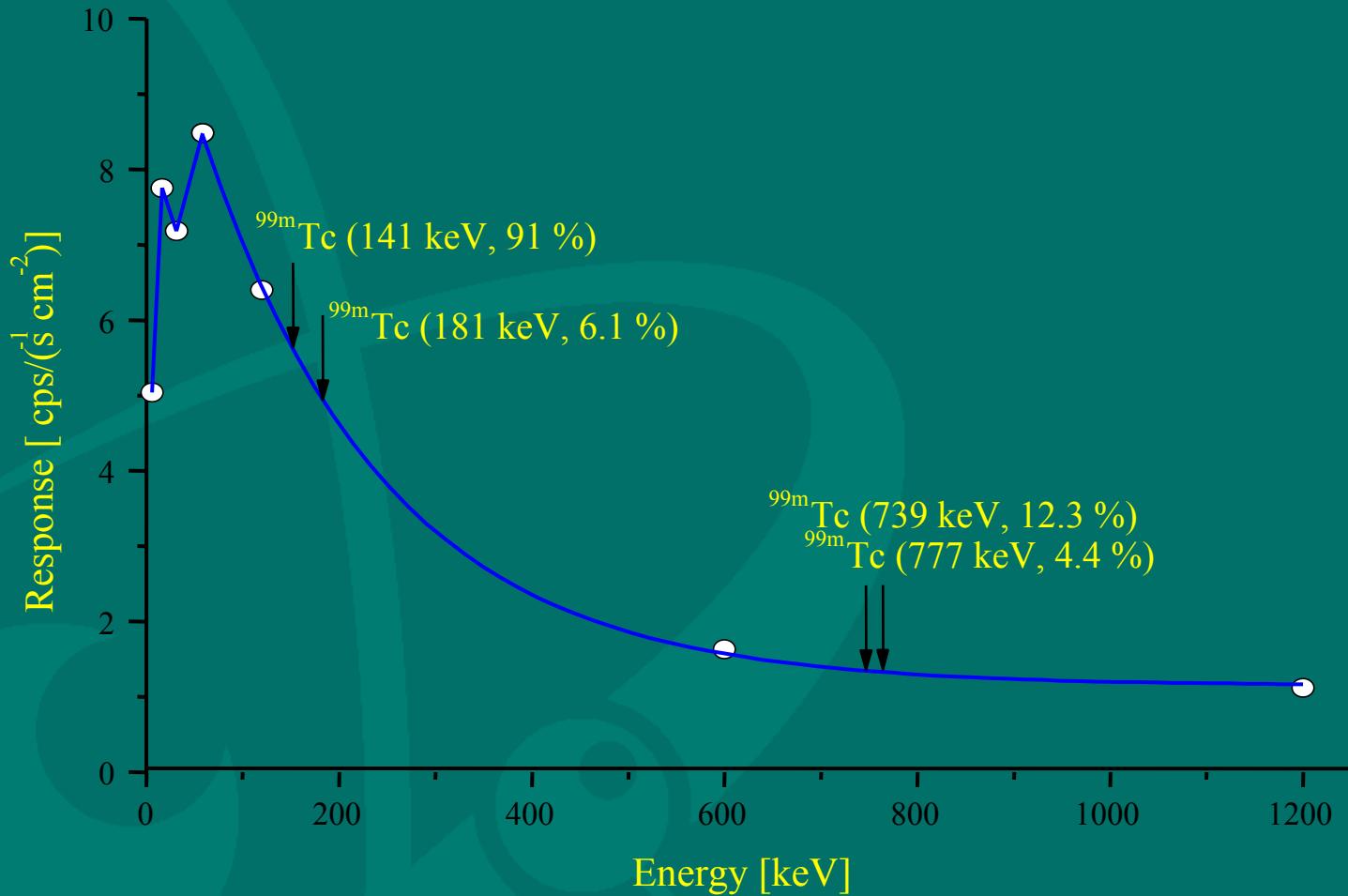
- **Radionuclide Sources - Photon Radiation**
- **Wide range of medical nuclides. e.g.**
 ^{99m}Tc , ^{201}Tl , ^{131}I , ^{57}Co
- **Often complex decay schemes & short half-lives**

Real World Radiological Protection Problems ?

Photon standard sources allows users a to type test
calibrate photon surface contamination monitors

Through energy response curve fitting interpolation
Photon contamination responses to other non standard
radionuclides encountered particularly in the nuclear
medicine diagnostic sector.

User is required to weight the contamination response curve
against the emission probabilities of photon energies of the
encountered radionuclide



Full energy response curve for a Mini Monitor 44B
 (major ^{99m}Tc photon lines marked for response interpolation)

TABLE 1 : Results Summary For Mini-Monitor + 44B Probe

Nuclide	Current Source Emission Rate [s ⁻¹ cm ⁻²]	Net Instrument Count Rate [cps]	Measured Response [cps / (s ⁻¹ cm ⁻²)]	Interpolated Response [cps / (s ⁻¹ cm ⁻²)]	Difference
^{99m} Tc	30.46	134.6	4.419	5.650	+27.9%
¹³¹ I	57.60	157.2	2.729	2.773	+1.6%
²⁰¹ Tl	38.33	300.9	7.850	7.918	+0.9%
¹³⁷ Cs	39.77	99.97	2.514	2.070	-17.7%

TABLE 2 : Results Summary For Mini-Monitor + 42B Probe

Nuclide	Current Source Emission Rate [s ⁻¹ cm ⁻²]	Net Instrument Count Rate [cps]	Measured Response [cps / (s ⁻¹ cm ⁻²)]	Interpolated Response [cps / (s ⁻¹ cm ⁻²)]	Difference
^{99m} Tc	23.21	11.45	0.4933	0.6248	+26.7%
¹³¹ I	57.60	22.31	0.3873	0.3725	-3.8%
²⁰¹ Tl	38.27	42.50	1.1105	1.4436	+30.0%
¹³⁷ Cs	39.77	15.80	0.3973	0.3159	-20.5%

TABLE 3 : Results Summary For RM5 + GP7/4

Nuclide	Current Source Emission Rate [s ⁻¹ cm ⁻²]	Net Instrument Count Rate [cps]	Measured Response [cps / (s ⁻¹ cm ⁻²)]	Interpolated Response [cps / (s ⁻¹ cm ⁻²)]	Difference
^{99m} Tc	17.64	20.5	1.1621	1.4572	+25.4%
¹³¹ I	41.35	26.5	0.6409	0.6873	+4.6%
²⁰¹ Tl	38.35	76.5	1.9948	1.9339	-3.1%
¹³⁷ Cs	39.77	16.5	0.4149	0.4871	+17.4%

CONCLUSIONS

Benefits of the ISO 8769-2 Reference Sources

- **Direct traceability of measurement**
- **Durable, long-lasting sources**
- **A simple calibration technique**
- **The use of sealed sources**