The Industry Need for Updated Gamma Spectroscopy Guidance

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The Universities at Shady Grove

Building 2 Conference Center

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Multitude of Guidance

- A quick sampling of standards amongst four standards organizations revealed nine standards and an ICRU Journal dedicated to the subject
- Issue dates span from 1994 to 2022
- Specific subject matter varies but laboratory based guidance is reasonably consistent
- Numerous papers on in-situ applications likely number in the hundreds

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ASTM

- ASTM D7282-21
  Standard Practice for Setup, Calibration, and Quality Control of Instruments Used for Radioactivity Measurements
  - For gamma spectroscopy, primarily limited to laboratory applications and associated QA
- ASTM E181-17
  Standard Test Methods for Detector Calibration and Analysis of Radionuclides
  - Not unlike D7282, more detailed theory, little QA
- A few more standards specific to particular sample media, soil, water, etc.

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ANSI

- ANSI N42.23-1996
  American National Standard Measurement and Associated Instrument Quality Assurance for Radioassay Laboratories
  - Perhaps depicts a better overall mapping between laboratory types and interfaces than ISO 17025
- ANSI N42.12-1994 (R2004)
  American National Standard Calibration and Usage of Thallium- Activated Sodium Iodide Detector Systems for Assay of Radionuclides
  - Strictly laboratory

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ANSI (continued)

- ANSI N42.14-1999
  American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides
  - Laboratory and standard based guidance
  - Does open door for longer geometry calibration intervals
  - Does not recognize sourceless calibrations

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ANSI (continued)

- ANSI N42.28-2002
  American National Standard for Calibration of Germanium Detectors for In-Situ Gamma-Ray Measurements
  - A great first step - now twenty years old
  - This measurement data exists, how can it get rolled up into a vendor V&V that incorporates additional documented studies to ease the burden on the user
  - Significant emphasis must be placed on geometry accuracy and verification
  - Expand upon inhomogeneity affects

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IEC and ICRU

- IEC 61275 Edition 2 2013
  Radiation protection instrumentation – Measurement of discrete radionuclides in the environment – In situ photon spectrometry system using a germanium detector
  - Calibrations per ICRU 53 or area sampling within field of view
  - Significantly dependent on source depth profile
- ICRU 53 Gamma-Ray Spectrometry in the Environment
  - Significant data source for potential enhancement of guidance

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ISO

- 19017 First Edition 2015
  Guidance for gamma spectrometry measurement of radioactive waste
  - Specific to waste packages (primarily rotating drums)
  - Relies on source calibrations but leaves the door open to sourceless calibrations,
    - "When performed correctly, with good methods, mathematical calibrations can have equal or better accuracy than most other large volume calibration methods."
  - Recommends spikes and blanks
  - Contains good information for updating guidance

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ISO (continued)

- 20042 First Edition 2019
  Measurement of radioactivity — Gamma-ray emitting radionuclides — Generic test method using gamma-ray spectrometry
  - Laboratory based
  - Does not preclude sourceless calibrations but specifies test standard calibrations when used,

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Perceived Gaps

- Most laboratory based guidance relies on the use of traceable geometry sources
  - Not unreasonable to an extent, what are the data quality objectives or the accuracy requirements?
  - Sourceless calibrations versus sourced calibrations can exhibit an unacceptable bias if not modeled correctly, modeling for laboratory applications or when is a right cylinder not a right cylinder?
  - Modeling should be verified buy qualified personnel

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Perceived Gaps (continued)

- Expanding to larger and larger in-situ measurements - the gaps become larger
  - DQOs and accuracy requirements may be broader
  - Example, a client wants a detector calibration certificate
    - For a traditional MARSSIM scan, is this a kerma exposure? where soil concentration to kerma remains modeled, homogeneity is unknow as is the actual size of the contaminated area
    - Compare a sourceless calibration response to a point source measurement even though the detector is not being used to monitor point sources?
    - How do I demonstrate a calibration?

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Wants and Needs

- ASTM D7282 and E181 may benefit from being merged into multiple standards by analysis type, e.g., Gammas, Beta, LSC, etc.
- Need to stress accuracy in sourceless modeling in standards and independent verifications
- How can we take more credit for modeling with less costly and time intensive verifications

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Wants and Needs

- Consider an ASTM or other standard that endorses vendor testing and V&V for a greater variety of in-situ measurements
- Can software packages be further qualified for applications without source based verifications using greater yet still acceptable uncertainties? Vendor supplied V&V

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Wants and Needs

- Revise ANSI N42.28-2002, American National Standard for Calibration of Germanium Detectors for In-Situ Gamma-Ray Measurements
  - Incorporate additional qualification measurements and any useful data from ICRP 53
  - Endorse vendor provided V&V for a range of geometries
  - Hardware should be designed, assembled and tested to ISO 9001
  - Similarly, software and V&V should be provided designed, and tested to ISO 9001

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Wants and Needs

- Mostly we need to make these tools easier to use and credit out of the box without having to do extensive testing for different projects and I believe we are far closer to this goal than we were 20 years ago

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