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Development of NUREG-1507, Revision 1

Minimum Detectable Concentrations With Typical Radiation Survey Instruments For Various Contaminants and Field Conditions

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NUREG-1507

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Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions

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NUREG-1507 History

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- First major update to NUREG-1507 since published to support the License Termination Rule (10 CFR 20, Subpart E)

- One of the technical basis documents for the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)
  - 1998 report was a collaboration between the NRC, the Oak Ridge Institute for Science and Education (ORISE), and Brookhaven National Laboratory

  - For this revision, continued collaboration with ORISE

Updates/Key Messages

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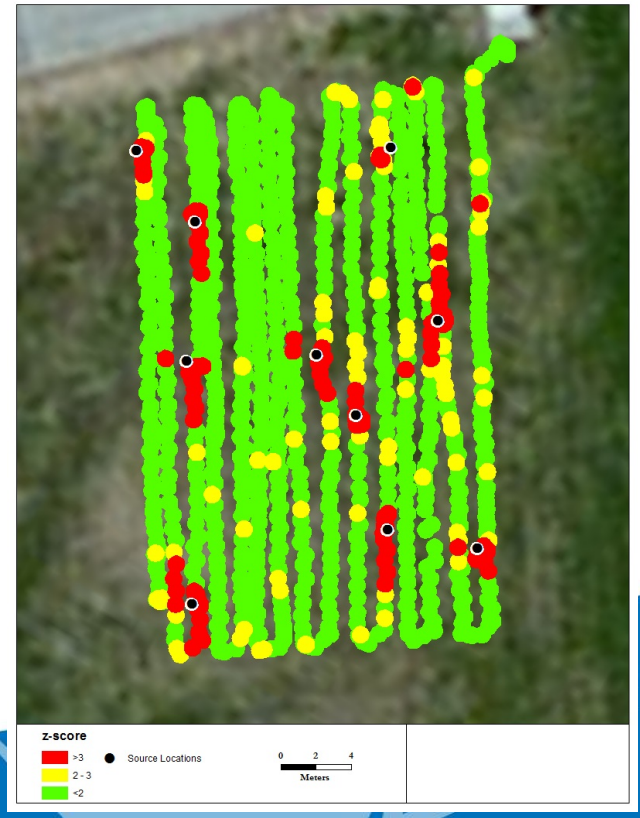
- Recognizes use of current radiological survey technologies methods and limitations

- Contains new information on data capture tools using global positioning system (GPS) and geographic information system (GIS) technologies

- Addresses decommissioning lessons learned including weighted detection efficiencies, background interferences, and signal degradation.

Chapter Updates

- Chapter 1: Added new information on current guidance
  - Additional references to MARSSIM, NUREG-1757 (screening levels) and discussion of how Derived Concentration Guideline Levels (DCGLs) are used
  - Overview of new topics in this report vs. the previous version
    - GIS approaches
    - ISO standards
    - Weighted efficiency



Chapter Updates

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- Chapter 2: Updated examples of field and laboratory instruments
  - Describes detectors in use now that were not described in detail in the 1998 version:
    - Plastic scintillators
    - Non-planar detectors
    - Dose rate meters
    - Gamma spectroscopy systems
    - Floor monitors
  - Discusses advanced positioning (GPS/GIS) tools

Chapter Updates

- Chapter 3: Did not change the fundamental statistical principles
  - Foundational statistics (going back to Currie, NCRP, Brodsky & Gallaghar, Strom & Stansbury)

- Chapter 4: Updated discussion of ISO 8769:2016 (probe size guidance) and ISO 7503 (surface efficiency), and weighted efficiency concepts
  - ISO-8769 clarified the recommended sizes for calibration sources (at least 100 cm^2)
  - Weighted efficiencies briefly introduced in the Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME) and ISO 7503:2016

Chapter Updates

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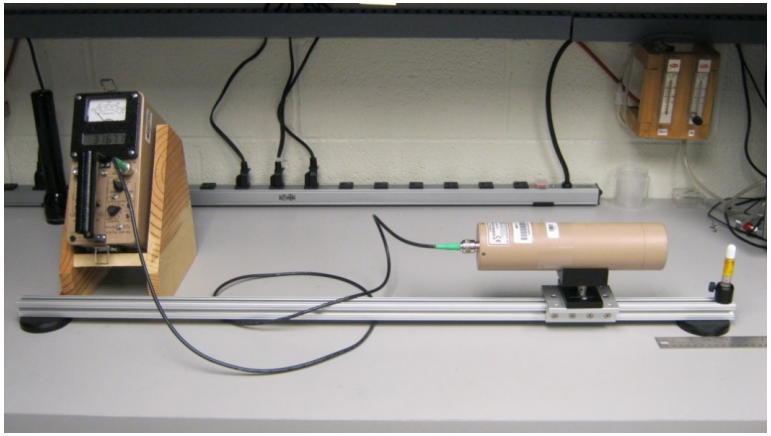
- Chapter 5: New information on
  - Effects of radon progeny and beryllium-7 on detection sensitivity and lessons learned from these interferences
  - Potential impacts from detector signal degradation
  - A detector signal degradation study was performed by ORISE using detectors of varying ages and levels of use



Apparatus for Controlling Detector-to-Source Distances

Chapter Updates

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- Chapter 6:
  - Expanded information on *a priori* vs. *a posteriori* detection decisions
  - Condensed existing information on signal detection/human factors
  - Provided alpha scan MDC equation (consistent with MARSSIM)
  - Enhanced *a priori* scan MDC examples and calculation derivations
  - Updated land-area a priori scan MDC calculations to include more commonly used detectors (1” x 1”, 3” x 3”, and FIDLER sodium-iodide detectors)

Chapter Updates

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- Chapter 6 (Continued): New discussions
  - *A posteriori* decision making concepts and examples (e.g., z-scores, upper tolerance level (UTL), upper simultaneous limit (USL), upper prediction limit (UPL)
  - Comparison of surveys performed with vs. without headphones
  - Data Quality Objectives for use with both *a priori* and *a posteriori* decision-making

Chapter Updates

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- Chapter 7: Expanded information on *in-situ* gamma spectroscopy
  - Included information from the 2006 NRC sponsored ORISE report, "Spatially-Dependent Measurements of Surface and Near-Surface Radioactive Material Using InSitu Gamma Ray Spectrometry (ISGRS) for Final Status Surveys [ML063600121]"
- Chapter 8: No technical changes on "Laboratory Instrumentation Detection Limits"

Chapter Updates

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- Appendix A: New appendix that provides guidance on weighted efficiency calculations, calibration methods, and case-study examples
  - Demonstrates implementation of weighted efficiency calculations
  - Steps through the MDC equations and shows examples using single source and multi-source calibrations (per current guidance: ISO 7503, ANSI N323AB-2013
  - Several examples provided showing the multisource calibration approach to represent realistic scenarios

Conclusions

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- Updates reflect "new" technologies and survey methods
  - Advanced positioning (GPS/GIS) surveys
- Discussed ISO 7503:2016 calibration guidance
- Lessons learned on radon progeny and beryllium-7 interferences, and potential impacts from detector signal degradation
- "Refreshed" the traditional *a priori* scan MDC examples/calculations
- Introduced *a posteriori* (post-processing) survey concepts, DQO processes
- Expanded discussion on *in-situ* gamma spectroscopy
- New appendix on weighted efficiency calculations, calibration methods, and case-study examples

Speaker Contact Information

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