EML

Environmental Measurements Laboratory

"A Federal Resource"

In Situ Spectrometry

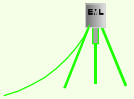
The scope of environmental cleanup taking place within the DOE and elsewhere necessitates rapid measurement techniques of radioactive contaminants during site characterization work as well as certification of areas following remediation. *In situ* gamma-ray spectrometry is a technique that provides information on the concentrations and associated dose rates for specific radionuclides that are present in soil and building materials. As the leading developers of this technique over the years, EML is active in promoting its use through consultation, training, demonstrations, and intercalibration exercises. EML also continues to develop new applications and analytical procedures that can be applied to radiological surveys. These efforts have led to implementation of *in situ* spectrometry at the Fernald Environmental Management Project and should ultimately lead to wide-scale deployment across the DOE complex.

Advantages

A typical measurement for a radioactive contaminant using a soil sampling approach requires collection, processing and laboratory-based analysis which is time consuming and has the potential to generate waste. Furthermore, it provides a measurement of only a few kilograms or less of soil. In comparison, an *in situ* measurement is non-intrusive and non-destructive and can take only minutes to make. The result is immediately available for interpretation. Moreover, it provides an average over several thousand kilograms of soil. In many situations, *in situ* spectrometry provides a highly cost effective technique for characterizing and certifying lands with actual or potential residual radioactivity.

Recent Training and Demonstrations by EML

- IAEA/USEPA Workshop on Environmental Radiation Measurements Using Spectrometric Techniques (1998)
- Brookhaven National Laboratory (1997)
- Fernald Environmental Management Project (1996)
- Canberra Users Group Meeting (1995, 1997)
- Weldon Spring Remedial Action Project (1995)
- Russian 3rd Environmental Remediation Course, Site Characterization Group (1995)
- IEEE Nuclear Science Symposium Short Course Program (1991, 1993, 1994, 1995)
- U.S. Nuclear Regulatory Commission (1994)
- U.S. Department of Defense (1999)



Detector Calibration

EML has developed specialized equipment and computer software for accurate calibrations of HPGe detectors for *in situ* spectrometry. Detectors can be calibrated for a variety of nuclides subject to a wide range of environmental conditions. Shown at the left is the evaluation of a HPGe detector using EML's calibration bench. This bench has platforms that feature translational and rotational capability for precise positioning of detectors, radiation sources and shielding.

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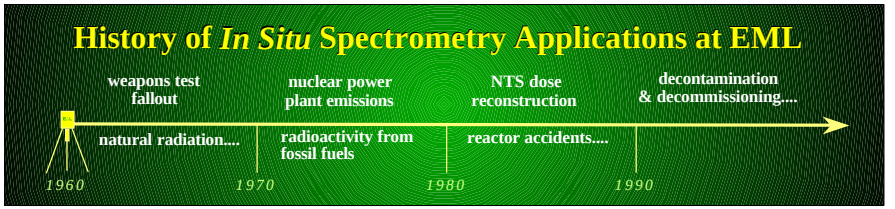
History of *In Situ* Spectrometry Applications at EML



EML Participation in Standards Development

- ICRU Report No. 53, "Gamma-Ray Spectrometry in the Environment."
- IEEE N42.28 "Performance Standard for the Calibration of Germanium Detectors for *In Situ* Gamma-Ray Measurements"
- IEC 61275, "*In Situ* Photon Spectrometry System Using A Germanium Detector"

Quality Assurance

EML has a strong tradition of providing data quality assurance for measurements of low-level radiation and radioactivity. EML is now applying this expertise to address the quality assurance of *in situ* measurements relating to environmental restoration. EML has staged *in situ* intercalibration exercises at the Brookhaven National Laboratory and at the Walker Field Calibration Pads in Grand Junction, Colorado. These exercises help to promote the acceptance and improve the overall quality of *in situ* gamma-ray measurements. Participants in these intercomparison exercises have included the Army Corp of Engineers, Duke Engineering and Services, Canberra, EPA, and Perkin-Elmer. For organizations that either cannot attend the intercalibration exercises or have special measurement issues, EML provides individual assistance. EML also addresses the issue of quality assurance of *in situ* measurements by participating in the development of consensus standards and guidance documents.

Recent EML Publications

- "Extension of a Generic Ge Detector Calibration Method for *In Situ* Gamma-Ray Spectrometry," Radioactivity and Radiochemistry, 11, 27-37 (2000)
- "Fluence Evaluations For Applications of *In Situ* Gamma-Ray Spectrometry in Non-Flat Terrain," USDOE Report EML-603 (1999)
- "An Application of *In Situ* Survey Techniques Using the MARSSIM Methodology," Proceedings of Spectrum 98 International Conference on Nuclear and Hazardous Waste Management, American Nuclear Society, Vol. 2, 847-853 (1998)
- "An Intercomparison of *In Situ* Gamma-Ray Spectrometers," Radioactivity and Radiochemistry, 9, 27-37 (1998)
- "An Alternative Approach to Hot Spot Identification Using *In Situ* Spectrometry Measurements on a Grid," Health Physics 74, 481-485 (1998)
- "A Computer Program to Analyze Data from a Series of *In Situ* Measurements on a Grid and Identify Potential Localized Area of Elevated Activity," USDOE Report EML-590 (1997)
- "*In Situ* Gamma-Ray Spectrometry for the Measurement of Uranium in Surface Soils," Health Physics 67, 140-250 (1994)