CANBERRA

Depth Profiling of Contamination Distribution: Invasive Solutions

Key Drivers:

- Map the contamination distribution when an invasive method is possible.
- Optimize financial cost with an upstream assessment of waste volumes and subsequent disposal costs prior to any dismantling or waste excavation field work.
- Collect all relevant data, before and during field work, allowing optimization of:
  - The most efficient dismantling/ excavation tools, techniques, methods
  - Field work duration
  - Waste sentencing
- Ensure worker safety in efficiently applying ALARA principles and mitigating risks.

Measurement bench for in-situ core samples characterization

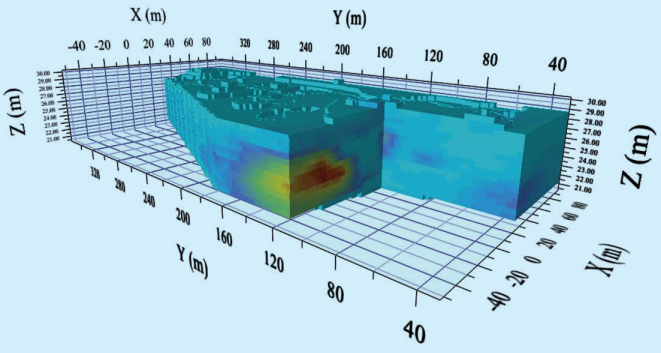
KEY BENEFITS

- Field Work Time Reduction
- Dose Exposure Reduction
- Cost Reduction of total project

Objectives:

- Accurate characterization of contamination distribution in homogeneous and non-homogeneous mediums (walls, slabs, soils…)
- 3D mapping of contamination allowing waste volume calculation per category.
- Gamma activity measurement.
- Provide customers with versatile solutions to perform:
  - Accurate upstream mapping of contamination
  - Fast in-situ measurements during D&D operations
  - Rigorous final verification measurements

3D mapping of soil contamination performed by geostatistical software



Advisor™
Expertise for Challenging Measurements

CANBERRA can customize the solution based on the unique requirements of the situation.
All the solutions offered in this flyer can be thoroughly performed by our Measurements & Expertise (M&E) team, without any purchase of products or systems.

MIRION TECHNOLOGIES

Depth Profiling of Contamination Distribution: Invasive Solutions

In-situ Measurement of Core Samples:

Technical description

- Core sampling and radiological analysis allows the determination of the extent and depth profile of the contamination of the material (wall, soil).

Principle:

– Retrieve the core samples from material for measurement. Perform ISOCS™ high resolution gamma spectroscopy using suitable Germanium detectors and analysis with Genie™ 2000.

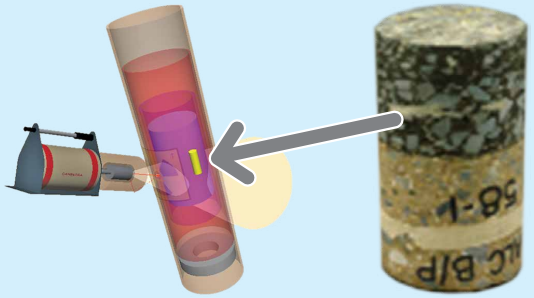
Tool:

– Standard ISOCS system and modelling software.

Key benefits

- Fast method with immediate results.
- Real-time analysis to guide the sampling plan.
- Maintain the safety and radiation doses to all personnel (ALARA), with no spread of radiological contamination.

Core samples are measured using ISOCS Mathematical Efficiency calibration.



In-situ Measurement of Depth Tagged Dust Samples (TruPro® Technology):

Technical description

- TruPro powders solid samples (slabs, walls, concrete, glass, refractory block, granite…) and collects all the drilled material according to the depth (dust collected inside a small container). We use ISOCS/LabSOCS gamma spectroscopic systems to measure depth-tagged dust samples and build gamma contamination profile. Additionally, iSolo® can be used to measure alpha/beta activity in smear samples.

Principle:

– Drill small holes (up to few cm diameter) but deep (up to 6 m) with a hollow drill, and collect dust samples at various depths (5cm incremental steps). Place the dust samples in lead shielding, to directly measure the activity by high resolution gamma spectroscopy using ISOCS system.

Tool:

– Dedicated drilling system (TruPro) with ISOCS system and iSolo® Alpha/Beta Counting System.

Key benefits

- Clean method eliminating cross contamination problems and minimizing secondary waste.
- Less invasive than coring.
- Flexible tool for probing areas with difficult access.
- Minimizes the operational time.
- Allows measurements up to 6 meters depth.

iSolo® Alpha/Beta counting system for in-situ measurements

Depth Profiling of Contamination Distribution: Invasive Solutions

Detectors Inserted Inside Drilled Holes:

Technical description

- A detector is inserted in a hole in the ground or in a wall, and moved inside to perform radionuclide identification, activity assessment and dosimetry mapping.

Principle:

– Insert a gamma detector into a drilled hole and shift the detector in several equal or non-equal distance positions. The results give the distribution of activity along the hole axis. In addition, using a gamma simulation code with a Monte-Carlo code based on this result gives a better evaluation of radionuclide distribution and dose rate.

Tool:

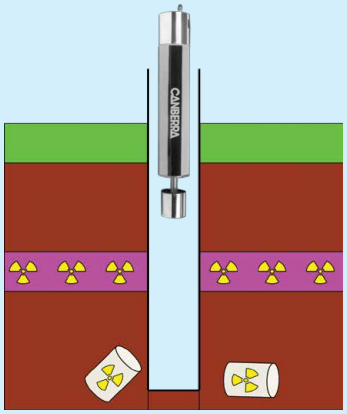
– CZT, LaBr, HPGe Sealed probe or Geiger Muller.

– Software: Genie™ 2000, MERCURAD, MCNP5.

Key benefits

- Allows measurements of up to 100 meters depending on the application (usually few tens of meters).
- Very accurate depth profiling.
- By means of high resolution spectroscopy, elimination of radon daughters due to geological factors.
- Can access narrow spaces such as collimators inside hot cell walls.

Invasive method, measurement inside drill holes



3D Mapping Software:

Technical description

- By combining the results collected during the measurement campaigns, a 3D mapping of the activities is performed by means of geostatistical data analysis software (Kartotrak® by Geovariances).

This software allows:

– Integration and visualization of all available data (surveys, surface measurements, DTM, aerial views, plans, etc.)

– Data control, validation analysis

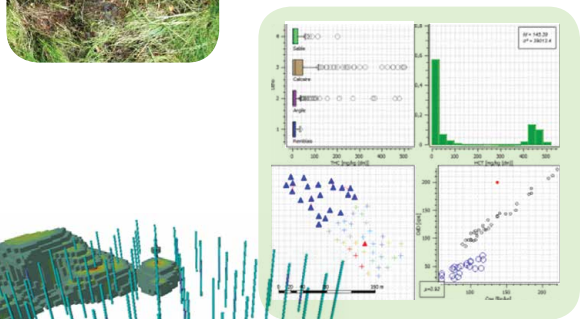
– 2D and 3D mapping

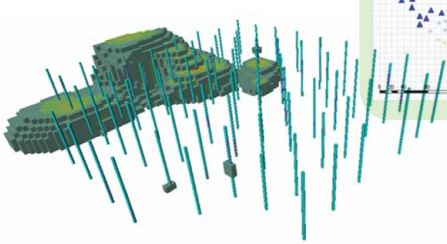
– Estimation of waste volumes and production of excavation plans

Key benefits

- Increased confidence in your data.
- Improved knowledge and understanding of the contamination.
- Time saving during site characterization thanks to integrated workflow.
- Better preparation of site remediation.
- Facilitated communication between project stakeholders.

Example of well logging using the HPGe sealed probe





Depth Profiling of Contamination Distribution: Invasive Solutions

D&D Capabilities and Solutions

Successful Achievements

Activity depth profiling of building in Brennilis (France):

1 Objective:

- Prior to the building decommissioning, perform the mapping of the walls, grounds and floors without releasing any dust. Measure the concrete alpha and gamma contamination.

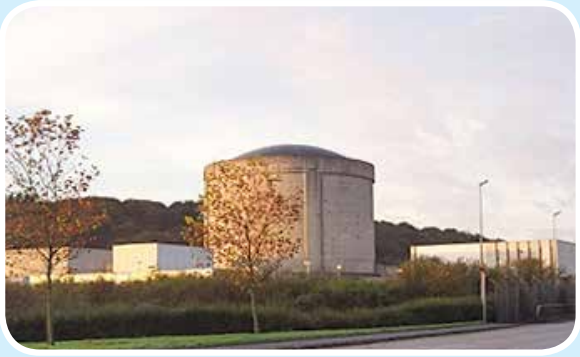
2 Method:

- Powdered granite and concrete samples, even highly contaminated elements, have been collected in 250ml vials. A measurement system with a portable radiometric instrument and ISOCS calibration has been used. The data have been analyzed with Canberra software Genie 2000. 280 measurements were carried out from TruPro samples in 21 working days.

3 Achievement:

- The excellent detection limits, the immediate availability of the data and their accuracy allowed the team to quickly and precisely identify and characterize hot spots, resulting in reduced project timescales and costs.

Brennilis site in France



Typical sample spectra (Steel and Concrete) Vandellos (Spain)

1 Objective:

- Identify and analyze the contamination of the building walls.
- Localize and measure the alpha and gamma contamination in concrete samples.
- Mapping of reactor's building surface.

2 Tools:

- ISOCS System, Genie2000 Software, iSolo Alpha/Beta Counting System.

3 Results:

- Excellent detection limit for the measurement.
- Reliable measurement and fast results : 10 mins per measure.
- Insignificant background noise and no perturbation.
- Beta background from ^{60}Co and ^{152}Eu meant that contamination of pure beta-emitters was not detectable.

Vandellos site in Spain

For more information, review the complete case study on our website:
www.canberra.com/measurements-expertise

- Activity Depth Profiling of building at Brennilis NPP, France (C40842)
- Real-time radiological analyses of transuranic soil cores (C48105)

Radiation Safety. **Amplified.** **www.canberra.com**

CANBERRA
Part of Mirion Technologies

C49115 – 06/2016