Form 2

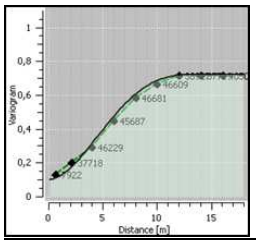
Technology Information	
Area	Technologies for detection of leaks – improvement of patrols (**POINT 1)**
Title	**METHODS AND TECHNIQUES TO IMPROVE MEASUREMENT AND RADIOLOGICAL CARTOGRAPHY**
Submitted by	CEA

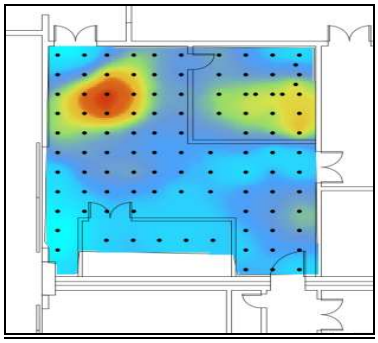
1. Overview of Technologies

Functions

Unmanned system for detection of radiological activity (leaks, etc.) and rapid cartography restitution:

- Non- destructive and distant measurement
- GPS /WIFI reporting
- Geostatistics to provide reliable methods for activity estimation, uncertainty quantification and risk analysis





Summary Descriptive

1. **Geostatistics :**

The radiological characterization of contaminated premises can be divided into three steps. First, the most exhaustive facility analysis provides historical and qualitative information. Then, a systematic (exhaustive or not) control of the radiation signal is performed by means of in situ measurement methods such as surface control device combined with in situ gamma spectrometry. Besides, in order to assess the contamination depth, samples can be collected at several locations within the premises and analyzed. Combined with historical information

and radiation maps, such data improve and reinforce the preliminary waste zoning. The relevance of the geostatistical methodology relies on the presence of a spatial continuity for radiological contamination.

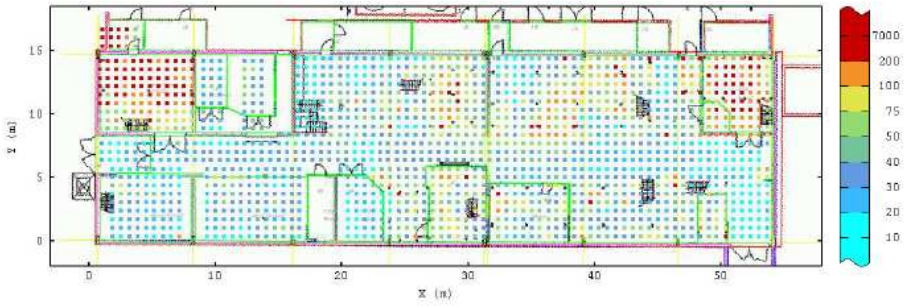


Figure 1: βγ-radiation (cps) with a 66 cm mesh in the "Atelier D" of ATUE facility.

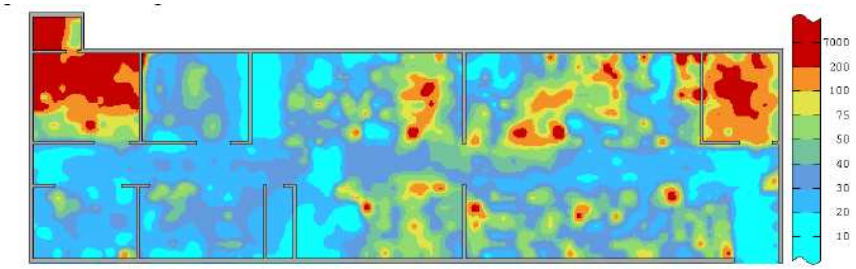
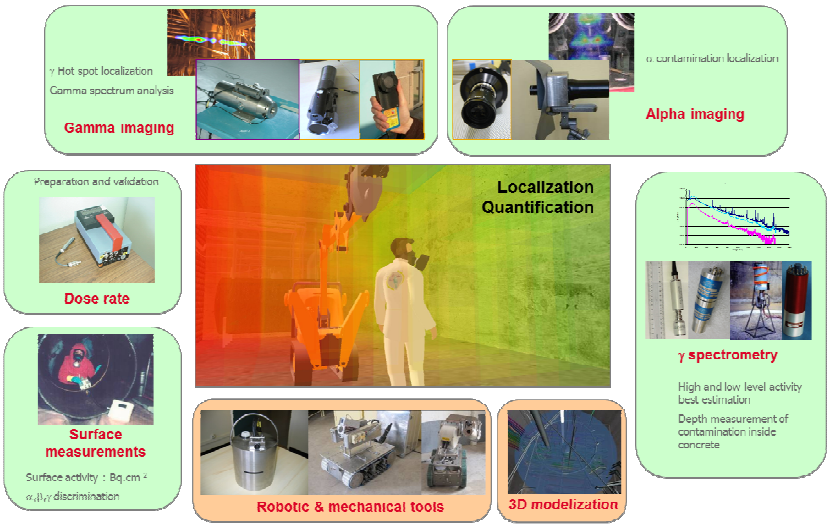


Figure 4: Kriged map of βγ-radiation (cps).

2 Non- destructive and distant measurement

CEA has developed many compact characterization tools to follow sensitive operations in a nuclear environment: decommissioning, accident situation, cleaning operations, …



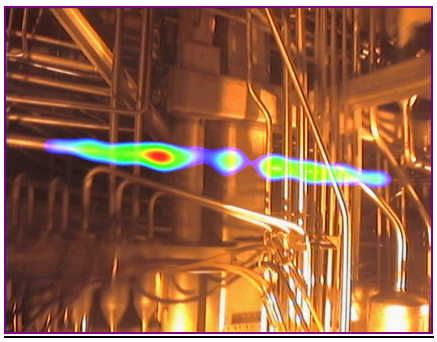
Features & Specifications

1°) Measurements

- Expertise unmanned vehicle (or pedestrian version)
- Detectors (see below an overview of non destructive tools under use industrially or under development; the LIBS system – see specific Areva / CEA presentation could also be adapted for leaks detection)
- GPS
- IRIS software

- Gamma imaging

  The gamma camera has been used by the CEA since the 1990s and several changes have made this device more sensitive, more compact and more competitive for nuclear plant operations. It is used to quickly identify hot spots, locating irradiating sources from 50 keV to 1500 keV.



- Alpha imaging

  The alpha camera is a new camera used to see invisible alpha contamination on severalkinds of surfaces in darkness condition. For example, the latest results obtained allowreal time supervision of a glove box cleaning operation (for ^{241}Am contamination).

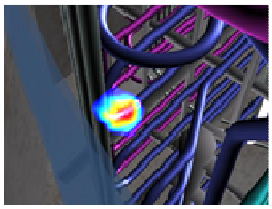
In situ compact gamma spectrometry to estimate hot spot activity

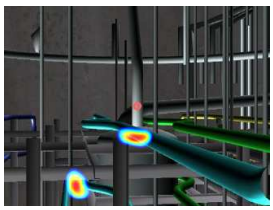
In situ gamma spectrometry methods developed by the CEA use compact gamma spectrometry probes (CdZnTe, LaBr3, NaI, etc.). The radiological data collected is used to quantify the activity of hot spots and can also then be entered in 3D models of nuclear plants to simulate intervention scenarios.

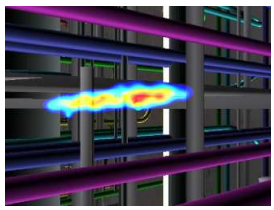
- *In situ* non destructive gamma spectrometry to estimate the depth profile of the activity in soil and concrete

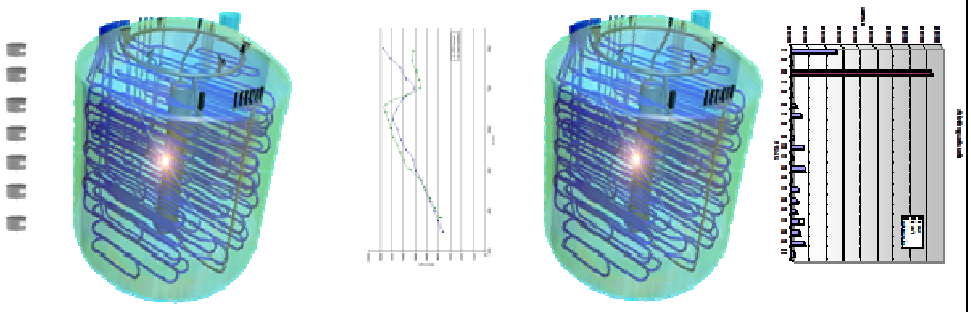
- 3D radiological mapping of the activity

The use of full 3D modeling can enable the validation of the hot spot positioning and be very helpful o estimate the final activity of particular components (tanks, pipes, internal components of tanks, …)









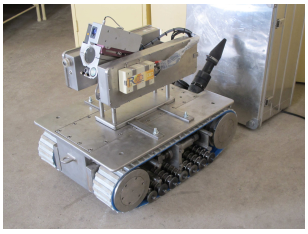
Example of activity estimation of fission products tanks using gamma imaging, gamma spectrometry measurements and gamma scanning modeling approach.

- Use of β measurements

  CEA is studying and developing several techniques to estimate the activity of β emitters (for example ^{90}Sr) with non destructive in situ measurements.

- Intervention robots and mechanical tools

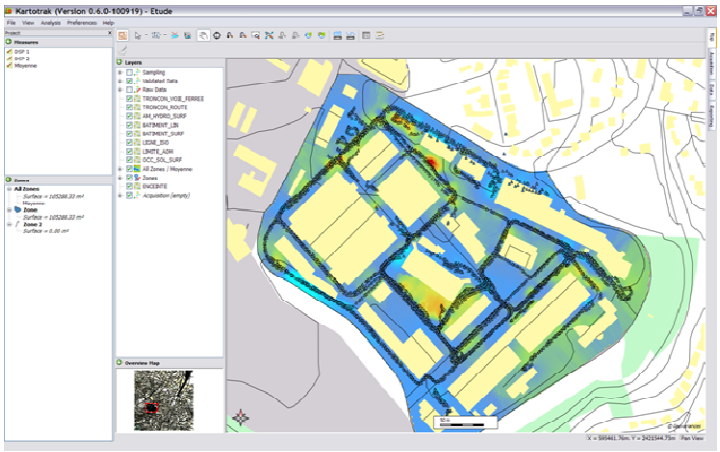
  To bring devices on site, the use of remotely controlled robots can also be required.

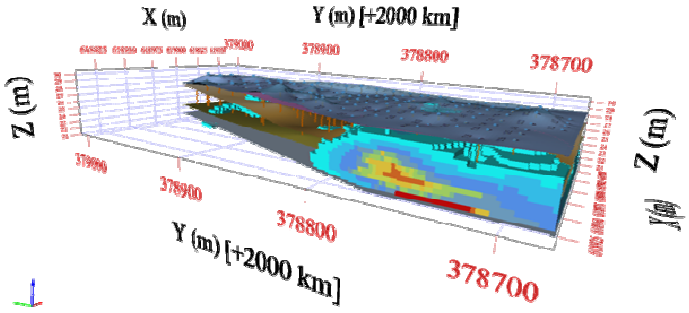


Mis en forme : Anglais (États Unis)

2°) Geostatistics

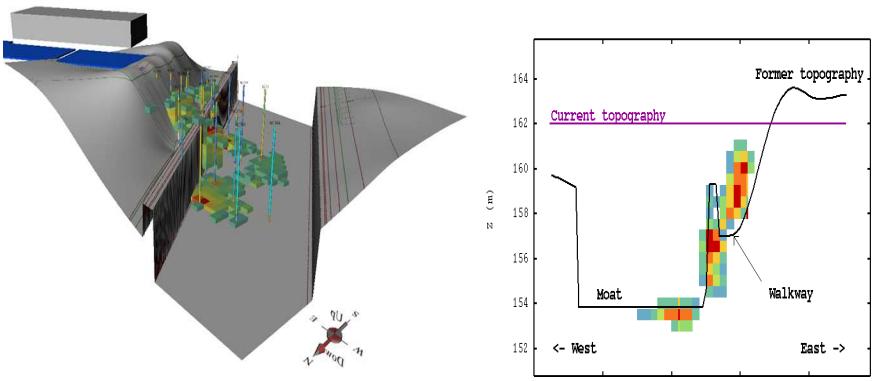
- KARTOTRAK is an Integrated workflow based on GIS component and 3D viewer
- Real-time data positioning and acquisition (GPS and measuring devices)
- Data analysis, quality control, contamination mapping and risk assessment based on geostatistical methods





Application fields:

- Soil pollution
- Hydrogeology
- Air quality
- Bathymetry
- Civil engineering
- Fisheries…



Advantages of the Technology

1. Measurements

- Minimization of dose rate and of manpower.

- On line cartographies
- Possibility of using different measurement devices from classical devices to LIBS systems, etc.

2. Geostatistics

- essential decision making tool for decommissioning and dismantling projects of nuclear installations.
- geostatistical framework provides answers to several key issues that generally occur during the clean-up preparation phase: How to optimize the investigation costs? How to optimize the sampling strategy,
- get a reliable mapping of the contaminated areas
- estimate the corresponding waste volumes.
- One methodology, many ways to apply:






Owner

1. Kartotrak :

Born-out from a partnership between CEA and the company Geovariances.The software platform is under Current industrialization and commercialised by Geovariances

2. Notes

Technology readiness level

More than 150 sites characterized and permanent feedback (2 facilities) .This geostatistical approach is currently applied to several former nuclear facilities of CEA in France ex: ATUE (enriched uranium workshops), etc.

Challenges for future applications

Industrialization of a device putting together all the tools seen above