

Andra Call for Projects with the support of the Investments for the Future Programme



MAUD

Measurement by Digital Autoradiography

Project supported by Andra under the "Investments for the Future Programme" ("Investissements d'Avenir") - Selected under the Andra Call for Projects "Optimization of post-dismantling radioactive waste management", organized in cooperation with the French National Research Agency (ANR).

Duration: 36 months

Project launch:
05/2016

Total project cost:
€2.18 million

**Sum covered under the
Investments for the Future
Programme:** €960,000

Type of financial support:
Subsidy with ROI guarantees
for the State

Locations: Saclay (91),
Nesles-la-Vallée (95), Poitiers (86).

Coordinator: CEA Saclay

Partners:

- CEA Saclay
- Ateliers Laumonier (ARL)
- Institute of Chemistry of Poitiers: Materials and Natural Resources (IC2MP)

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BACKGROUND

During decommissioning projects, on-site radioactivity measurements need to be taken to determine the presence and activity level of radionuclides in given areas. This is important for specifying clean-up measures to be implemented in terms of worker and environmental protection and compliance with waste disposal requirements.

Knowing the distribution of contaminated areas on a decommissioning site helps minimise the volume of waste generated and to manage areas differently depending on the type and intensity of radiation.

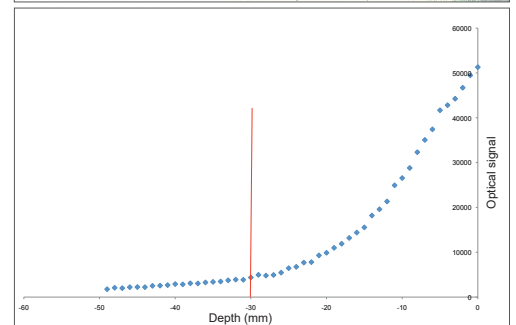
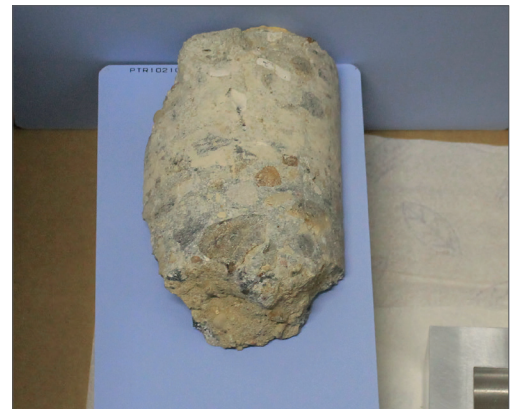
Conventional techniques achieve this through on-site measurements and taking samples which are then analysed in the lab. Currently only one type of radiation (gamma) can easily be measured on site. Other radionuclides (alpha and beta emitters) are often difficult to measure and require more in-depth analysis in the lab, which takes a considerable amount of time.

OBJECTIVES

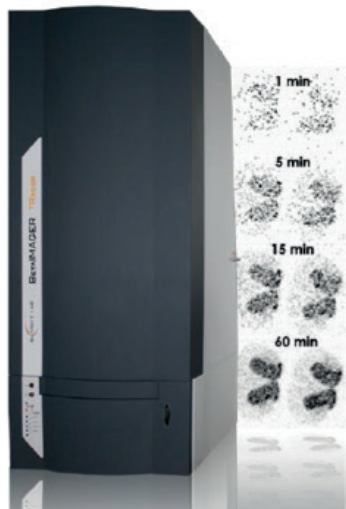
The MAUD project's main aim is to improve the detection of radionuclides that are difficult to measure and make it possible to provide *in situ* measurements via the development of a transportable system that combines activity level measurement and characterisation of radionuclides. It seeks to adapt reliable autoradiography analysis methods developed for research in biology (monitoring of biomolecules with very weak tritium content) and geology (detection of uranium in mining exploration) to the constraints of decommissioning.

The consortium comprises three partners: the French Alternative Energies and Atomic Energy

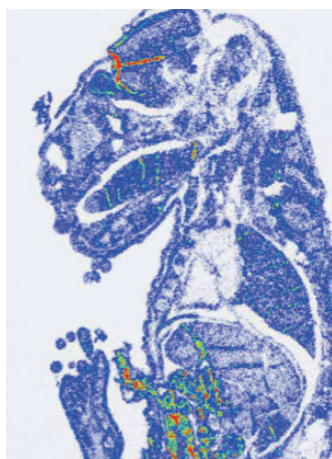
Commission - CEA - (MAUD coordinator with the LASE laboratory), the University of Poitiers (with the IC2MP laboratory) and the SME Ateliers Laumonier (ARL).



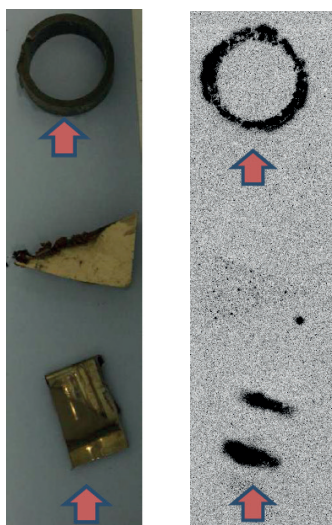
- Autoradiography of a core sample of concrete -
Top: core sample during measurement, placed on a blue autoradiography screen. Middle: measurement results. The black part shows the presence of radioactivity (^3H). Bottom: contamination profile generated by the measurement.



► Commercial beta imaging system from ARL.



► Measurement of ^{35}S , a low-energy beta emitter, by autoradiography of a mouse embryo.



► Sorting of tritium-bearing radioactive waste using autoradiography - verification of contamination and location of activity.

In particular, the MAUD project aims to:

- develop autoradiography by using reusable screen technology. These screens provide radioactivity imaging and have concrete applications for decommissioning and characterising radioactive waste. They can be used to view the radioactivity of radionuclides that cannot easily be measured;
- use ARL's technical knowledge of autoradiography by optimising the effective commercial products developed for the biology sector, in order to adapt them to the constraints of decommissioning waste management;
- model and validate the images obtained by autoradiography devices on real radioactive waste and environmental samples.

PROJECT SEQUENCE

The project will develop and study the two known methods of radioactivity observation for autoradiography (gas and solid scintillation techniques) by applying them to the characterisation of radioactivity on decommissioning sites. Once the methods have been developed, an industrial prototype will be built that optimises performance and costs.

The project will bring three entities together over a three-year period to work on an aspect of industrial development. It will also include two post-doctoral researchers from the CEA and University of Poitiers, and at least six people from the ARL SME, including mechanical engineers, project engineers, on-board systems engineers and software engineers.

EXPECTED RESULTS

Innovation

Nuclear measurement imaging techniques have been available for many years for gamma emitters. Difficult-to-measure radionuclides such as alpha and beta emitters (tritium, chlorine-36) are harder to map. The MAUD project seeks to achieve this more easily.

The development of a beta and/or alpha activity measurement method that can easily be installed on site will be an important complement to current techniques, thereby increasing the flexibility of characterisation and improving the availability of information on the location and intensity of radioactivity on decommissioning sites.

The MAUD system has been recently patented.

Economic impact

ARL is an SME that manufactures autoradiography devices for biological imaging. Adapting these commercial devices to decommissioning is a new application of this French technology. This project should ultimately lead to the creation of an industrial organisation, but could draw on the experience of systems sold around the world for biological measurements.

Impact on radioactive waste management

This industrial project aims to obtain images of the location of difficult-to-measure radionuclides on solid materials found in nuclear waste generated by decommissioning (mainly concrete, plastic and metal). Information from these characterisations will help better plan decommissioning sites and reduce the doses received by workers as much as possible. In-depth and optimised characterisation will save time and money in processing decommissioning waste.

APPLICATION AND COMMERCIALISATION

The characterisation system developed will be an important tool for improving the measurement of difficult-to-measure radionuclides on decommissioning sites. There may be a very broad scope of application as the device will be optimised for operation on a variety of solid matrices, including metals, concretes and plastics. Advances from the project could be applied to biological and geological research.