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

TOMIS

In Situ Low Dosimetric Impact Multi-Energy Tomograph

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

Duration:
48 months

Project launch:
04/2017

Total project cost: €5.14 million

Sum covered under the Investments for the Future Programme: €2.39 million

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

Locations:
Cadarache,
Gennevilliers

Coordinator: CEA

Partners:
- CEA
- Thales Communications & Security (TCS)

Contact: Eric SIMON,
eric.simon@cea.fr

BACKGROUND

Tomography is an X-ray imaging technique widely used in the medical field to study the volume of an organ from a series of two-dimensional X-rays. It is also used in the nuclear field, for example to characterise the contents of radioactive waste containers in a non-destructive manner. Using knowledge of the contents of the containers, tomographic information coupled with non-destructive radiological measurements reduce contaminant detection limits and uncertainties and improve quantification of contents and radioactivity.

At present, however, the use of tomography for characterising radioactive waste remains rather restrictive since these devices require the construction of heavy and costly facilities, such as fixed bunkers requiring imposing civil engineering. The waste containers must then be transported to these facilities for analysis.

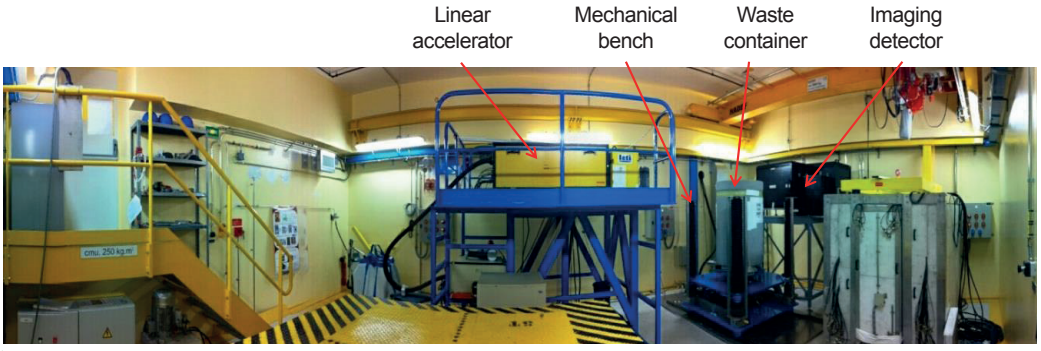
OBJECTIVES

The low dosimetric impact multi-energy TOMograph In Situ (TOMIS) project proposes:
- to develop a powerful tomography tool that can be implemented in situ, for the physical characterization of old waste, decommissioning waste, as well as possible parts of structures and equipment;
- to constitute a non-destructive tool which supplements radiological characterization by combining it with measurement methods such as gamma spectrometry and neutron measurement.

The particularity of TOMIS, which will make it a unique tool, is its mobile and adaptable nature, so that it can be used directly on nuclear and non-nuclear sites storage, disposal, dismantling, etc. The TOMIS tomograph can thus be moved as close as possible to containers, which are sometimes difficult to transport.

In particular, the mobility of the TOMIS system requires a drastic reduction in its dosimetric impact, linked to the use of a linear electron accelerator.

CINPHONIE high energy tomograph at CEA Cadarache



▶ High energy tomograph at the CEA Cadarache CINPHONIE facility. The installation is located in an underground, shielded bunker. It can accommodate waste containers of up to five tons to produce tomographic or radiographic examinations with a spatial resolution of several millimetres.

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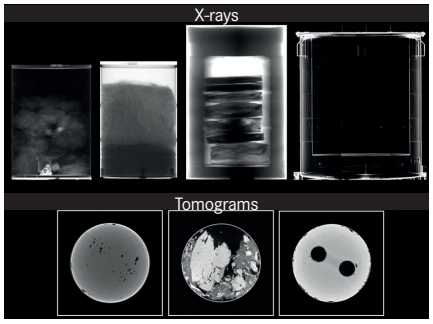
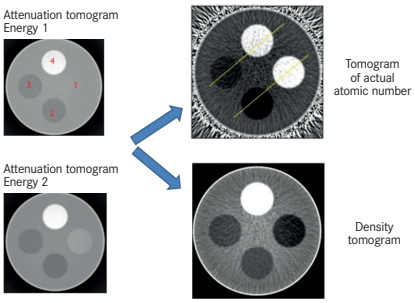
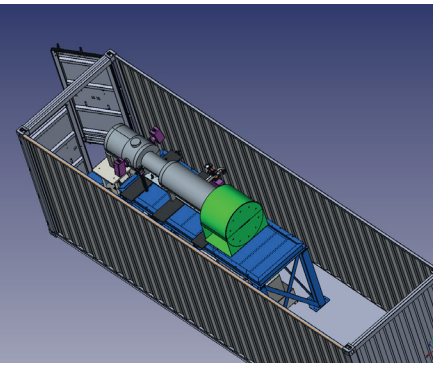
TOMIS: Low Dosimetric Impact Multi-Energy In Situ Tomograph



Example of high energy imaging produced in a permanent bunker on a dense package: X-rays and tomographic sections. Internal structures, material distribution and defects can be detected by these examinations.



Simulation of a dual-energy tomographic examination, which makes it possible to determine the effective density and atomic number of the contents of a container.



Sketch of planned TOMIS system. The linear accelerator produces a fan beam that intercepts the rotating waste drum (not shown). The accelerator, waste mechanical support and detector module are assembled within a dedicated container for easily relocation. Additional shielding (not shown) are used in close proximity of the container for radiological safety purpose. After computer reconstruction, the transmitted images gives a tomographic information about a slice of the waste drum. The operation is repeated for different drum elevations.

For this, the project includes the development of:

- a dedicated self-shielded linear accelerator;
- an optimised method (detectors and interrogator beam) for tomographic examination;
- a specific portable shielding system in the measuring area.

PROJECT SEQUENCE

The TOMIS project is a four-year project. It consists of the design and production of a prototype tomograph, including a self-shielded linear accelerator, a high-precision mechanical bench, an imaging system, as well as radiation protection studies for the design basis of the portable equipment that can be deployed on site. Each sub-assembly will be developed semi-independently, as the system will be integrated during the last phase of the project on a pilot site before testing.

EXPECTED RESULTS

Innovation

Its transportability and adaptability make TOMIS innovative. There is currently no transportable high energy tomography system in Europe. With TOMIS, it will be possible to carry out non-destructive testing of waste containers as close as possible to their storage location without having to transport them over long distances to a dedicated facility.

Economic impact

Once the usability of the TOMIS tomograph has been demonstrated in real conditions on a waste recovery or dismantling site, the system could be produced on a larger scale and sold commercially to benefit several sites in parallel. The mobile nature of the system means that it can be used at several sites in succession. On this basis, it was estimated that around five units are required for the French market alone. However, the application of high energy tomography is not limited to France, nor to the nuclear market alone, but has applications in other industries employing non-destructive testing on dense or voluminous objects using highly penetrating radiation.

Impact on radioactive waste management

A new in situ characterization method will lead to a better evaluation of the contents of radioactive waste containers, and thus make managing them more efficient. For the recovery of old waste, introducing high-energy imaging characterization could greatly improve its characterization and make it possible to better determine the final solution for the waste, or lead to re-categorisation of certain waste to lower activities (ILW-LL to LILW-SL or LLW-LL, or LILW-SL to VLLW). The associated disposal costs could thus be reduced, resulting in a rapid return on investment.

Social impact

The objective of the TOMIS project is to enable large-scale development in France for distribution and sale in France and abroad. In this context, such a project is attractive for the industrial and commercial development effort of Thales Communications & Security as well as its suppliers and subcontractors. The primary location of this activity in France makes it possible to envisage the rise in competence of an existing know-how, the sustaining of specific trades over the long term and the creation of some ten jobs on the region.

APPLICATION AND COMMERCIALISATION

Apart from applications for non-destructive testing on radioactive waste containers, TOMIS could be applied to any sector requiring the implementation of high precision imaging on dense and bulky items, or on fixed items that cannot be moved for inspection. The automobile, metallurgy, petrochemicals and aeronautics industries could have uses for the product and be potential buyers of the technology.