



Characterization of Conditioned Nuclear Waste  
for its Safe Disposal in Europe

# CHANCE Project - Characterization of conditioned nuclear waste for its safe disposal in Europe

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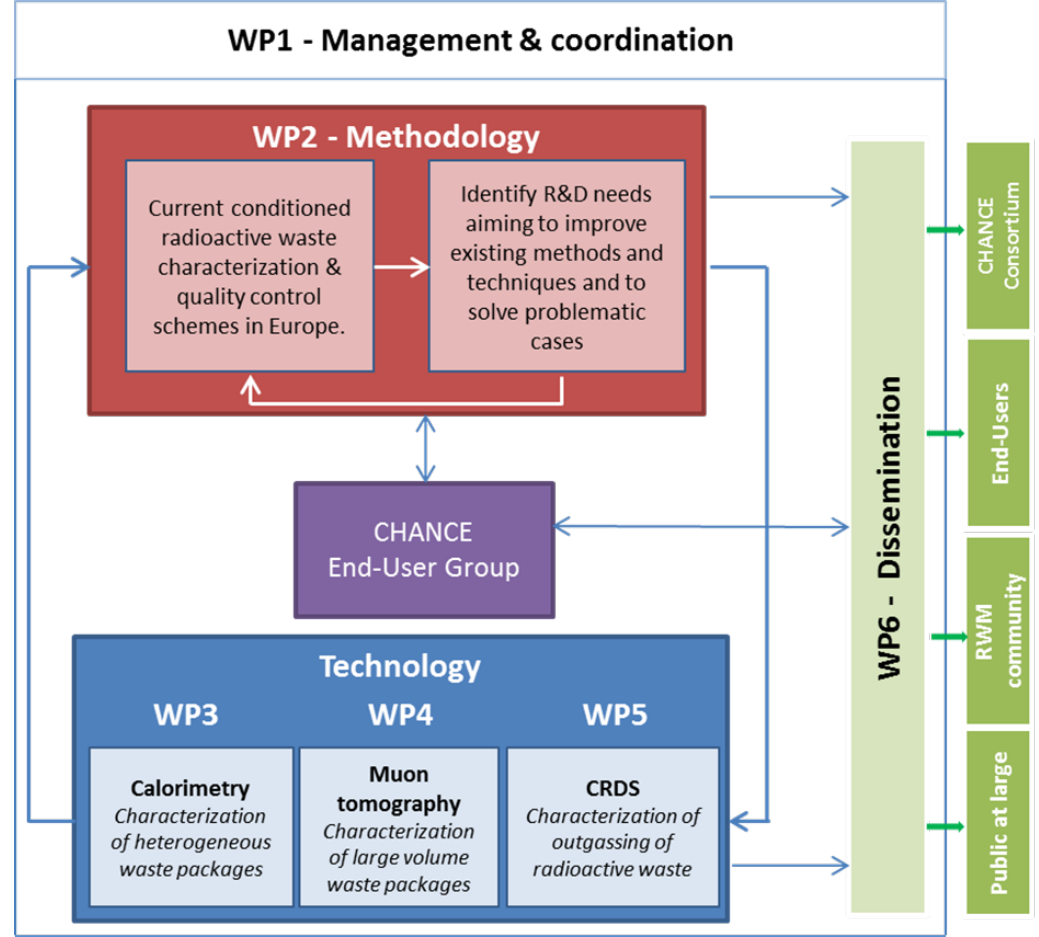
# CHANCE

Characterization of Conditioned Nuclear Waste for its Safe Disposal in Europe

- Euratom research and training programme 2014-2018
- NFRP 7-2016-2017 topic "Research and innovation on the overall management of radioactive waste other than geological disposal"
- 4 years project: 1.6.2017 - 31.5.2021 (probable extension to 30.11.2021)
- Total budget: 4.25 M€ (3.98 M€ EC contribution)
- Consortium: 11 partners from 7 European countries



- To establish at the European level a **comprehensive understanding of current conditioned radioactive waste characterization and quality control schemes** across the variety of different national radioactive waste management programmes
  
- To further develop, test and validate **novel non-destructive techniques** that will improve the characterization of conditioned radioactive waste
  - **Calorimetry** as a non-destructive technique to reduce uncertainties on the inventory of radionuclides
  - **Muon Tomography** as a non-destructive technique to control the content of large volume nuclear waste
  - **Cavity Ring-Down Spectroscopy (CRDS)** to characterize outgassing of radioactive waste



## Objectives

To identify **current methodologies** and shortcomings of current characterization and metrology of CRW in Europe

- **Key parameters** that need characterization and uncertainties assessment
- **Technologies commonly used** for conditioned waste characterization
- **Specific problematic issues** for the characterization of CRW
- **Knowledge and technology gaps** for radioactive waste package characterization methodologies
  - Driven by end-user requirements for the characterization of radioactive waste

## Status

- A questionnaire was prepared to obtain a broad overview of the characterization of conditioned radioactive waste
  - **End-User-Group Questionnaire** (D2.1 available at [www.chance-h2020.eu](http://www.chance-h2020.eu))
- Questionnaire completed by EUG members (13 questionnaire answers received)
  - **Synthesis of questionnaire answers** (D2.2 available at [www.chance-h2020.eu](http://www.chance-h2020.eu))
- Identification of **R&D needs** on characterization of conditioned radioactive waste
  - Under progress (final version expected for the first quarter 2021)

# WP3 -Calorimetry

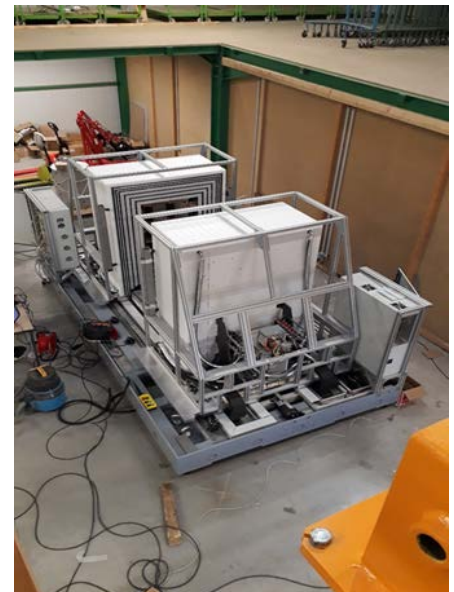
Leader: KEP Nuclear – Contributors: CEA, SCK•CEN, WUT

## Objectives

- To test and evaluate the performance of calorimetry for inventory of radionuclides (measure Beta or alpha radiation heat source)
- To identify how calorimetry can complement existing, widely-used techniques (gamma spectrometry and neutron passive measurement)
- To carry out an exhaustive study of uncertainties assessment related to calorimetry and its coupling to other non-destructive techniques

## Status

- Construction of a novel calorimeter with an optimized detection limit (1.5mW) to host a 200L drum (10-3000mW range)
- Measurements of mock-up drum (Pu pellet (100 microW) in concrete matrix)
- Monte Carlo modelling of calorimeter combined with gamma spectrometry



Leader: University of Bristol – Contributors: SCK•CEN, University of Sheffield, WUT

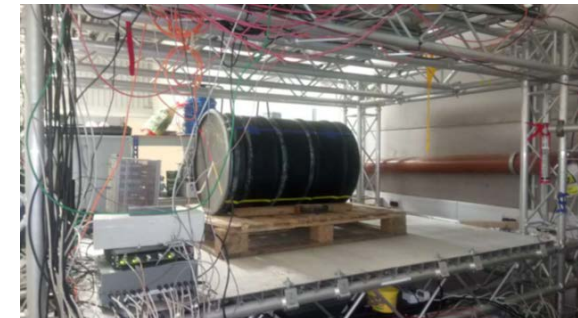
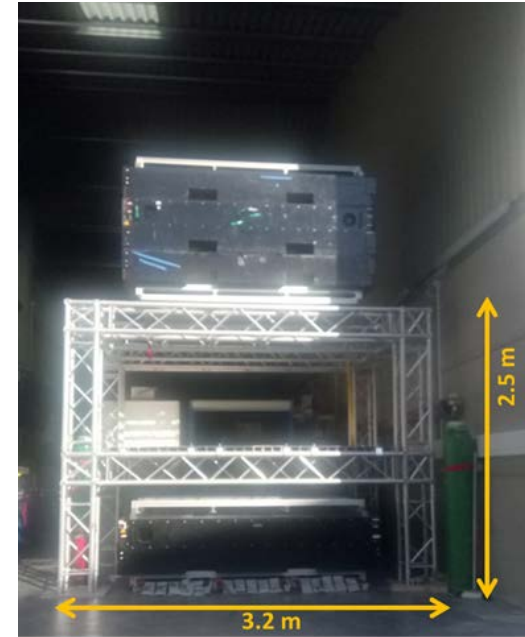
## Objectives

To develop mobile muon tomography instrumentation to address imaging of large volume and heterogeneous nuclear waste packages

- build a suitable mobile muon detection system
- demonstrate real waste drum muon tomography
- evaluate performances of the technique

## Status

- The detector system was commissioned in a non-laboratory environment
- Track fitting and image processing for imaging a mock-up drum in progress
- Modellings associated to identification of materials and image reconstruction have been done



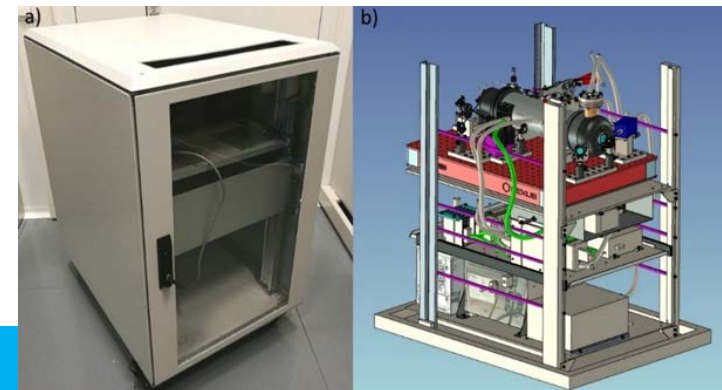


## Objectives

- Develop new CRDS instrumentation for  $\text{H}^{36}\text{Cl}$
- Study  $^{14}\text{C}$  waste outgassing using CRDS (e.g. from irradiated graphite)

## Status

- Identification of a  $\text{H}^{36}\text{Cl}$  absorption line
- Some challenges associated to the experimental measurements of  $\text{H}^{36}\text{Cl}$
- Development of a transportable C-14 instrument for analysis of irradiated samples in a radiation laboratory
- Analysis of outgasing from solid graphite pieces has been started





# Survey synthesis

## Challenges regarding characterisation

- proper characterization of the ***conditioned legacy/ historical waste packages***
- determination of a viable **source term** in already conditioned waste
- detection of **difficult to measure isotopes** and sealed radioactive sources
- **little traceability** of the chemical content of waste packages
- **accessibility** of the waste for sampling, difficulties in monitoring waste drums packed deeply in a storage facility
- characterization and reconditioning of the **waste already stored** in a repository
- the **lack of standardized processes** for the characterization and repackaging (or reconditioning) of spoilt drums/containers.

- Developing of ***non-destructive methods*** capable to detect the radiological (including  $\alpha$  and  $\beta$  emitters) and fissile mass, as well as the chemical content
- The new developed methods should be able to be applied:
  - for **homogeneous and heterogeneous waste**
  - on waste packages of **different sizes**, including SNF casks.

## On-going R&D programs

- High energy X-ray imaging (detectors, higher energy, dual energy imaging)
- Gamma-ray spectroscopy (detectors, electronics, data processing)
- Passive neutron measurement (detectors, correction of matrix and localization effects)
- Active neutron interrogation (detectors, correction of matrix and localization effects)
- Active Photon Interrogation (i.e. photofission)
- Prompt Gamma Neutron Activation Analysis
- Fast Neutron Analysis with the Associated Particle Technique
- Beryllium characterization by photon activation analysis
- **Calorimetry, muon tomography, CRDS in CHANCE**

- Finalisation of state of art about on going R&D techniques for the characterization of conditioned radioactive wastes
  - Feedback from end-users
- Training courses
- Combination of different characterization methods to reduce uncertainties
- Validation of methods developed in CHANCE if possible with real waste

# **CHANGE**

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# Thank you for your attention !