The CHANCE Project
Characterization of Condensed Nuclear Waste for its Safe Disposal in Europe

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WP1 – Management and Coordination

Andra (PL) – FZJ

CHANCE targets a comprehensive understanding of current condensation of nuclear waste (CNW) characterization, management and national Q&A/QA control schemes.

- CHANCE aims to test / evaluate non-destructive metrology approaches and complementing the characterization of CHRN and addressing large and heterogeneous waste compounds
- CHANCE will focus on large volume and heterogeneous waste forms
- Very Low Level Waste (VLLW)
- Intermediate Level Waste (ILW)
- High Level Waste (HLW)
- Based on input and requests from end-users (e.g. WPT) such as waste management organizations, regulators, waste producers and repository operators

WP2 – Methodology & User Groups

Andra (WPL) – CEA, ENEA, FZJ, SCK-CEN, RATEN, INCT

To identify current methodologies and shortcomings of current characterization and metrology of CMW in Europe

- Key parameters for characterization and uncertainties assessment
- Technology commonly used for conditioned waste characterization
- Specific problematic issues for the characterization of CHRN
- Knowledge of morphology and radioactive waste package characterization methodologies
- Drives by the end-user requirements for the characterization of radioactive waste
- Waste Management Organizations (WMOs), regulators, disposal operators, waste producers...
- CHANCE cooperate with a specific End-Users Group (EUG)

WP3 – Calorimetry

KEP (WPL) – CEA-Cad, FZJ, SCK-CEN, WUT

To develop calorimetry to reduce uncertainties on the inventory of radioactivity that are often hidden or difficult to measure but non-the-less important for the disposal declaration and safety analysis

Objectives:
- Test and evaluate the performance of calorimetry in inventory of radioactivity (measure Beta or alpha radiation source heat)
- Identify how calorimetry can complement existing, widely used techniques (gamma spectrometry and neutron passing measurement)
- Carry out an exhaustive study of uncertainties assessment related to calorimetry and its coupling to other non-destructive techniques

Table: Energy Deposition in the Material (kWt)

<table>
<thead>
<tr>
<th>Material</th>
<th>Energy Deposition (kWt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bamboo</td>
<td>1.59E+00</td>
</tr>
<tr>
<td>iron</td>
<td>1.07E+04</td>
</tr>
<tr>
<td>graphite</td>
<td>73.19</td>
</tr>
<tr>
<td>copper</td>
<td>2.18E+00</td>
</tr>
<tr>
<td>lead</td>
<td>1.46E+04</td>
</tr>
<tr>
<td>steel</td>
<td>87.46</td>
</tr>
</tbody>
</table>

Deliverables:
- Applicability of calorimetry to real waste characterization (published in www.chance-h2020.eu)
- Overview of NDA techniques (graphite methods, neutron methods, calorimetric methods)
- NDA study of U, Cl, LCAT, modeling of energy deposition of various radioactive sources, e.g. Co 60 source (see table)
- Evaluation of gamma energy and neutron deposition inside the calorimeter and impact on the measurement, uncertainties and lower detection limit / maximum mixed masses
- Development and construction of a new 200 litters half-shell calorimeter with bottom layer glass chamber reference cell, optimized for very low detection limit
- Experiments on test drum, mock-up drum, mystery drum, real drum (CEA and SCK-CEN) including measurements by calorimetry and other techniques such as gamma spectrometry or neutron counting
- Conclusion and evaluation of experimental results and of uncertainties related to NDA characterization methods in conjunction with calorimetry

WP4 – Muon Tomography

UoB (WPL) – FZJ, SCK-CEN, UoB, WUT

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

Objectives:
- Build a suitable mobile muon detection system
- Demonstrate muon tomography applicability and feasibility with a test drum, mystery drum and eventually a real waste drum
- Evaluate performances of the technique

WP5 – CRDS Outgassing & Monitoring

VTI (WPL) – CEA-Cad, ENEA, FZJ

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

Objectives:
- Build new instrumentation for HCl outgassing
- Demonstrate an application of the technique to the monitoring of HCl outgassing

Deliverables and current status:
- Development of CRDS HCl measurement
- Identification of a suitable HCl absorption line
- Matrix composition - potential impact of water has been studied
- The construction of a prototype of CRDS instrument dedicated to HCl measurement
- Monitoring of the transfer of HCl measurement and evaluation of the detection limit and comparing CRDS with ULC (liquid sorbent counting)
- Studying the chemical transformation of NASO into HCl
- Investigation of the release behaviour of HCl
- Study of sampling line and CO2 outgassing from normal graphite
- Study of release behavior of carbon in the form of methane and carbon dioxide from inorganic waste and organic waste under different storage conditions using CRDS
- Comparison with well-established ULC techniques and evaluation of data and samples

Deliverables:
- Design, build-up and detailed description of a mobile MT detector system, its performance, data reconstruction algorithm and material recognition
- Detector installation and commissioning in a non-laboratory environment in progress
- NDA and DO testing to be run in a facility with a definition of benchmark standards (e.g. figure-of-merit) and material recognition and expected resolution levels
- MT capacity for detection of low density / high-Z areas in concrete (hydrogen bubbles) has been demonstrated
- Experimental program deemed and can be done, test and mystery drums have been received
- Large volume waste experiments in preparation
- Detailed and thorough report on the tuned algorithm, performance and thorough evaluation of the experiments, feasibility and limits of the methods and, eventually, summarizing the results and outlining the potential of MT, the limits and merits for the application in large volume casks radioactive waste management

WP6 – Dissemination and Training

SCK-CEN (WPL) – Andra, ENEA, FZJ, INCT

To integrate, communicate and disseminate CHANCE results within the European community involved in radioactive waste management

- Communication to broader European community involved in radioactive waste disposal
- News on social and ethical concerns associated to the innovative methods for characterization of radioactive waste
- Training and education of young professionals

Synthesis report integrating all CHANCE results

Communication tools
- Public website: www.chance-h2020.eu
- Public events and workshops
-Specific communication through IGDP (website, newsletter, ...
- Topical day on conditioned radioactive waste characterisation
- Training course

WP7 – Dissemination and Training

SCK-CEN (WPL) – Andra, ENEA, FZJ, INCT

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MT algorithms and MCNP study of figure-of-merit aspects

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