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WP1 – Management and Coordination

Andra (PL) – FZJ

CHANCE targets a comprehensive understanding of current conditioned radioactive waste (CRW) characterization, management and national QM/QA control schemes.

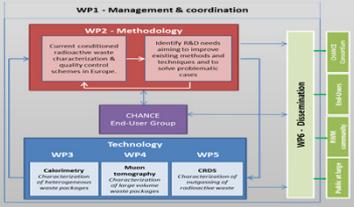
CHANCE aims to test / evaluate non-destructive metrologies improving and complementing the characterization of CRW and addressing large and heterogeneous waste compounds

- Calorimetry (WP3)
- Muon Tomography (WP4)
- Cavity Ring-Down (Laser) Spectroscopy (CRDS) (WP5)

CHANCE will focus on large volume and heterogeneous waste forms of:

- Very Low Level Waste (VLLW)
- Low Level Waste (LLW)
- Intermediate Level Waste (ILW)
- High Level Waste (HLW)

Based on input and requests from end-users (see WP2) such as waste management organisations, 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 CRW in Europe

- Key parameters for 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 the end-user requirements for the characterization of radioactive waste
- Waste Management Organizations (WMOs), regulators, disposal operators, waste producers...
- CHANCE cooperates with a specific End-Users Group (EUG)

The CHANCE End-User Group (EUG)				
Andra	Waste Management Organisation	France	CSR Demokritos	Nuclear Facility Operator
ANDR	Waste Management Organisation	Romania	NRG	Nuclear Facility Operator
Areva	Nuclear Facility Operator	France	Nucleco	Waste Management Organisation
CEA	Nuclear Facility Operator	France	RWM	Waste Management Organisation
DMT	IAEA Technical Expert Consulting Group	Germany	SCK-CEN	Nuclear Facility Operator
EDF	Nuclear Facility Operator	France	SKB	Waste Management Organisation
Enresa	Waste Management Organisation	Spain	SOGIN	Nuclear Facility Operator
IRSN	Technical Support Organisation	France	ZUOP	Waste Management Organisation

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
- Study on social and ethical concerns associated to the innovative methods for the characterization of radioactive waste
- Training and education of young professionals
- Synthesis report integrating all CHANCE results

Communication tools

- Public website: www.chance-h2020.eu
- Participation in national and international events (conferences, workshops,...)
- Specific communication through IGD-TP (website, newsletter,...)
- Topical day on conditioned radioactive waste characterization
- Training course

CHANCE training: Topical Day in Mechelen, Belgium, 20 - 22 Mar 2019

Gather students, scientists and experts dealing with RW research themes.

- Objectives: overview of methods and issues and share experiences and future challenges
- Public workshop/mini-conference
- ~50 (~100) participants
- Free of charge
- More info: www.chance-h2020.eu

Glossary: PL = Project Leader; WPx = Workpackage x; WPL = Workpackage Leader

WP3 – Calorimetry

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

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

Objectives:

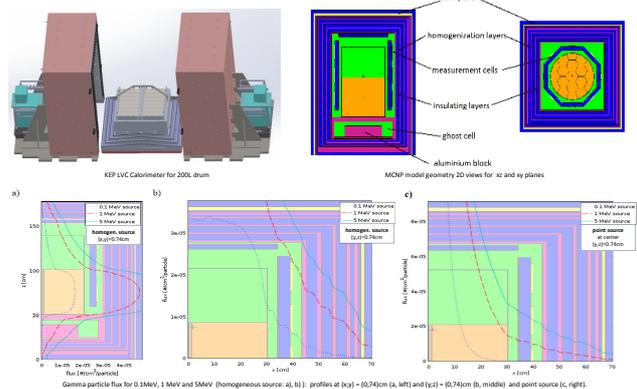
- Test and evaluate the performance of calorimetry for inventory of radionuclides (measure Beta or alpha radiation heat source)
- Identify how calorimetry can complement existing, widely-used techniques (gamma spectrometry and neutron passive measurement)
- Carry out an exhaustive study of uncertainties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

Layer	Homogeneous source		Point source at center	
	energy (J/kg)	power (mW/g)	energy (J/kg)	power (mW/g)
drum	1.57E+00	1.05E+04	72.27	2.18E+00
thermal block	1.70E-01	1.14E+03	6.77	5.85E-02
homogenization layer 1	1.00E-01	6.71E-02	3.99	3.47E-02
homogenization layer 2	8.15E-02	5.47E-02	3.95	2.93E-02
homogenization layer 3	6.63E-02	4.45E-02	2.65	2.30E-02
homogenization layer 4	5.32E-02	3.57E-02	2.12	1.83E-02
cold plate	4.65E-02	3.12E-02	1.86	1.61E-02
measurement plates	4.55E-02	3.05E-02	1.82	1.45E-02
aluminum block	1.29E-02	8.68E-03	0.52	5.75E-03
reference plates	1.09E-02	7.32E-03	0.44	3.75E-03
bottom measurement plate	1.01E-02	6.95E-03	0.41	3.69E-03
measurement cells	1.13E-03	7.61E-04	0.05	3.50E-04
insulation layer 1	1.01E-03	6.78E-04	0.04	3.38E-04
insulation layer 2	8.23E-04	5.53E-04	0.03	2.74E-04
insulation layer 3	6.65E-04	4.46E-04	0.03	2.23E-04
measurement chamber	4.94E-04	3.32E-04	0.02	1.54E-04
insulation layer 4	3.31E-04	2.22E-04	0.01	1.10E-04
insulation layer 5	2.86E-04	1.98E-04	0.01	6.95E-05
insulation layer 6	1.10E-04	7.40E-05	0.00	3.68E-05
ghost chamber	6.20E-05	4.16E-05	0.00	2.08E-05
sum total	2.17E+00	1.46E+04	86.59	2.38E+00
sum detected	1.95E+00	1.30E+04	73.19	2.13E+00
				1.60E+04
				95.59
				87.46

* energy deposited in one gram of the material in the layer | ** calculated power of one gram of the radioactive material

Deliverables:

- Applicability of calorimetry to real waste characterization (published on www.chance-h2020.eu)
 - Overview of NDA techniques (Gamma methods; Neutron methods, calorimetric methods)
 - MCNP study of LVC calorimeter, modelling 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 missed masses
- Development and construction of a new 200 liters two-half-shell-calorimeter with bottom layer ghost 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, UoS, WUT

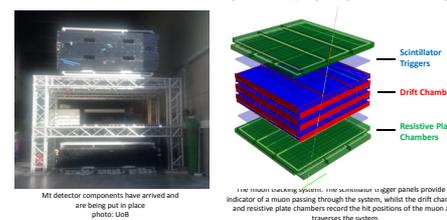
To develop mobile muon tomography instrumentation to address the imaging of large volume and heterogeneous nuclear waste packages.

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

WP4 Current status

- The detector system is being commissioned in a non-laboratory environment
- Topics of interests/goals:
 - detection of U cobalts embedded in concrete with a few mm resolution.
 - distinguishing between cobalts of U, W and Pb.
 - detection of voids (e.g. gas bubbles) in the matrix.
 - Hot drum simulations and estimates for large volume and heterogeneous waste compounds
- Looking for industry partners to guide our activities
- Imaging of large-scale CASTOR drums containing high-Z material
- Cd & Pb loaded materials for neutron/gamma stopping using muon monitoring



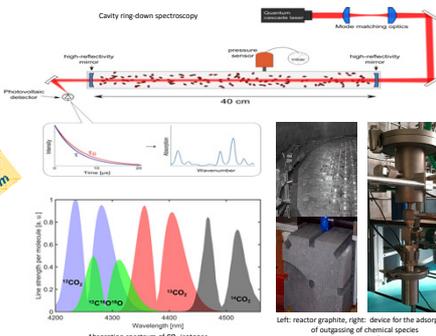
WP5 – CRDS Outgassing & Monitoring

VTT (WPL) – CEA-Cad, ENEA, (FZJ)

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

Objectives:

- Develop new instrumentation for H³⁵Cl
- Demonstrate an application of the technique to the monitoring of ¹⁴C outgassing



Deliverables and current status:

- Development of CRDS H³⁶Cl measurement
 - Identification of a suitable H³⁶Cl absorption line
 - Matrix composition – potential impact of water has been studied
 - The construction of a prototype of CRDS instrument dedicated to H³⁶Cl measurement
 - Experimental validation of the transitions with ³⁶Cl standards and the evaluation of the detection limit and comparing CRDS with LSC (liquid scintillation counting)
 - Studying the chemical transformation of Na³⁶Cl into H³⁶Cl
- Investigation of the release behaviour of ¹⁴C
 - Study of sampling line and CO₂ outgassing from normal graphite
 - Study of the release behaviour of radiocarbon in the form of methane and carbon dioxide from irradiated graphite waste and organic waste under different storing conditions using CRDS
 - Comparison with well-established LSC-techniques and evaluation of data and samples

