ACED
Assessment of Chemical Evolution of ILW and HLW Disposal Cells

D. JACQUES (WP leader), Berlin, 3-4 December 2018

Content of presentation

1. WP Main Objectives
2. WP Expected impacts
3. WP Participants
4. WP – Task Breakdown and WP Board
5. WP – Planned resources
6. WP – Tasks' descriptions
7. Key challenges and objectives in the first year – to communicate near-term focus

WP Main Objectives

- Improve methodologies to obtain multi-scale quantitative models for the chemical evolution at the disposal cell scale
  - **Process level knowledge integration**
    - To describe reactivity at interfaces
    - To use process knowledge in a multi-process & multi-scale modelling framework for assessing at waste package scale and disposal cell scale
  - **Process-based upscaling**
    - To identify the processes controlling the chemical evolution at the disposal cell scale
    - To define the level of detail in which processes and features have to be represented in models for supporting PA/SA

WP Expected impacts

- Chemical evolution at the disposal cell scale is important for many subdomains:
  - RN release from waste forms (chemical conditions)
  - RN fate and migration
  - Interfaces with waste packages and backfills
  - Chemical perturbations (metallic, cementitious, clayey…)
  - HLW/ILW near field evolution (chemical evolution)

WP Expected impacts

- Implementation:
  - Methodologies applicable for specific program
  - Applications provide input to identify critical features in the design of a diposal cell

- Safety: process-based evaluation of the barrier evolution at relevant scales (relevant for assessing safety and performance related aspects)
  - Assessment of (generic) safety functions
  - Reduce conservatism, uncertainty, quantify safety margin
  - Define material requirements

WP Expected impacts

- Different EU Programs
  - Analysis for generic designs but include most interfaces present in current European cell design

Models on 6 interfaces
Glass-steel, cement-granite, cement-clay, steel-clay, steel-cement, steel-granite

4 representative disposal cells
HLW – glass / steel / clay (-host material)
HLW – glass / steel / cement (-host material)
ILW – organic waste / cement (-host material)
ILW – metallic waste / cement (-host material)

ACED Participants

Organisations
✓ **Andra**, France ▪ BRGM, France
✓ **BEL V**, Belgium
✓ **CEA,** France ▪ EDF, France
✓ **CIEMAT**, Spain ▪ UAM, Spain
✓ **CNRS**, France ▪ IMT Atlantique, France ▪ ULorraine, France
✓ **COVRA,** Netherlands
✓ **ENRESA**, Spain ▪ UDC, Spain
✓ **FZJ**, Germany ▪ UFZ, Germany

Organisations
✓ **IRSN**, France ▪ Mines ParisTech, France
✓ **JSI**, Slovenia ▪ ZAG, Slovenia
✓ **LEI**, Lithuania
✓ **MTA EK,** Hungary
✓ **NAGRA**, Switzerland ▪ UBERN, Switzerland
✓ **NRG**, Netherlands
✓ **PSI,** Switzerland
✓ **SURAO**, Czech Republic ▪ UJV, Czech Republic
✓ **SCK-CEN**, Belgium
✓ **VTT**, Finland

ACED – Task Breakdown and WP Board

- **ACED Leader**: D. Jacques (SCK•CEN, BE) djacques@sckcen.be

- **Task 1 - S/T Coordination, State-of-the-Art, Training Material**
  - D. Jacques (SCK-CEN, BE), E. Neeft (COVRA, NL), G. Deismann (FZJ, GE)

- **Task 2 - Reactivity of Steel/Material Interfaces at the Interface Scale**
  - A. Dauzères (IRSN, FR), R. Cervinka (UJV, CZ)

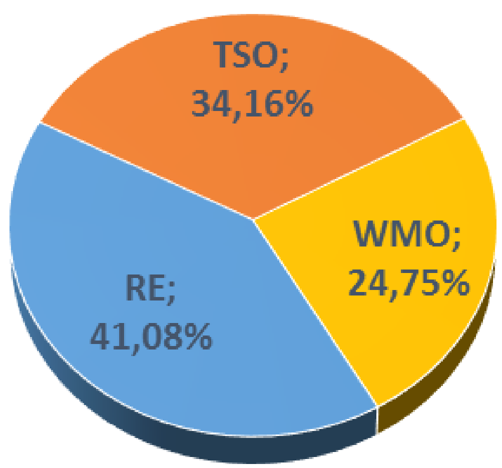
- **Task 3 - Waste Package Scale**
  - G. Kosakowski (PSI, CH), C. Martin (ANDRA, FR)

- **Task 4 - Disposal Cell Scale**
  - P. Rajala (VTT, FI), J. Govaerts (SCK-CEN)

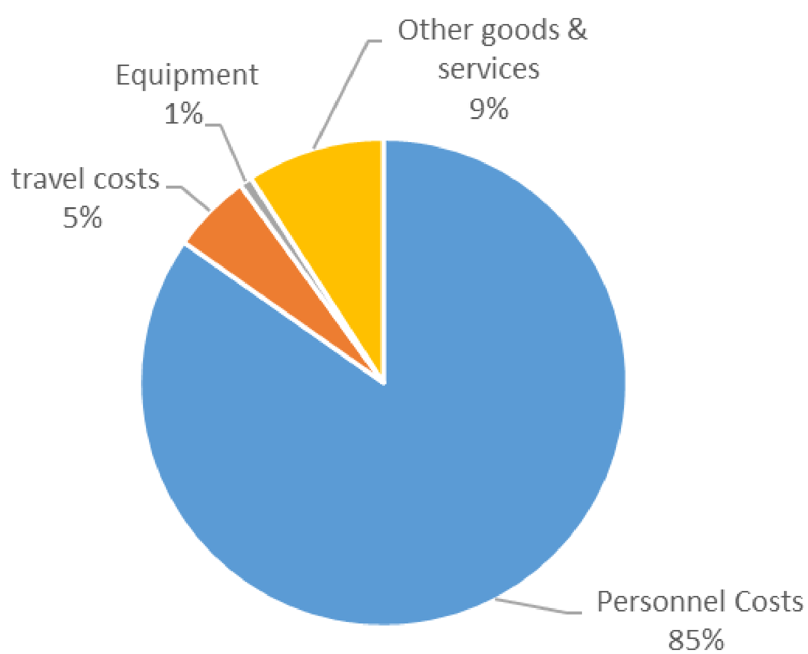
ACED – Planned resources

TOTAL BUDGET	5,1M€
EC requested contribution	2,5M€

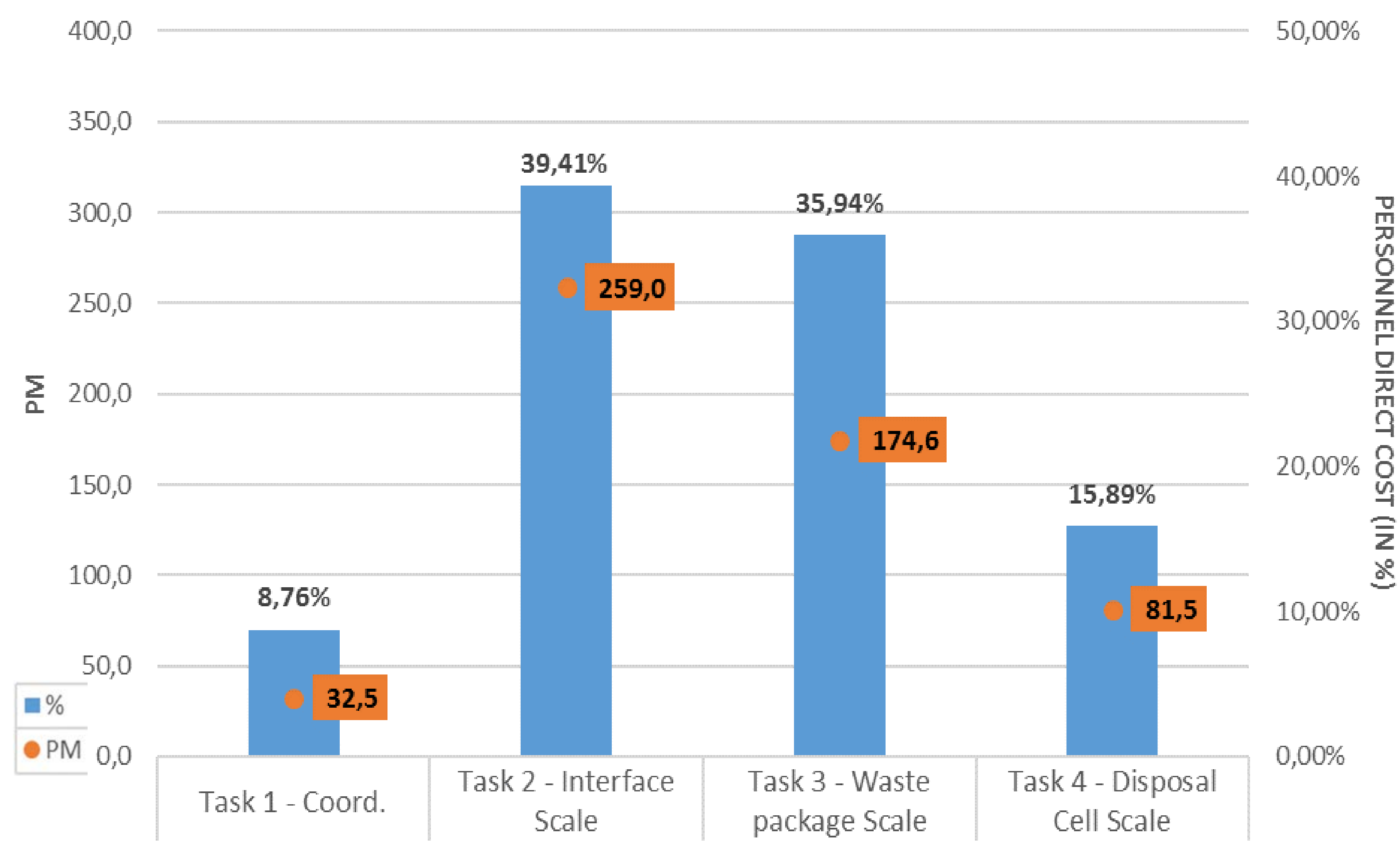
**ACED WP:
Distribution of EC Contribution
between categories of Actors**



ACED WP - Budget distribution between categories of direct costs



**ACED WP:
Personnel costs breakdown per task
(in % and in PM) - Total PM: 547,6**



ACED Task 1 - S/T Coordination, State-of-the-Art, Training Material

- S/T Coordination & Training materials (Y1-4)
- State-of-the-art (Y1)
  - Compilation of processes description and models for 6 interfaces
  - Overview of current handling of chemical evolution
  - Overview of existing experimental data on interface processes
- Integration report (Y4)
  - Update of SOTA
  - Synthesis of new methodologies, integration of knowledge, complexity

- Knowledge from many EU projects will be used (e.g., ECOCLAY I, II, NF-PRO, REDUPP, CAST, CEBAMA, MIND, …) and SOTAs from other WP (e.g., CORI, HITEC)

ACED Task 2 –Reactivity of Steel/Material at the Interface Scale

- Key aspects:
  - Steel/clay and steel/cement interfaces
  - Experiments & reactive transport at the interface scale
  - Using existing experiments and new state-of-the-art experiments
- Key output:
  - Geochemical and coupled reactive transport models as basis for task 3 and 4
  - Information on
    - Corrosion rate of steel in contact with clay or cement for different variables (T, redox, chemistry, heterogeneity of contact)
    - Fate of Fe(III) in cement or clay (-> link with CORI)
    - Physical-chemical evolution of interfaces
    - Evolution of transport properties
- Method:
  - Start from SOTA for initial models and experimental design (Y1)
  - Updating models & interaction modelers-experimentalists (Y3-Y4)
  - Interaction with WP3 & 4 (meetings and WP level)
- Complement other EU projects will be used (e.g., CEBAMA)

ACED Task 3 – Waste Package Scale

- Key aspects:
  - Conditioned waste, disposal container, overpack
  - Existing experiments complemented with additional measurements
  - Evaluation of processes knowledge integration in reactive transport model
  - Evaluation of model abstraction techniques as input to T4
  - Iterative approach (adapting models at ~Y3)
- Key output:
  - Additional characterization of systems relevant for ILW and HLW waste packages with a time span of a year up to a few decades (Y1 experimental plan, Y3 reports)
  - Critical processes at waste package scale (Y4)
  - Information for implementation at disposal cell scale (Y2, Y4)
- Information from CORI (Y1, Y3), GAS (Y1). Joint workshop with GAS & DONUT on model abstraction. Interaction with DONUT on numerical benchmarking and numerical challenges.

ACED Task 4 – Disposal Cell Scale

- Key aspects:
  - Process-based reactive transport model for ILW and HLW as a benchmark for abstraction methodologies
  - Evaluation of abstraction methodologies using the process-based model
  - Application of abstracted models over a wider range of variables
- Key output:
  - Detailed reactive transport model for ILW and HLW disposal cells (Y2 – refined model Y4)
  - Review upscaling and abstraction methods (Y2)
  - Evaluation abstraction methods (Y4)
  - Identification of key processes, parameters and features at disposal cell scale (Y4)
- Information from CORI (Y1-Y3) and GAS (Y1). Joint workshop with GAS & DONUT on model abstraction. Interaction with DONUT on numerical benchmarking and numerical challenges.

Key challenges & objectives for Year 1

- Specifications of ILW and HLW disposal cells (T1, M1-M2)
- Development of SOTA (T1, M1-M7)
  - Knowledge on interactions at the interface scale & process models
  - Collection of (current) conceptualization of chemical evolution at disposal cell scale in EU countries
- Development of experimental program (T2&3, M2-M7)
  - Workshops for exchange between experimentalists and modelers
- Set-up new experiments (T2&3, M7-…)
- Development conceptual models (T2,3&4, M7-M12) and implementation (M7-…)