

Towards the development of industrially useful measurement protocols for nuclear decommissioning

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KNOWLEDGE IN ACTION

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NuTeC

Nucleair Technologisch Centrum

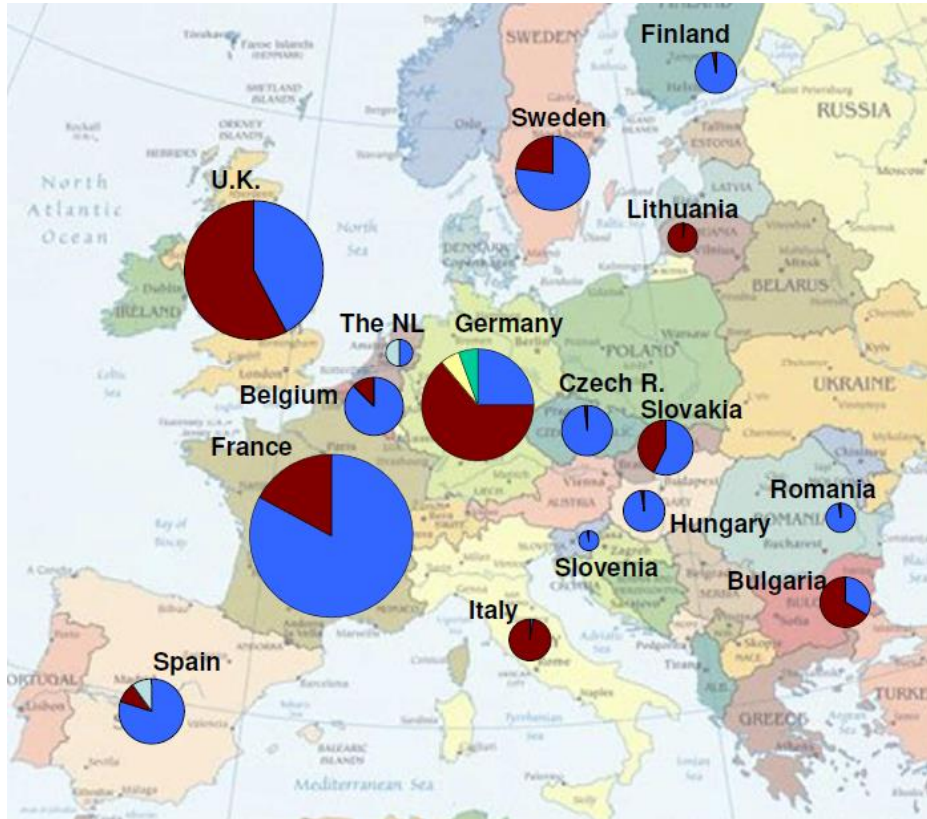
Outline

1. Introduction
2. Industrially useful characterization methods & reference materials for nuclear decommissioning
3. Automation of measurements during nuclear decommissioning
4. Conclusion & outlook

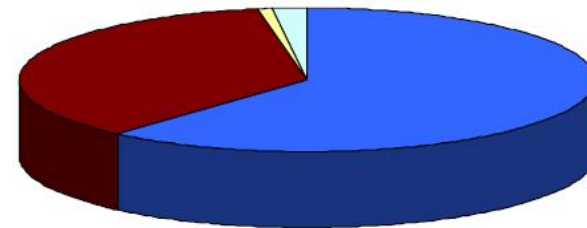
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Several nuclear power plants in EU are entering decommissioning

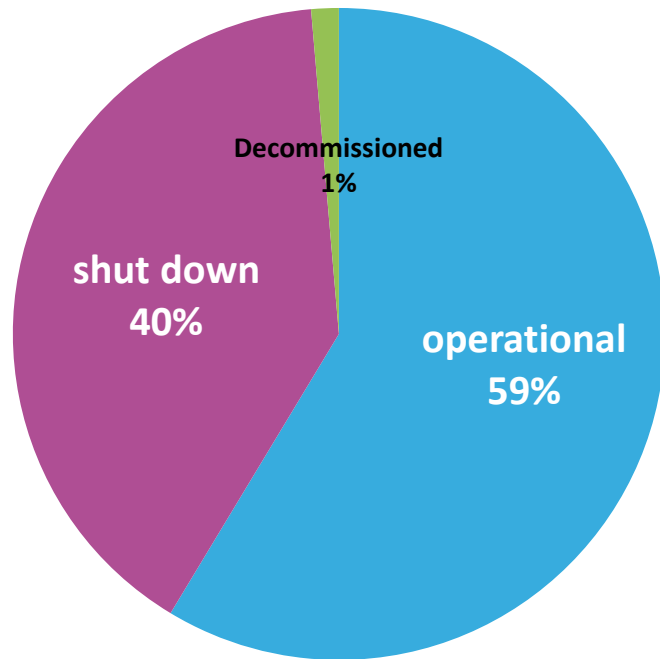


- Operational
- Shutdown - Dismantling
- Fully Dismantled
- Long Term Safe Enclosure



TOTAL
 Power reactors in EU: 222
 Operating reactors: 131

Several nuclear power plants in EU are entering decommissioning



- How to motivate young researchers/students to do the work?
- Many measurement challenges are present:
 - Suitable measurement methods for challenging environments?
 - Labour intensive methods are used
 - Suitable concrete reference materials are lacking
 - ...

How to motivate students for a career in nuclear decommissioning?



Problematic issues?

- Breaking down = not attractive
- Do we have to clean up the nuclear heritage of previous generations?
- Once the decommissioning of a plant is completed... What will happen to my job?

How to motivate students for a career in nuclear decommissioning?

On the bright side:

- **Recycling = cool**
 - Decommissioning to recycle as much as possible
 - Nobel cause: restore a safe environment, closing the nuclear energy cycle
- Emerging activity: possibilities for **career development**
 - **High job security**
 - Options for **traveling** in Europe



How to motivate students for a career in nuclear decommissioning?

On the bright side:

- Much more than cleaning and demolishing:
 - **Appealing technological challenges**
 - Freedom to implement **creative solutions** (much more than in a operational development)
- Money is less of an issue compared to **security/radiation protection**
- **And... one could consider implementing a robotic approach for measurements**



Measurements during nuclear decommissioning

Labour and time intensive measurements:

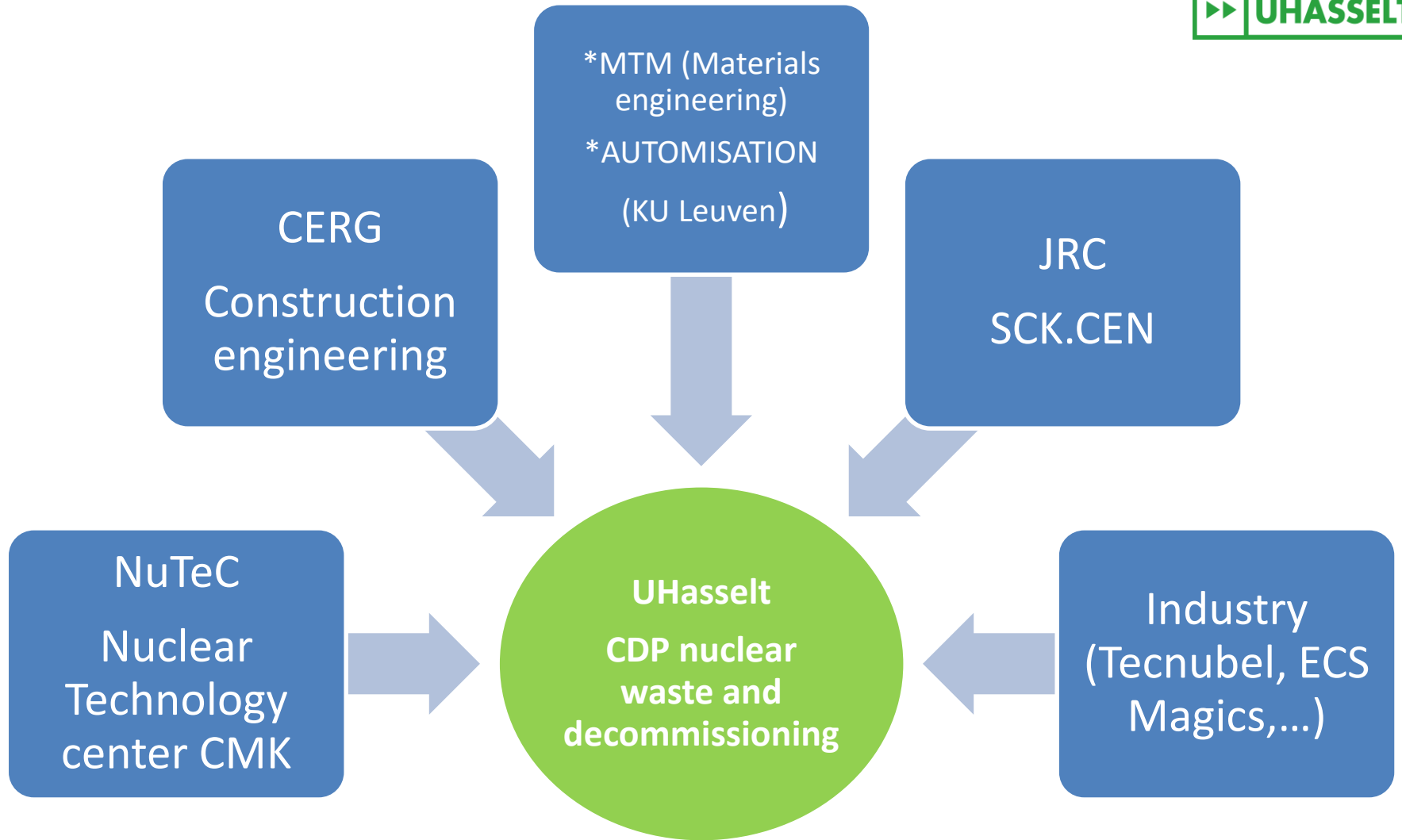
1. Ambient dose rate and nuclide identification measurements taken at specific places to **map an unknown region**
2. **Surface contamination** measurements
3. **Atmospheric contamination** measurements
4. Measurements for **waste characterization**
 - Especially with the aim of improving free release measurements.

→ Options for fresh minds to reshape these completely!

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Collaborative Doctoral Partnerships : JRC



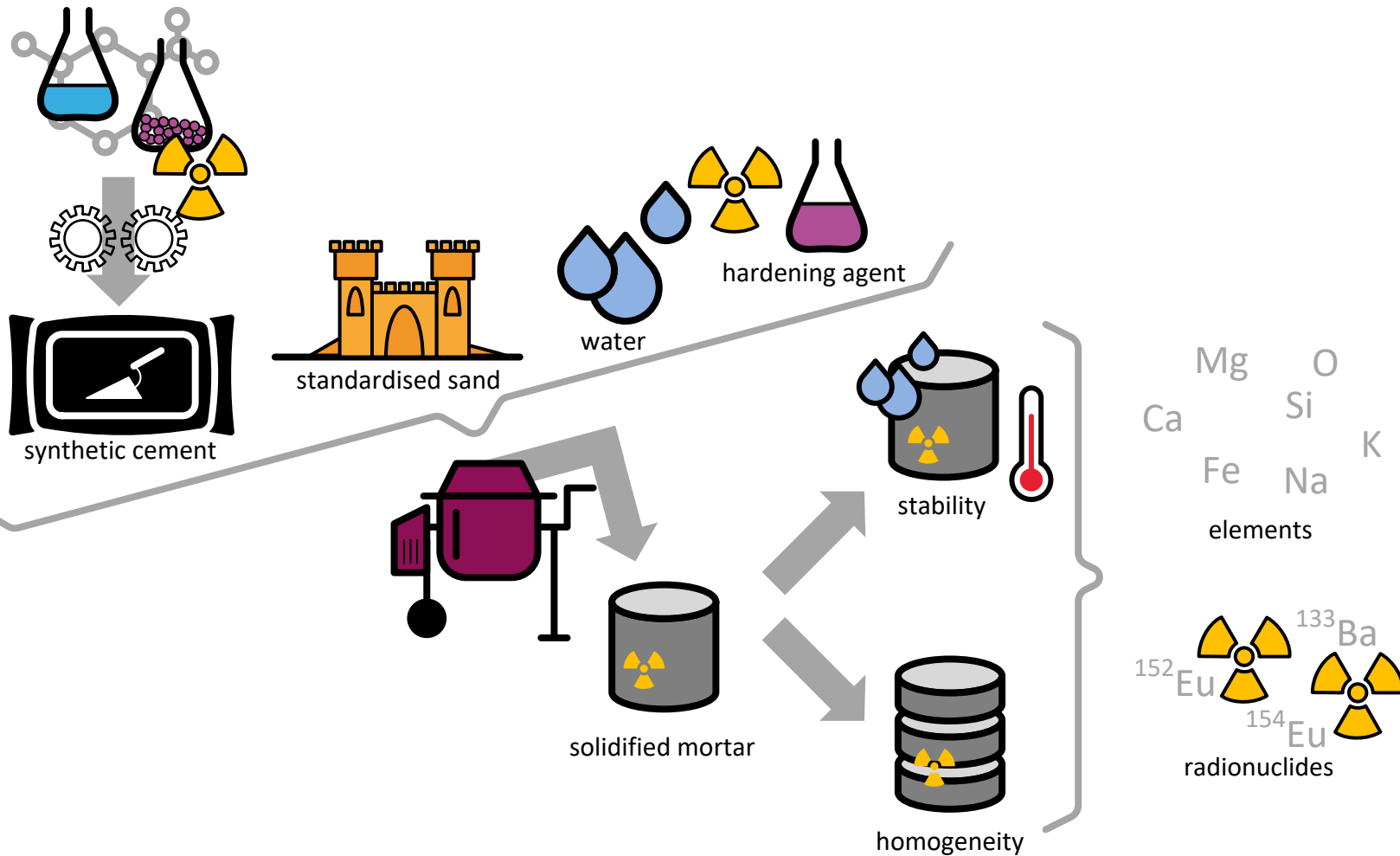
Collaboration in education and research

Collaborative Doctoral Partnerships : JRC

- Strong collaboration with JRC in training activities on nuclear waste and decommissioning
 - Eg. During Cherne activities (Nirim2, 25th Nov 2019)
- Collaboration in master thesis and PhD research



Towards industrially useful characterization methods & reference materials for nuclear decommissioning



[PhD Lowie Brabants: collaboration JRC-Geel; Nov 2018 – Nov 2022]

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Measurements during nuclear decommissioning

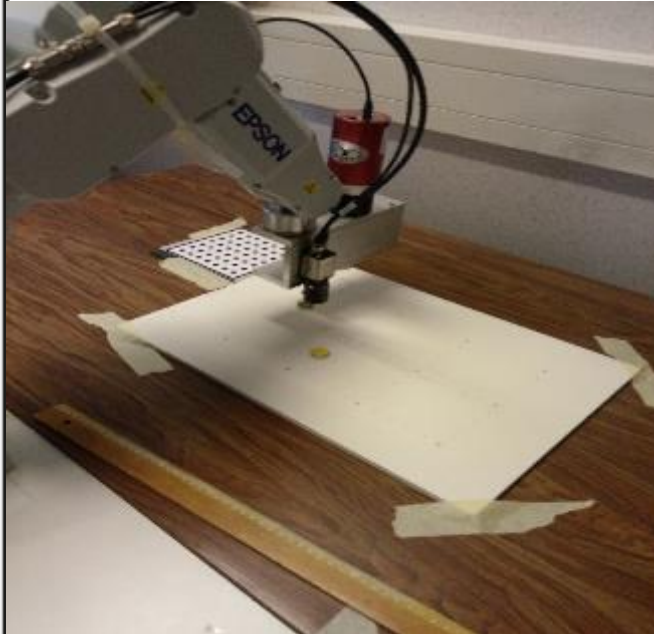


▪ Energy transition funds projects

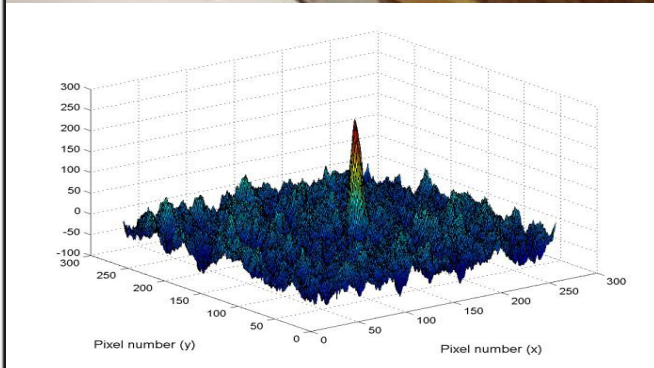
- **"Autonomous Robot platform for CHaractERization"**
during dismantling, decontamination (**ARCHER**)
[UHasselt, KULEuven, Tecnubel & Magics Instruments]
- **"Automation of clearance measurements during decommissioning"**
[UHasselt, KULEuven, ECS]
- **"Characterisation during decommissioning"**
[UHasselt, KULEuven, ECS]

Autonomous Robot platform for CHaractERization during dismantling, decontamination (ARCHER)

Energy transition funds project (funded by Belgian Federal Authority)



- **Exploratory measurements**
- Characterizing/**imaging** of hotspots in potential **high radiation environment**
- Using **light weight probes / camera's** in a **robotics platform**



[UHasselt, KULeuven, Tecnubel & Magics Instruments; Oct 2018 – Oct 2021]

Automation of clearance measurements during decommissioning

Energy transition funds project (funded by Belgian Federal Authority)

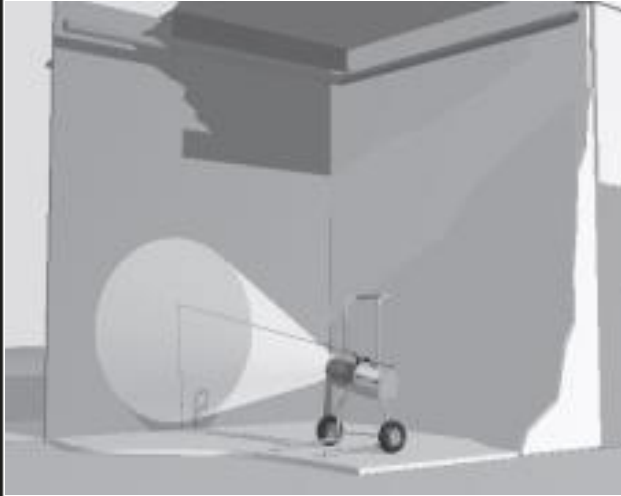


- Development of a **more automated** method for clearance measurements
 - Tool to support **ergonomic** aspects
 - Implementation of **robotic support** tools
 - Improving the **efficiency of the operators, traceability** and **reproducibility**
 - **Reducing the margin of error**
- Improving on-site methods
 - Study of **alpha and beta on-site measurement options**
 - **Automated data + position storage**

[UHasselt, KULeuven & ECS; Jan 2019 – Jul 2020]

Characterisation during decommissioning

Energy transition funds project (funded by Belgian Federal Authority)



- Study of measurement systems based on **gamma spectroscopy** for **nuclear decommissioning waste in several containers** (200 & 400 l barrels, m³)
 - Systems for sorting waste in appropriate waste category
- Study of on-site characterisation systems



[UHasselt, KULeuven & ECS; Dec 2018 – May 2020]

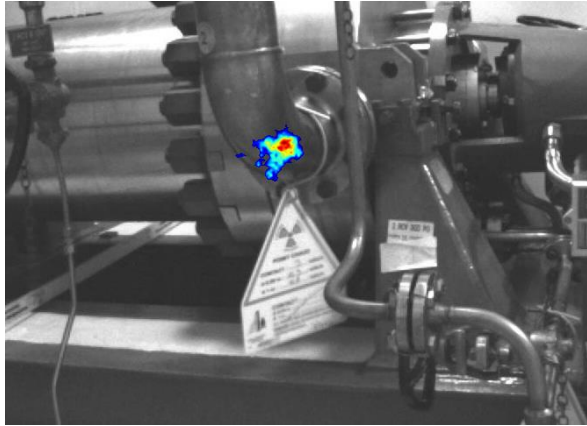
Measurements during nuclear decommissioning

- Demonstration (measurement) tools
 - 3 D (radiological) mapping
 - Strong involvement of master students
 - Training sessions and dissemination sessions linked to the projects are under preparation
- Projects to trigger the imagination for new students to go into field of nuclear decommissioning

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Conclusion & outlook



- Automated measurement solutions and reference materials for nuclear decommissioning are under development
- Collaboration academic and industrial partners



- Training sessions and dissemination sessions are under preparation
- These case studies can trigger the interest and involvement of students