NUCLEAR SITE INTEGRATED CHARACTERIZATION FOR RADIOACTIVE WASTE MINIMIZATION: THE INSIDER PROJECT

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Share WP3 Workshop October 22-23rd, 2020

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About the INSIDER project

http://insider-h2020.eu/

Highlights of the development and benchmarking


INSIDER

Improved Nuclear Site characterization for waste minimization in DD operations under constrained EnviRonment

Research and innovation action

NFRP-2016-2017-1

Guidelines and Pre-Standards on Sampling Strategy, Laboratory Analysis and on Onsite Measurements in Constraint Environments

Deliverable D7.10

Perspectives: Methodological guides and recommendations

About the INSIDER project

http://insider-h2020.eu/

Development status report- Use case studies

Perspectives: Methodological guides and recommendations

Main objectives

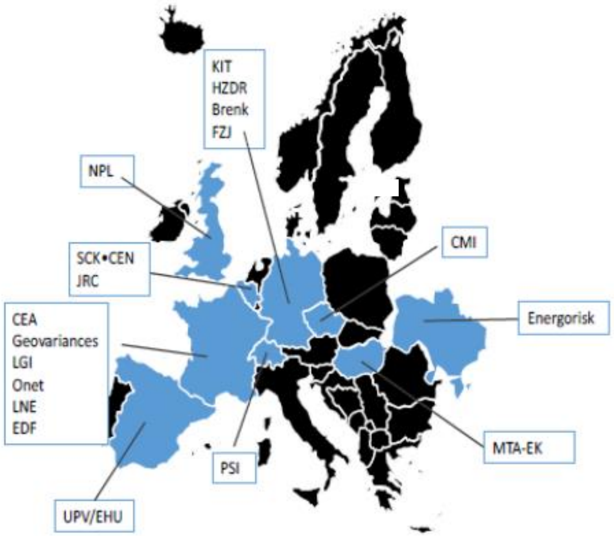
- Improved Nuclear SIte characterisation for waste minimisation in D&D operations under constrained EnviRonment
- **A EU-funded Horizon 2020 project:**
  - “Research and innovation on the **overall management of radioactive waste other than geological disposal**”
  - “Management of **non-standard waste** including D&D waste”

- **Main Objective**

  To develop and validate a new and improved integrated characterization methodology and strategy during nuclear decommissioning and dismantling operations (D&D) in a waste-led approach.
- **Results are being validated through 3 case studies:**
  1. Liquid waste storage tanks : Fuel cycle facility
  2. Nuclear reactor Biological shield : NPP
  3. Contaminated soil: Post incidental

A European Consortium

- Launched in June 2017: 4-year project
- 17 partners from 10 European countries



EUG
IAEA
IRSN
ANDRA
ENRESA
SOGIN
NDF
Kraftanlaghen Heidelberg
KAERI
ORANO
IRE
ENGIE

Project organisation

Global methodology

Establish common methodologies to deploy reference guidelines

identification, development, implementation

In situ and in lab measurements: suitability, proficiency, performances

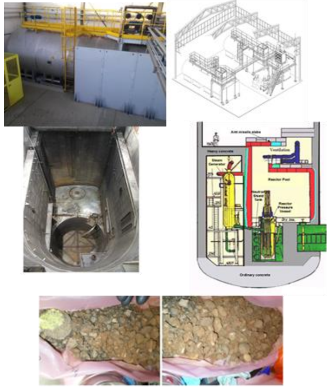
Uncertainty sources and different impact factors

WP2 objectives and methodology

WPL : Paolo Peerani

Objectives

- Present practices and actual needs
  - operational needs and regulatory)constraints
  - Objectives for cartography and characterisation
  - State of the art and technological gaps
  - Economic impact assessment
- Define and organise an experimental benchmark
  - As a common validation of the INSIDER concept under real conditions
- Elaborate good practices and guidelines



1. Decommissioning of a back/end fuel cycle and/or research facility - Ispra (JRC)
2. Decommissioning of a nuclear reactor - Mol (SCK/CEN)
3. Post accidental land remediation - (CEA)

Methodology

- Survey involving partners and EUG
- Identification of on going relevant D&D project
- Derive lesson/compare to present practices

WP3 objectives & global methodology

sck cen Belgian Nuclear Research Centre *WPL : Sven Boden*

Objectives

- Statistical approach development and implementation
- Application to 3 different reference use cases
- Statistical approach guide

Selection of state of the art techniques concerning sampling design optimization

Use of prior information and multiple iterations

Testing this approach in different UCs

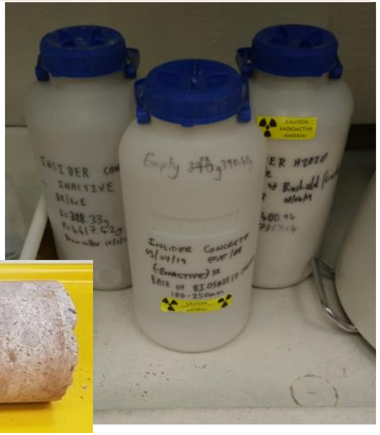
Use REX from overall uncertainty calculations

WP4 objectives and methodology

NPL National Physical Laboratory *WPL : Ben Russel*

- **Comprehensive review of radiochemical measurement techniques,**
  - Based on a survey
- **Validation of a radiochemical microsystem for Fe-55 extraction**
- **Provide 2 certified reference materials, characterised for radionuclide content to an accuracy better than 10 % at 95 % confidence level**
  - Matrix representative: real concrete spiked (^{133}Ba, ^{152}Eu, ^{154}Eu, ^{60}Co) and liquid
  - Certification by 3 NMI within the project

Characteristic	Aqueous CRM
Matrix	Spiked aqueous sample
Radionuclides	^{63}Ni (1-10 Bq/g) ^{90}Sr (1-100 Bq/g) ^{238}Pu (0.1-10 Bq/g) $^{239,240}Pu$ (0.1-10 Bq/g) ^{241}Am (1-10 Bq/g) ^{60}Co (0.1-10 Bq/g) ^{137}Cs (1-200 Bq/g) ^{55}Fe (0.1-5 Bq/g) ^{238}U (0.1-10 Bq/g)
Additional information	• Stable element composition



$$x_{MRC} = y_{car} + \delta_{hom} + \delta_{lts}$$

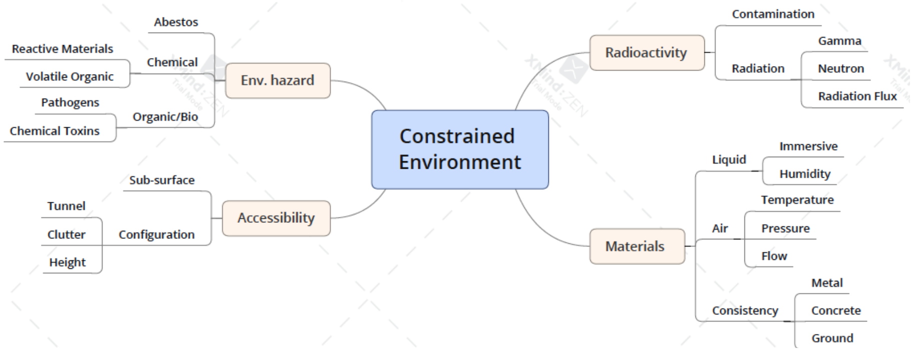
$$u^2_{CRM} = u^2_{car} + u^2_{hom} + u^2_{lts}$$

WP5 objectives and status

WPL : Margarita Herranz

Universidad del País Vasco / Euskal Herriko Unibertsitatea

- **Review the different available techniques for in-situ measurements in constrained environments**
- **Classification of the constrained environments and suitability of existing methodologies**
- **Organization of the participation in the in-situ measurement campaigns**
  - BR3 nuclear reactor
  - ISPRA tanks
- **Adaptation / Validation in situ**



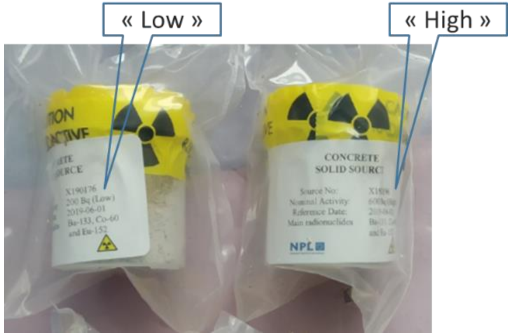
Rooms	Type of installation	Step	Contamination	Gamma Dose rate	Neutron Dose rate	Radiation flux
Process Hot cells	Reactors Plants	Initial Intermediate Final	very high high	very high high	very high high	no
Process ducts	Reactors Plants	Initial	very high high	very high high	very high high	no
Ventilation ducts	All	Intermediate	low	no	no	no
Chimney	All	Final	low	no	no	no
Reactor coolant system	Reactors	Initial	very high high	Very high high	very high high	no
secondary cooling system	Reactors	Intermediate	low	no	no	no
Tanks	All	Initial Intermediate	very high high	very high high	very high high	no

WP6 objectives and status

WPL : Marielle Crozet

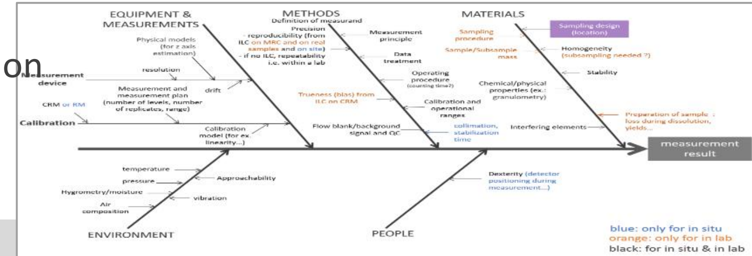
Objectives

- **Test the ability of different techniques/methods (proficiency test) to carry out measurements**
- **Estimate the measurement (in lab or in situ) uncertainty on synthetic and real samples**
- **Try to establish a complete uncertainty budget including every step of the INSIDER methodology (geostat & measurement)**



Methodology

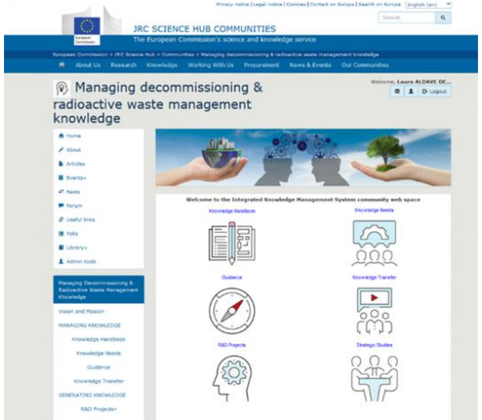
- **InterLaboratory comparisons on Certified Reference Materials (CRM)**
  - Proficiency test and method performance
- **Benchmarking results analysis for in situ measurement and on real samples**
  - proficiency test and measurement performance in realistic condition
- **Uncertainty budget**
  - *Different sources and relative importance*

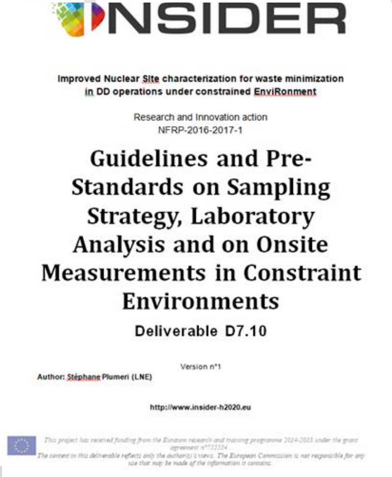


WP7 objectives and methodology

JRC EUROPEAN COMMISSION *WPL : Laura Aldave de la Heras*

- EUG assessment and interface management
- Public communications
- Dissemination
    - State of knowledge (JRC Hub)
    - Standardisation commission
        - Mapping of existing standards linked to INSIDER's topics is achieved. ISO, NF, AIEA documents…
    - Trainings (Elinder initiative)
    - Project workshops

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Version n°1

Author: Stéphane Plumeri (LNE)

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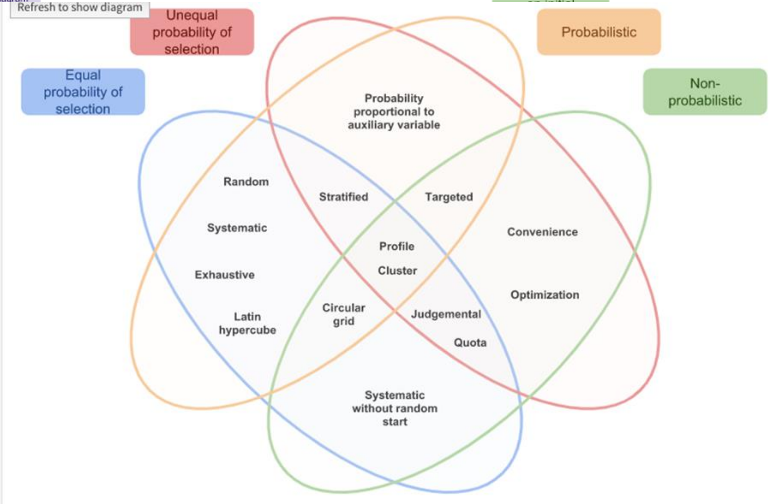
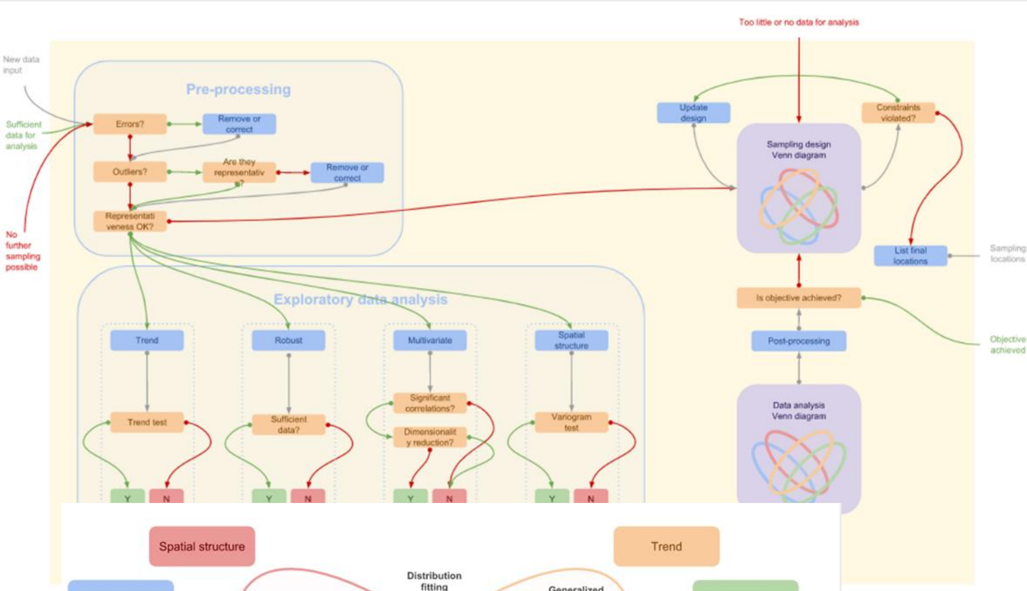
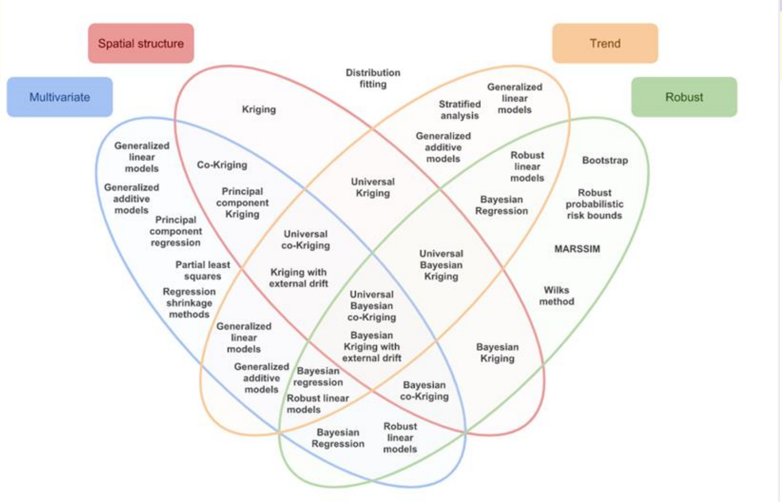
WP3 sampling strategy- Statistical approaches







Coupling to in situ & in lab measurements

Gathering all possible consistent and reliable data

In-situ measurements

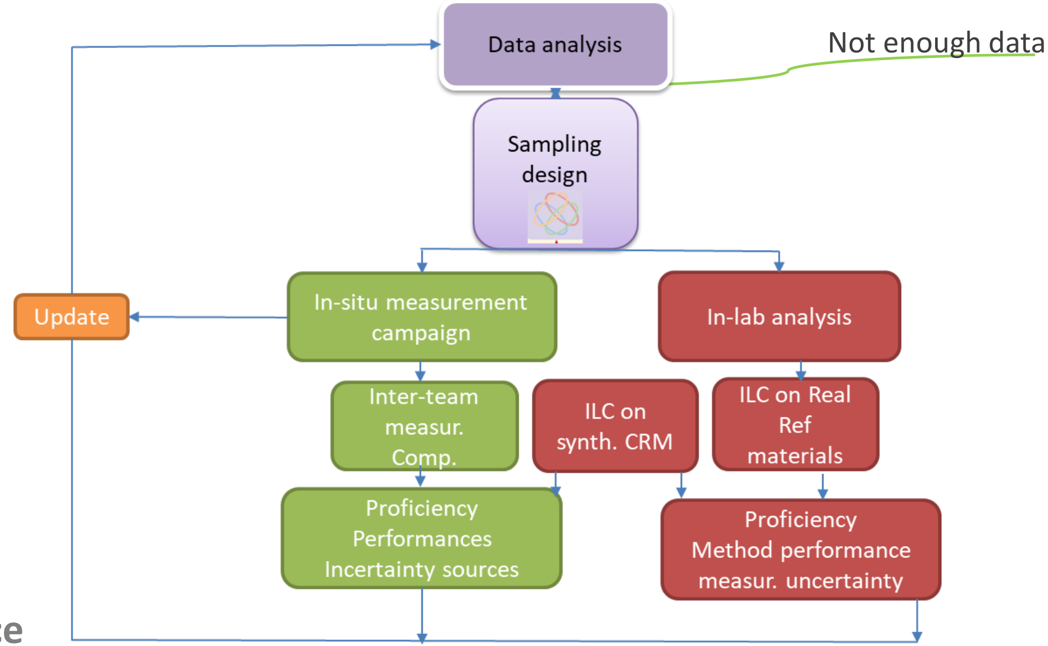
- Suitable techniques
- Depending on analytical objectives

In-lab analysis

- Real collected samples

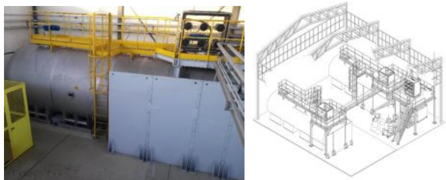
Performance assessment and refinement

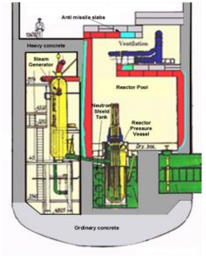
- Statistical processing of measurement result
  - Interlaboratory and team comparison
- CRM for calibration and method performance



Benchmarking: Three case studies

Apply the methodologies to real worksites under decommissioning





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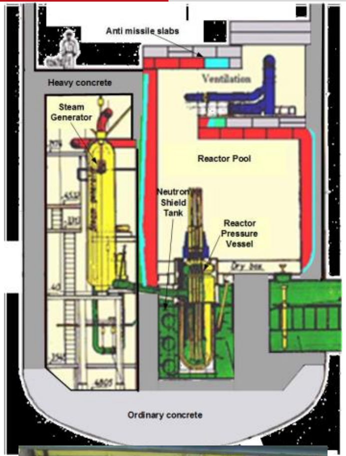
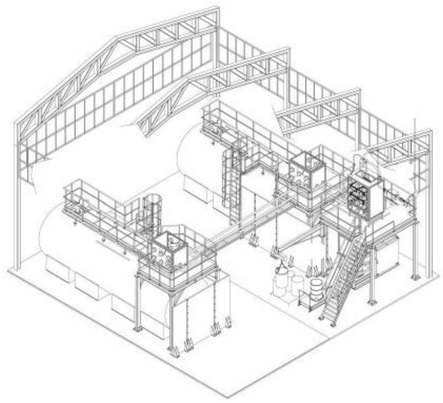
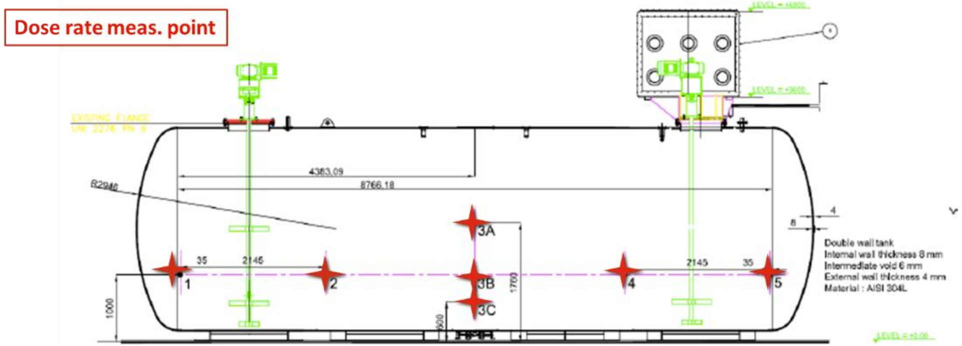
Benchmarking on Use case 2: BR3 reactor
The in-situ campaign



- **Dose rates and total gamma** in three points, the same for all teams.
- At each point, measurements in contact and at 10 cm.
- Points: one in the low activity range, one in the medium and one in the high
- Gamma spectrometry in only one point

Benchmarking on use case 1
The in-situ campaign





Dose rate measurement points
1, 2, 3A, 3B, 3C, 4 and 5

Dose rate measurements point

- Dose rates in 8 points, the same for all teams.
- At each points, measurements at 10 cm.
- Points: along the horizontal and vertical tank axis, in both tanks.
- Points in the “inner” part of the tanks.

Gamma Spec meas. points

- Gamma Spec in 2 points, the same for all teams.
- Points: along the vertical tank axis, in both tanks.
- Points in the “outer” part of the tanks.

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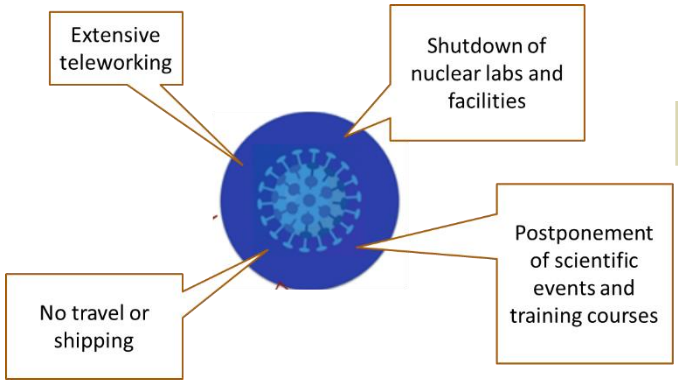
Perspectives



- Impact on the experimental part:
  - Benchmarking and ILC
  - **Extension of the project is unavoidable (4 to 6 months)**
- Impact on recommendations guide publication
- Impact on dissemination & communication

Postponement to the end of project (9-10/2021):

- Statistical approach guideline
- Guidelines on in-situ method implementation and method validation
- Establishment of uncertainty budget and recommendation guide
- Standardisation recommendations
- State-of knowledge

Conclusions

Innovative metrological study based on a multidisciplinary network and D&D key activities

- New D&D matrix reference materials development
- Intercomparisons on real samples and Inter-team
- Analytical innovation needs identification, development and implementation
- Advanced integrated approach for site radiological characterisation and automation of characterization process…
- Decommisionning operating experience

Methodological guides updated according to benchmarking feedback

- Established link with standardisation commissions (ISO) for future international standards
- Contribution to European learning (ELINDER)
- Potential Interface with other EU initiative (SHARE, METRODECOM projects)

Discussions

Potential further opening of the project in the future Horizon Europe Euratom work program

- Extension/application of the methodology and approaches : historic wastes, graphite reactors, NORM…
- Nuclear standards (CRM, Standards and measurements)
- Management of other waste (legacy waste, NORM, future waste…)
- Decommissioning standardized practices, remediation issues

THANK YOU for your attention

Any questions?

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