

EUROPEAN COLLABORATIVE
EFFORTS TO ACHIEVE
EFFECTIVE,
SAFE, AND COST-CONTROLLED
DISMANTLING OF NUCLEAR
FACILITIES

-
FISA, 01/06/2022

N. MALLERON (Cyclife SAS), M. GUERIN (EDF), D. ROULET (ONET), M. MICHEL (CEA), C. RIVIER (CEA),
P. LEFEVRE (EDF), M.-B. JACQUES (CEA)

Summary



CONTEXT : DISMANTLING OF
NUCLEAR REACTOR IN EUROPE

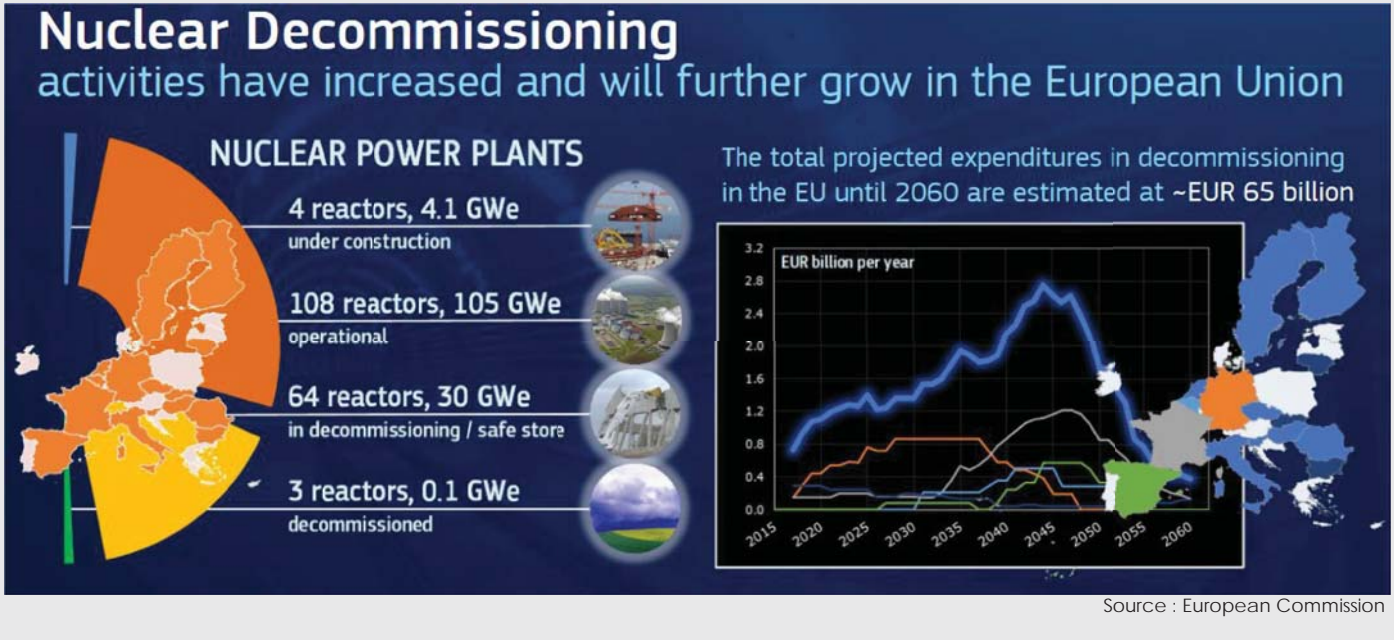


A BRIEF OVERVIEW OF EUROPEAN
COLLABORATIVE PROJECT
SUPPORTED BY EURATOM



ZOOM ON SOME ACHIEVEMENTS
OF THE EURATOM'S PROJECTS AND
PERSPECTIVES

Context



Stakes in power generation nuclear reactors dismantling

Graphite reactors: Many technical challenges due to huge dimension, thickness of concrete and steel, large amount of graphite to be safely retrieved

Other reactors (PWR, BWR, HWR...): technical feasibility has been established

In both cases, today's main practices are only partially industrial:

- Operation are mainly carried out manually
- Extensive use of personal protection measures
- Poorly reproducible nature of the operations
- Poor ratio between time consumed to perform the operations and time used to plane, monitor and control them

Euratom's projects



common goal

Move forward to an efficient, safe, cost-controlled and industrial way of dismantling using the full potential of the so-called « 4.0 industry » technologies :

- Digital technologies
- Automatised or semi automatised robotics
- Laser cutting
- ...

Overview of the projects (1/5)



Platform based on Emerging and Interoperable Applications for enhanced Decommissioning processES

- 3 years (01/10/2020 - 30/09/2023)
- 14 partners from 7 countries
- Coordinated by CEA



Overview of the projects (2/5)

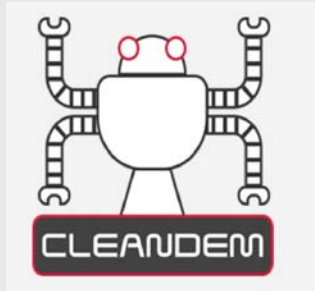


Improved Nuclear Site characterisation for waste minimisation in Decommissioning and Dismantling operations under constrained EnviRonment

- 4 years (06/2017 - 11/2021)
- 18 partners from 10 countries
- Coordinated by CETAMA (CEA Energies Division)



Overview of the projects (3/5)



Cyber physical Equipment for unmanNed
Nuclear DEcommissioning Measurements

- 3 years (03/2021 - 02/2024)
- 11 partners from 4 countries
- Coordinated by CEA list



Overview of the projects (4/5)



Laser Dismantling
Environmental and Safety
Assessment

- 4 years (07/2020 - 06/2024)
- 6 partners from 4 countries
- 21 external stakeholders (Expert Group, End User Group and Support Group)
- Coordinated by ONET Technologies



Overview of the projects (5/5)

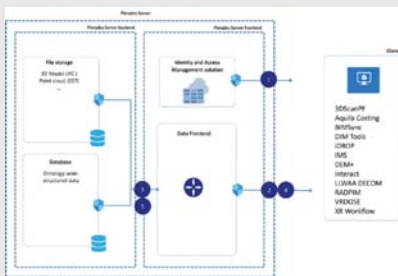


INNOvative tools FOR dismantling of GRAPHite moderated nuclear reactors

- 3 years (10/2020 - 09/2023)
- 13 partners from 5 countries
- Coordinated by EDF



Example of achievements



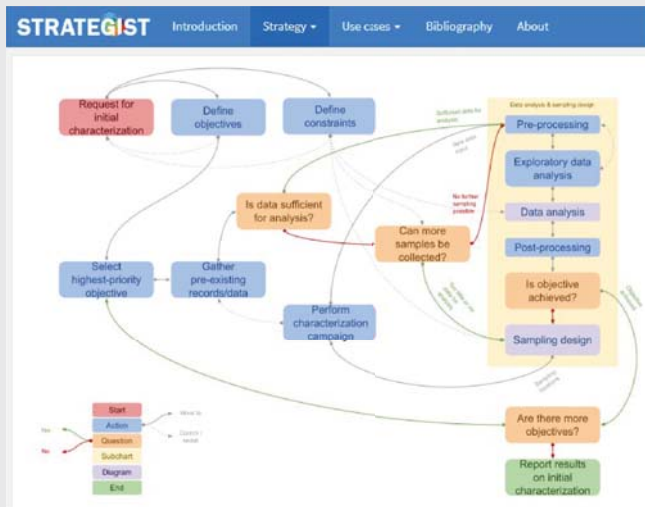
PLEIADES platform, which architecture aims at maximising the collaboration between its different software modules.

It is based on common ontology (a common language) and a common BIM-like database to make the interaction between the software as efficient as possible

→ 3D models of the three nuclear facilities provided by IFE (left), ENRESA (middle) and EDF (right) as use cases of PLEIADES platform:



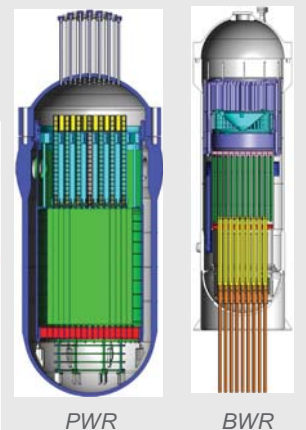
Example of achievements



INSIDER developed digital tools to help in characterization phases implementation:

- **STRATEGIST** (Sampling Toolbox for Radiological Assessment To Enable Geo-statistical and statistical Implementation with a Smart Tactic): step-by-step guide to implement the sampling strategy for the characterization of contaminated sites (<https://strategist.sckcen.be/>)
- **INSPECT** (In Situ Probe Selection Tool): decision helping tool for the selection of the suitable detectors for the different D&D phases

Example of achievements



Three milestones achieved up to now:

- Specifications for the dismantling of reactor components agreed.
- Qualification activities in the Technology Qualification Plan are completed.
- Technical countermeasures defined at laboratory scale.

Cutting tests (demonstrators) to be started from September 2023

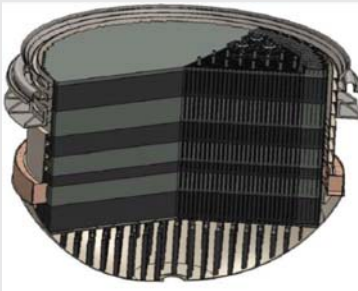
Up to 200mm in thickness in air (14kW laser power)

Achievements during and beyond Inno4Graph



Design of a representative and full scale mock-up of the Chinon A2 graphite stack

- To **minimise risks** of the complex and repetitive operations (several thousands bricks for a single stack) of the graphite core retrieval and **increase the probability of success**

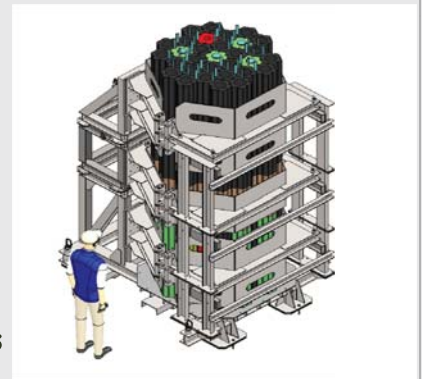


Developments of methodologies and tools

Demonstration to stakeholders

Operator training

Development of alternative methodologies and tools during on-site operations



Achievements during and beyond Inno4Graph

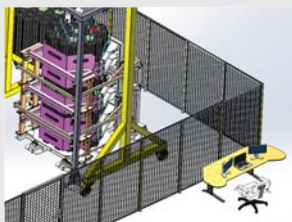


- Testing programme is defined according to the **risk analysis associated to the graphite extraction scenario**
- Tests to be performed in the **Industrial Demonstrator** from 2022

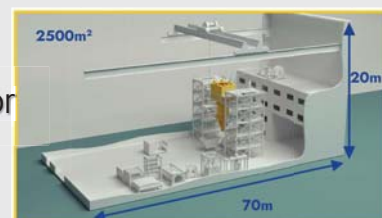


Numerical simulations

Physical tests



Remote control tests
(from Industrial Demonstrator control room)



Conclusions and perspectives

5 projects, 1 common goal: to implement 4.0 Industry technologies in order to :

- Improve the knowledge reliability of the installations
- Minimise dose rates
- Facilitate the sharing of information between the stakeholders of a dismantling project

Beyond the traditional technical locks, 2 other challenges have been tackled:

- Tools and methodologies must be applicable to a maximum of various projects
- Drastic proof of safety and reliability of new technologies are required

As a result of the 5 projects :

- A unique common data and knowledge base
 - New tools design or methods natively taking into account the needs of a maximum of dismantling operators. 10 different European countries are involved in the five projects, plus Switzerland, Ukraine, United-Kingdom and Japan through end-user groups.
 - New test facilities have also been put in place and will allow the joint work undertaken to be continued.
- All of this paves the way to further collaborative projects and developments, in order to continue to implement safe, reliable and efficient new technologies in European dismantling projects.

Further information: Websites and contacts

<https://www.inno4graph.eu/>

<https://ldsaf.eu/>

<https://pleiades-platform.eu/>

<https://insider-h2020.eu/>

<http://cleandem-h2020.eu/>

- **N. MALLERON**, Cyclife SAS, nicolas.malleron@cyclife-edf.fr
- **M. GUERIN**, EDF, michele.guerin@edf.fr
- **D. ROULET**, ONET, droulet@onet.fr
- **M. MAUGAN**, CEA, maugan.michel@cea.fr
- **C. RIVIER**, CEA, cedric.rivier@cea.fr
- **P. LEFEVRE**, EDF, philippe-n.lefevre@edf.fr
- **M.-B. JACQUES**, CEA, marie-benedicte.jacques@cea.fr