Group B
Session 2: Project Management and Costing

Session will start at 13:50, CET

Fanny FERT - CEA

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement nº 847626.
## Agenda

### Dec. 1st

<table>
<thead>
<tr>
<th>Time</th>
<th>2A</th>
<th>Presentation of IAEA DACCORD (+ CERREX + ISDC, etc.) by Patrick O’Sullivan, IAEA (10min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:50</td>
<td>2B</td>
<td>Presentation of NEA activities relating to costing of decommissioning and legacy management by Simon Caroll, VATTENFALL (10min)</td>
</tr>
<tr>
<td>14:00</td>
<td>2C</td>
<td>Presentation of EU-H2020 Project PLEIADES by Caroline CHABAL, CEA (10min)</td>
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<tr>
<td>14:10</td>
<td>2D</td>
<td>Presentation of first achievements from SHARE in this area + introduction to post it session, by Fanny Fert, CEA</td>
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**14:40- 16:50 - Post it session by sub-thematic area**

| Link MURAL 25 | 25 | Methodologies and guidance for cost estimation |
| Link MURAL 28 | 28 | Methods and tools for sensitivity and uncertainty analysis in cost estimation |
| Link MURAL 26 | 26 | Software for cost estimation |
**Group B**  
**Session 2: Project Management and Costing**

**Agenda**

<table>
<thead>
<tr>
<th>Dec. 2nd</th>
<th>9:00- 12:00 - Post it session by sub-thematic area</th>
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<tbody>
<tr>
<td></td>
<td><strong>Link MURAL 19</strong></td>
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<tr>
<td></td>
<td>19 Methodologies and software tools for comparison of alternative decommissioning strategies</td>
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<tr>
<td></td>
<td><strong>Link MURAL 21</strong></td>
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<tr>
<td></td>
<td>21 Tools for data collection in the field (e.g. for work monitoring)</td>
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<tr>
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<td><strong>Link MURAL 22</strong></td>
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<td></td>
<td>22 Digital transformation in decommissioning (big data, business intelligence)</td>
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<td></td>
<td><strong>Link MURAL 27</strong></td>
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<tr>
<td></td>
<td>27 Development of mechanisms for cost benchmarking</td>
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<td></td>
<td><strong>12h00- 13-00 Lunch Break</strong></td>
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<td></td>
<td><strong>13:00- 15:00 - Post it session by sub-thematic area</strong></td>
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<td><strong>Link MURAL 24</strong></td>
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<td></td>
<td>24 Methods and tools for communication (public)</td>
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<td><strong>Link MURAL 20</strong></td>
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<td></td>
<td>20 Methodologies and software tools for project management and performance monitoring</td>
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<td></td>
<td><strong>Link MURAL 23</strong></td>
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<td></td>
<td>23 Supply chain management for Decommissioning</td>
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</table>
Plan of Presentation

- Global Status of Nuclear Decommissioning
- International Structure for Decommissioning Costing (ISDC)
- DACCORD Project Main Results
Global Status of Nuclear Facilities

[Sources: IAEA 10-2020 : PRIS, Research Reactor, and INFCIS databases]

### Power Reactors

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<th>Count</th>
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<td>In construction</td>
<td>54</td>
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<tr>
<td>in operation</td>
<td>442</td>
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<tr>
<td>Permanent Shutdown, in</td>
<td>172/18</td>
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<td>decommissioning / Decommissioned</td>
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<td>677</td>
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</table>

### Research Reactors & critical assemblies

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<td>in operation</td>
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<td>Long-term / temporary Shutdown</td>
<td>28</td>
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<tr>
<td>Permanent Shutdown, in</td>
<td>125/444</td>
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<td>decommissioning / Decommissioned</td>
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### Nuclear Fuel Cycle Facilities

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<td>in operation</td>
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<td>Long-term / temporary Shutdown</td>
<td>27</td>
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<td>Permanent Shutdown, in</td>
<td>158/131</td>
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<tr>
<td>decommissioning / Decommissioned</td>
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<td>704</td>
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</table>

Small industrial facilities using radioactive material: several ‘000s
Numbered matrix of typical decommissioning activities and cost categories

Levels 1 and 2 are aggregating levels

Level 3 is the reference level

Open for any additional user’s defined numbering down to level 3

Level 1 Principal activities

Level 2 Activity groups

Level 3

Cost Categories are defined which are to be allocated at each ISDC level

Cost items (typical decommissioning activities) with detailed definitions and examples (the “4th level”)

01 Pre-decommissioning actions
02 Facility shutdown activities
03 Additional activities for safe enclosure or entombment
04 Dismantling activities within the controlled area
05 Waste processing, storage and disposal
06 Site infrastructure and operation
07 Conventional dismantling and demolition and site restoration
08 Project management, engineering and support
09 Research and development
10 Fuel and nuclear material
11 Miscellaneous costs

Total costs
Labour costs
Investment costs
Expenses
Contingency

Cost calculation structure (any type)
04 Dismantling activities within the controlled area

04.0500 Dismantling of main process systems, structures and components

04.0501 Dismantling of reactor internals

- Preparation of the work area for dismantling, extracting and packaging the waste for disposal
- Construction of dams on vessel nozzles or gates to isolate and contain the pool being used for disassembly (if performed underwater)
- Installation of handling devices and protection systems
- Control-rod blades and motors, rod guide tubes, RSA-guide tubes
- Steam dryer
- Feedwater sparger ring
- Core shroud, including fixing
- Fuel channels in channel type reactors
- Monitoring of the disassembly
- Operation of the segmentation tooling
- Maintenance and change-out of support equipment (purification and ventilation filters)
- Accepting and preparation of the disposal containers as well as loading and processing containers for transport
- Removal of handling devices and protection systems

04.0502 Dismantling of reactor vessel and components

- One-piece-removal of reactor
- Reactor pressure vessel top head
- Reactor core top head
- ...

Examples of activities:

- Preparatory activities
- Dismantling of components
- Supporting activities
- Finishing activities

Subject of costing are elementary activities including all relevant cost drivers such as:

- staff
- equipment, materials, energy, ...
- services
- etc.
Uncertainties in Decommissioning Cost Estimates

Collaborative Project: Costing of Research Reactor Decommissioning (DACCORD)

- **Objective**
  - Sharing current good practice on costing of research reactor decommissioning including characterization and addressing uncertainties

- **Timeframe**
  - 2013-2019
  - Final Technical Meeting – 21-25 October, Cadarache [EVT1804580]

- **Deliverable**

- **Main topics Addressed**
  - Cost estimation for decommissioning
  - Illustrative costing cases
  - Uncertainty analysis
  - Impacts of planning and characterization on decommissioning

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**Actual Cost [USD 2013] vs. Thermal Power [kW]; (IAEA Database)**

**Total cost on ISDC L1, [USD]**

**Uncertainty of input parameters**

**Labour rate**
DACCORD Phase 2: Decommissioning Strategies

Research reactor types analyzed in Phase 2

Current status of participating reactors

Decommissioning strategy

Average waste generated (participating reactors)
# In-scope Cost Assessment (Illustrative)

![Graph showing cost assessment](image)

Probabilistically and deterministically calculated total cost for JSI TRIGA (Slovenia)

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<td>Pre-decommissioning actions</td>
<td>231 577</td>
<td>33 081</td>
<td>264 658</td>
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<tr>
<td>02</td>
<td>Facility shutdown activities</td>
<td>38 462</td>
<td>7 369</td>
<td>45 831</td>
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<tr>
<td>03</td>
<td>Additional activities for safe enclosure or entombment</td>
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<td>0</td>
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<tr>
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<td>Dismantling activities within the controlled area</td>
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<td>480 891</td>
<td>2 656 897</td>
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<td>05</td>
<td>Waste processing, storage and disposal</td>
<td>1 574 282</td>
<td>276 430</td>
<td>1 850 712</td>
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<tr>
<td>06</td>
<td>Site infrastructure and operation</td>
<td>2 028 462</td>
<td>202 846</td>
<td>2 231 308</td>
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<tr>
<td>07</td>
<td>Conventional dismantling and demolition and site restoration</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>08</td>
<td>Project management, engineering and support</td>
<td>5 250 000</td>
<td>525 000</td>
<td>5 775 000</td>
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<tr>
<td>09</td>
<td>Research and development</td>
<td>131 538</td>
<td>13 154</td>
<td>144 692</td>
</tr>
<tr>
<td>10</td>
<td>Fuel and nuclear material</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>11</td>
<td>Miscellaneous expenditures</td>
<td>150 000</td>
<td>15 000</td>
<td>165 000</td>
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<td><strong>Total</strong></td>
<td></td>
<td>11 580 327</td>
<td>1 553 771</td>
<td>13 134 098</td>
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</table>
Out of scope risks

- Discovery of asbestos
- Unanticipated low level waste (LLW) waste identified during implementation of decommissioning
- External pressure from stakeholders to demolish the buildings
- Unexpected contamination of concrete due to unknown leakage
- Change of the strategy – contractor will be involved instead of own staff
Thank you!

@IAEANE

www.iaea.org/nuclearenergy
NEA activities relating to costing of decommissioning & legacy management

Niklas BERGH & Simon CARROLL
EU-H2020- SHARE-Decommissioning
Virtual Workshop, 1-3 December 2020
Key Milestones at the NEA in Decommissioning

1978
First decommissioning programme in the NEA

1985
NEA Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD)

2001 - 2018
Working Party on Decommissioning and Dismantling (WPDD)

2018
Committee on Decommissioning of Nuclear Installations and Legacy Management (CDLM)

2020
Expert Group on Costing For Decommissioning of Nuclear Installations & Legacy Management (EGCDL)
Extensive work decommissioning costing, including:

- An international structure for presenting NPP decommissioning costs - ISDC 2012 (joint report of NEA, EC & IAEA)
- Preparing and reviewing decommissioning cost estimates (‘Practice’, 2015; ‘Peer Reviews’, 2014)
- Uncertainties in decommissioning costing, 2017 (joint report with IAEA)
- NPP decommissioning cost benchmarking, 2019
- Costs of NPP decommissioning (COSTDEC) 2016
- Workshops and presentations relating to these

Links to these reports are included at the end of this presentation
The CDLM and costing

• The CDLM was established in 2018 as a Standing Technical Committee of the NEA.

• As noted in the CDLM Mandate, one of the objectives of the committee is to:

  "further develop approaches for the estimation of decommissioning project costs by improving understanding of the risks associated with financial consequences in regards to cost estimating and financing; and decommissioning planning for uncertainties, with an overall aim to assist member organisations to develop robust and efficient project management throughout the decommissioning process;..."
CDLM has created an Expert Group on Costing (EGCDL)

The EGCDL will, for example:

• **foster exchange of information** and experience between its members on issues concerned with cost estimation;

• **describe good practices** in the field of cost estimation for decommissioning and legacy management projects, including understanding of the risks …

• **advise the parent body** on major and emerging issues in the area of cost estimation for decommissioning and legacy management, and provide appraisals of the state of the art;

• **define, conduct and oversee studies** aimed at improving the transparency and reproducibility of cost estimates…
Starting work at the EGCDL

• The EGCDL has its initial ‘kick-off’ meeting in September 2020.
• A Programme of Work is under development for 2021-2022
• A Chairpersonship and Bureau Members has been appointed

<table>
<thead>
<tr>
<th>EGCDL Bureau</th>
<th>Organisation &amp; Country</th>
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<tbody>
<tr>
<td>Milena KOSTOVA  <em>(Chair)</em></td>
<td>CNSC, Canada</td>
</tr>
<tr>
<td>Alec KIMBER</td>
<td>ANSTO, Australia</td>
</tr>
<tr>
<td>Niklas BERGH</td>
<td>Westinghouse, Sweden</td>
</tr>
<tr>
<td>Paolo GUI</td>
<td>SOGIN, Italy</td>
</tr>
<tr>
<td>Karl SANDERSON</td>
<td>NDA, UK</td>
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EGCDL is developing its Programme of Work for 2021-2022

- Several themes identified as possible priority areas

<table>
<thead>
<tr>
<th>Topic</th>
<th>Examples of considerations for potential development into specific activities &amp; ToR for work</th>
</tr>
</thead>
</table>
| Further development of benchmarking work & analysis of data          | • Stepwise building on previous work  
• Identification of necessary data & relevant metrics  
• Practical considerations in data sharing & comparisons  
• Identification of cost drivers & risk factors                                                                 |
| Review & update of existing guidance                                 | • Integrate & update ISDC & uncertainties  
• Broaden applicability to address legacy management  
• Extend range of facilities and situations covered                                                        |
| Cost information as a tool for communication with stakeholders and decision makers | • Validation & 3rd party review of estimates  
• Guidelines on presenting cost information                                                                  |
Relationship between CDLM and EGCDL

- The EGCDL is a task-oriented expert group, providing specialised inputs into the work of CDLM.
- The EGCDL will report to a new Working Party which has a portfolio of work related management and organisational aspects of decommissioning and legacy management (WPMO).
- The WPMO is expected to start work in 2021.

Diagram:

1st level
Guidance and decision making
CDLM

2nd level
Discipline oriented
Technical aspects
New! WPTES

Management aspects
New! WPMO

3rd level
Task oriented
Cost issues
EGCDL
Niklas BERGH, Westinghouse, berghne@westinghouse.com

Simon CARROLL, Vattenfall, simon.carroll@vattenfall.com

Martin BRANDAUER, NEA, martin.brandauer@oecd-nea.org

THANK YOU.
## Selected reports

| Decommissioning Cost Estimation Group (DCEG) | International Structure for Decommissioning Costing (ISDC) of Nuclear Installations, 2012 *(with IAEA & EC)*  
Guide for **International Peer Reviews** of Decommissioning Cost Studies for Nuclear Facilities, 2014  
The **Practice of Cost Estimation** for Decommissioning of Nuclear Facilities, 2015  
**Addressing Uncertainties in Cost Estimates for Decommissioning Nuclear Facilities, 2017 *(with IAEA)***  
**Cost Benchmarking** for Nuclear Power Plant Decommissioning, 2019  
PLEIADES
a Smarter Plant Decommissioning

Caroline CHABAL (CEA, project leader)
PLEIADES: introduction

- **P**latform based on **E**merging and **I**nteroperable **A**pplications for Enhanced **D**ecommissioning **P**rocess

- Call for projects: H2020 NFRP-2019-09 – "Fostering innovation in decommissioning of nuclear facilities"

- Duration: 3 years (1/10/2020-30/09/2023)

- Consortium: 14 partners
  - 7 countries: FR (6), DE (2), NO (2), ES (1), FI (1), BE (1), SK (1)
  - Academic (1), TSO (1), research organisations (3), industrial companies (4), SMEs (5)
PLEIADES: Objectives

- Develop an innovative platform based on a BIM approach
- Define a BIM approach to **design scenario**, **improve safety**, **minimize radiation exposure**, **optimize costs and planning**, **communicate**
PLEIADES: Objectives

 vrai Develop an innovative platform based on a BIM approach

 → define a BIM approach to design scenario, improve safety, minimize radiation exposure, optimize costs and planning, communicate

 → based on a “multi-dimensional modelling”, including 3D model, time, dose, feasibility studies, waste and costs

 → 11 emerging software provided by the consortium (TRL 5-7) capable of exchanging data (interoperability).

<table>
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<th>Consortium</th>
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PLEIADES: Objectives

✓ Develop an innovative platform based on a BIM approach

→ define a BIM approach to design scenario, improve safety, minimize radiation exposure, optimize costs and planning, communicate

→ “multi-dimensional modelling”, including 3D model, time, dose, feasibility studies, waste and costs

→ 11 emerging software provided by the consortium (TRL 5-7) capable of exchanging data (interoperability)

→ implementation on real cases
PLEIADES: Objectives

- Develop an innovative platform based on a BIM approach
  - define a BIM approach to design scenario, improve safety, minimize radiation exposure, optimize costs and planning, communicate
  - “multi-dimensional modelling”, including 3D model, time, dose, feasibility studies, waste and costs
  - 11 emerging software provided by the consortium (TRL 5-7) capable of exchanging data (interoperability)
  - implementation on real cases

- Develop an associated methodology and impose it as a standard
  - establish a standardized process to organize the data collected throughout the project in datasets (codebooks, instructions, naming conventions...)
PLEIADIES: Objectives

- Develop an innovative platform based on a BIM approach
  - define a BIM approach to **design scenario, improve safety**, **minimize radiation exposure**, **optimize costs and planning**, **communicate**
  - “multi-dimensional modelling”, including **3D model**, **time**, **dose**, **feasibility studies**, **waste** and **costs**
  - 11 emerging software provided by the consortium (TRL 5-7) capable of **exchanging data** (interoperability)
  - implementation on real cases

- Develop an associated methodology and impose it as a standard
  - establish a **standardized process** to organize the data collected throughout the project in datasets (codebooks, instructions, naming conventions…)

- Prepare the exploitation of the PLEAIDES platform
  - the **market** potential
  - a comprehensive **exploitation** strategy with preliminary business plan
  - training for the application in decommissioning
## PLEIADES: Planning

<table>
<thead>
<tr>
<th>Leader</th>
<th>WP1 - Requirement analysis, specification and test design</th>
<th>WP2 - PLEIADES platform development</th>
<th>WP3 - Implementation of PLEIADES platform on real use cases</th>
<th>WP4 - Modelling and results evaluation</th>
<th>WP5 - Standardisation efforts, Exploitation &amp; Training</th>
<th>WP6 - Dissemination, Communication &amp; Stakeholders engagement</th>
<th>WP7 - Project coordination and management</th>
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<tr>
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Thank you!

Contact:
Caroline CHABAL
Caroline.chabal@cea.fr