The management of nuclear dismantling at CEA

Laurence Piketty
CEA / Nuclear Energy Division
Director of Nuclear Cleanup and Dismantling Division
860 employees (CEA/Nuclear Energy Division) who work for dismantling program, waste management, facilities’ exploitation and R&D for dismantling

580 M€: Annual financing guaranteed by French Government in the Framework of the « waste management » law (June, 28th, 2006)

More than 80% goes toward Industry

11 billion € long term financial charges for the next decades

+ than 30 industrial partners, 2500 employees from suppliers

22 facilities in the process of cleaning and dismantling

5 CEA's sites concerned: Fontenay-aux-Roses, Saclay, Grenoble, Marcoule et Cadarache

More than 100 projects of decontamination/dismantling, retrieval and conditioning of legacy wastes, investments for new facilities in support (waste treatment, interim storage, R&D, transport packaging, waste management

From 5, 30 or even 50 years: average duration of projects

From 350 M€ to several billions €: dismantling’s cost for an entire site

840 000 m³ of Radioactive wastes, whose almost 50% have a very low activity level
CEA'S NUCLEAR ENERGY DIVISION / DISMANTLING PERIMETER

- LHA, ULYSSE, OSIRIS, INB 72
- APM, G1, PHENIX
- Fontenay-aux-Roses
- Saclay
- INB 165 & 166: STED/STEL
  - RM2, Bât. 18
- Passage: SILOETTE, MELUSINE
  - SILOE, LAMA, STED/STEL
  - Green
- UP1: Usine, dégainage, SPF/AVM, ASE
- HARMONIE, RAPSODIE, PHEBUS
  - ATPu, ATUE, STED
- Civil
- Défense
- Decommissioned
- On going projects
- Future works
Rigorous management of fuel cycle « back end »:
- Dismantling of shutdown nuclear facilities
- Retrieval, conditioning of legacy wastes

CEA objective: carry out in safety and in respect of cost and delay all DD&R program

CEA’s strategy (regulatory framework: nuclear laws 2006 TSN & wastes):
- Immediate and total decommissioning when feasible.
- Technical and economical optimization pursuit
- End state: Removal of all dangerous material (in particular radioactive ones).
  - If impossible: decommissioning with constraints, with an impact always less than 300 µSv/h
- Solid and liquid waste: minimization, optimization of categorization, on line evacuation
Huge facilities variety:
- Reactors: pond, fast breeder, gas graphite, ...
- Accelerators & irradiators,
- Laboratories, workshops & plant
- Waste treatment facilities (solid & liquid), storage facilities

No scale nor «series effect»

Different sizes:
- Reactor: Ulysse INSTN -> Phénix (NPP)
- LAMA -> building 18 FAR -> APM -> UP1

R&D facilities,
- Modifications traceability, history (not always known or registered)
- Various waste, ...

Chemical treatment, irradiated spend fuels:
- Contamination and irradiation level could be high

Historical nuclear sites
Shielded Cell CYRANO
Dismantling of research reactor and R&D Hot Laboratory

SILOE Reactor

LAMA
Analytical Lab for Active Material

Futur re-use, as new office building
R&D has a special role to help decrease costs, schedules, dose uptake, waste and to improve work safety & security.

- CEA leads R&D actions and develops expertise in 6 main axes:
  - **Overall facility characterization**
    - Alpha and gamma cameras
    - In situ measurement species
  - **Liquid and solid waste treatment**
    - Embedding with geopolymer
    - Plasma torch incineration
  - **Structure and soil decontamination**
    - Laser ablation, gel foams, etc
  - **Waste characterization**
    - Non destructive analysis
  - **Work in hostile environments**
    - Remote technologies
  - **Methods and IT Tools**
    - 3D simulation
    - Virtual reality
APM (MARCOULE PILOT WORKSHOP) DISMANTLING

Characterization by Gamma camera

APM : Pilot Workshop in Marcoule:
• 760 rooms : 30 HA cells; 230 glove boxes
• 2 600 tons of waste in active cells

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
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<tr>
<td>Cs 137</td>
<td>41.9%</td>
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<tr>
<td>Cs 134</td>
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<tr>
<td>Rh 106</td>
<td>27.6%</td>
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<tr>
<td>Sb 125</td>
<td>23.9%</td>
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Overall facility characterization

Cs 137 37.1%
Cs 134 4.3%
Rh 106 17.6%
Sb 125 41.00%
Real reconstitution of inactive cell, for testing remote tele-operated arm.

3D simulation (APM Cell 414)

Coupling with virtual reality resources
MAESTRO transferred on APM in March 2015

First life sized use: cutting of legacy wastes and equipment into shielded cell
CEA DD&R : CONCLUSION

- A key mission of the Nuclear Energy Division/CEA
- Huge Program:
  - Dismantling of the Nuclear facilities on 5 nuclear centers,
  - Recovery of Old Wastes
- Draw projects within strict respect of delay, cost and safety
- Maintain and valorize the project management skills
- Discussions on final end state and on waste disposal management,
- Optimization of waste volume and on-line evacuation
- Today, mature D&D: Grenoble feedback experience is an evidence,
  first of its kind total liberation of a nuclear site,
- Valorize R&D and make progress to lead the operation to be Safer, Easier,
  Smarter & Cheaper, and to spread the knowledge on national and international basis.
Thank you for your attention