DE LA RECHERCHE À L'INDUSTRIE

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PREDEC 2016

International Symposium on PREparation for DECommissioning

The management of nuclear dismantling at CEA

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KEY FIGURES 2015 - DD&R PERIMETER (DECOMMISSIONING/DISMANTLING & WASTE RECOVERY)

CEA/NUCLEAR CLEANING AND DISMANTLING DIVISION/NUCLEAR ENERGY 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

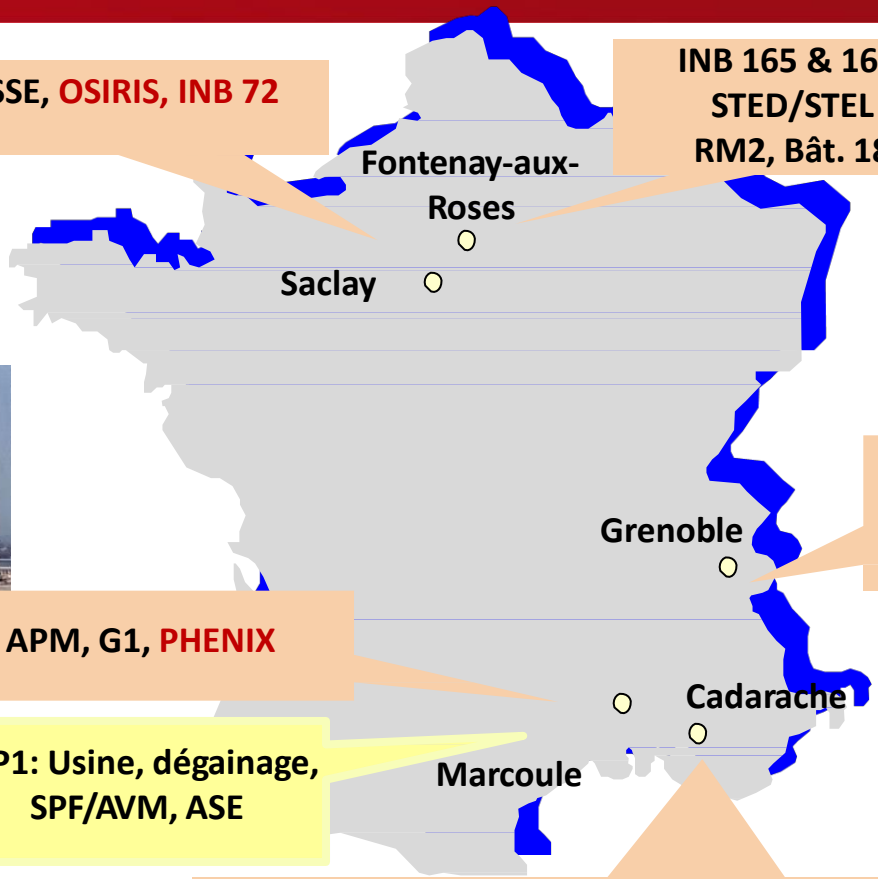
INB 165 & 166:
STED/STEL
RM2, Bât. 18

Passage: SILOETTE, MELUSINE
SILOE, LAMA, STED/STEL
Green

APM, G1, PHENIX

UP1: Usine, dégainage,
SPF/AVM, ASE

HARMONIE, RAPSODIE, PHEBUS
ATPu, ATUE, STED



Civil
Défense

Decommissioned
On going projects
Future works

CEA'S NUCLEAR ENERGY DIVISION
LEGACY RADIOACTIVE WASTE RETRIEVAL PERIMETER

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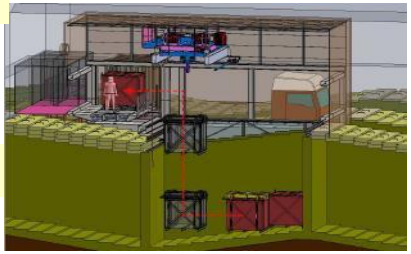
HA4- Organic liquid tank

INB 72

Mg waste - UP1

Bituminous drums

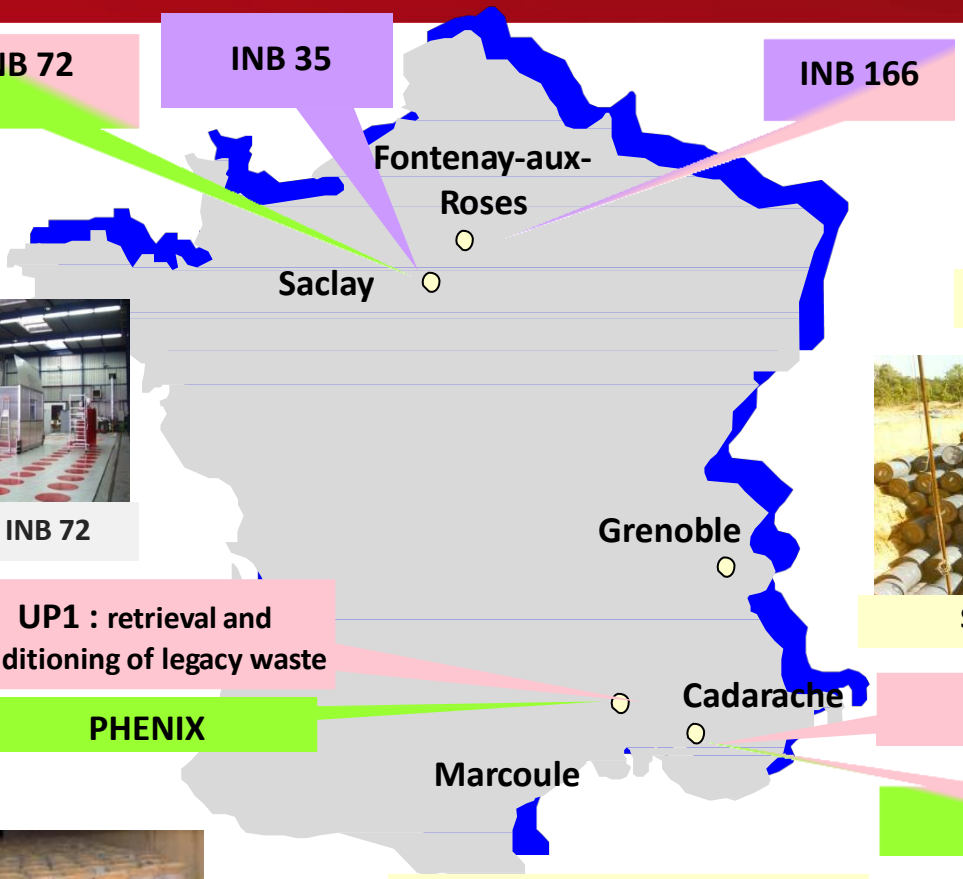


Retrieval of legacy waste

CIRCE – Radioactive liquid tank

Solid waste

PEGASE Pool



UP1 : retrieval and conditioning of legacy waste

PHENIX

RCD 56

PEGASE

Liquid waste (including organics)

Legacy solid waste

Used fuel

CEA DECOMMISSIONING: AT STAKES, OBJECTIVES, STRATEGY

Rigorous management of fuel cycle « back end » :

- Dismantling of shutdown nuclear facilities
- Retrieval, conditioning of legacy wastes

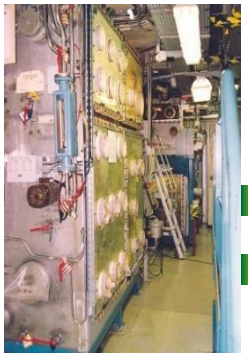
CEA objective : carry out in safety and in respect of cost and delay all DD&R program

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**

CEA's DD&R UNIQUENESS

- **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**

FONTENAY-AUX-ROSES: DISMANTLING OF A SHIELDED CELL

Shielded Cell CYRANO

Dismantling of research reactor and R&D Hot Laboratory






SILOE Reactor





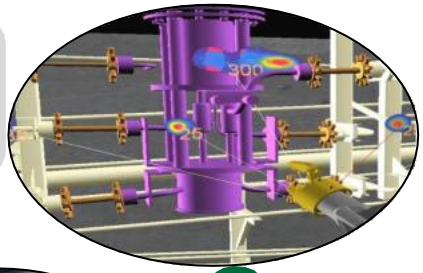

LAMA
Analytical Lab for Active Material

Futur re-use, as new office building

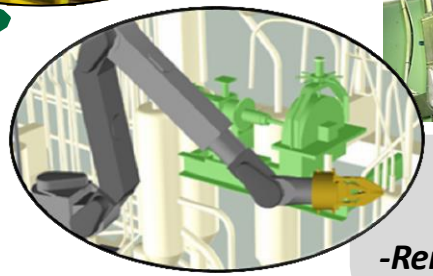
CEA D&D R&D, TECHNOLOGIES AND PROCESSES

- 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 axis

Overall facility characterization
- ***Alpha and gamma cameras***
- ***In situ measurement species***

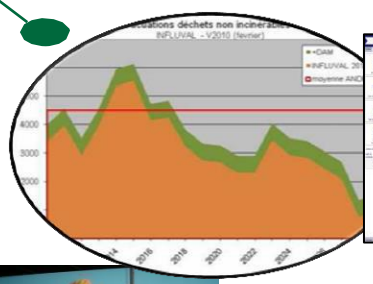


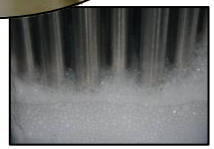
Waste characterization
- ***Non destructive analysis***



Work in hostile environments
-Remote technologies

Liquid and solid waste treatment
- ***Embedding with geopolymer***
- ***Plasma torch incineration***





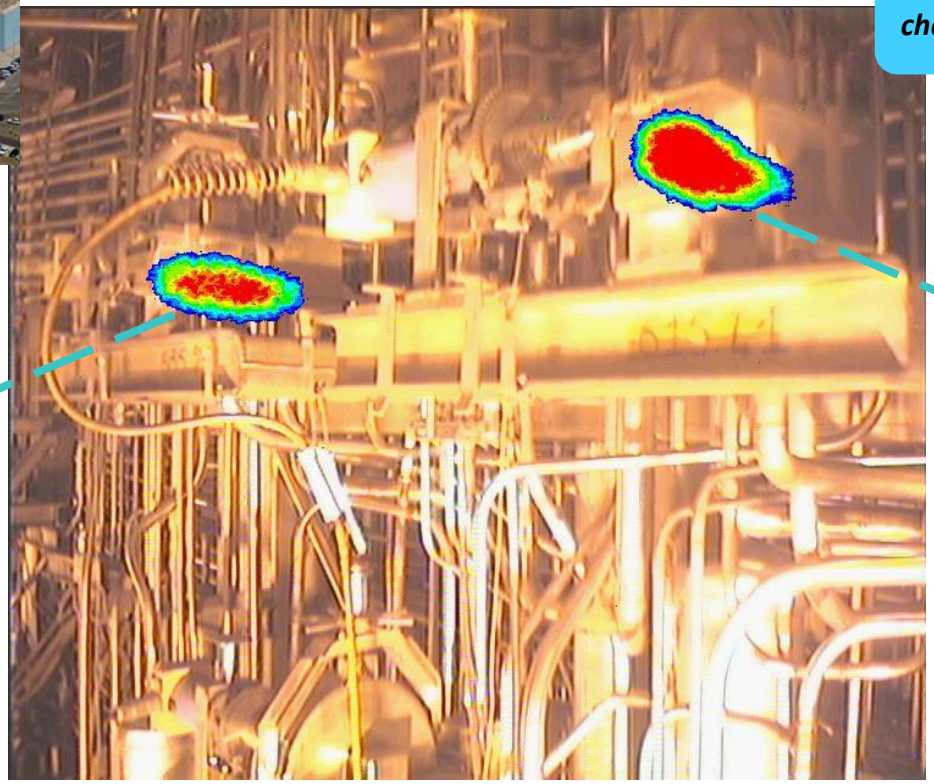
Structure and soil decontamination
- Laser ablation, gel foams , etc

Methods and IT Tools
- ***3D simulation***
- ***Virtual reality***

APM (MARCOULE PILOT WORKSHOP) DISMANTLING

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

Overall facility characterization

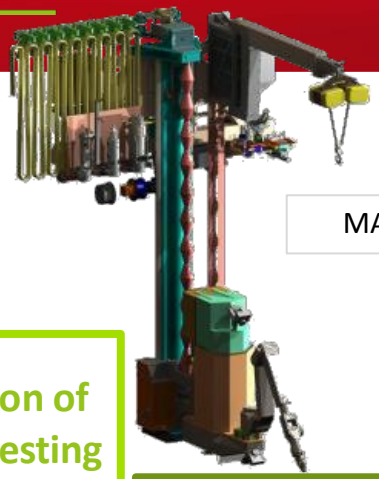


Cs 137	41.9%
Cs 134	6.6%
Rh 106	27.6%
Sb 125	23.9%

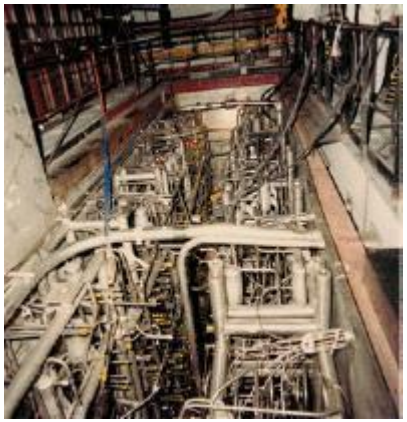
Cs 137	37.1%
Cs 134	4.3%
Rh 106	17.6%
Sb 125	41,00%

Characterization by Gamma camera

APM DISMANTLING : USE OF REMOTE TELE-OPERATED ARM MAESTRO

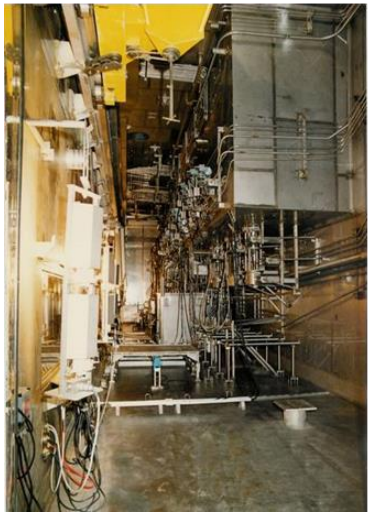


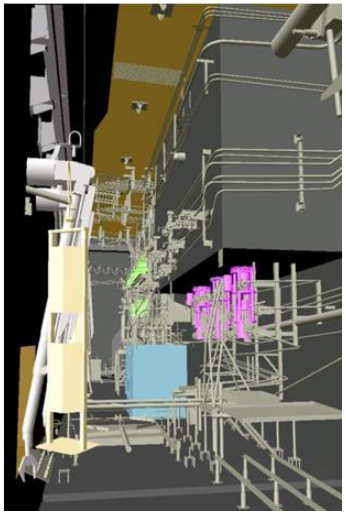
MAESTRO



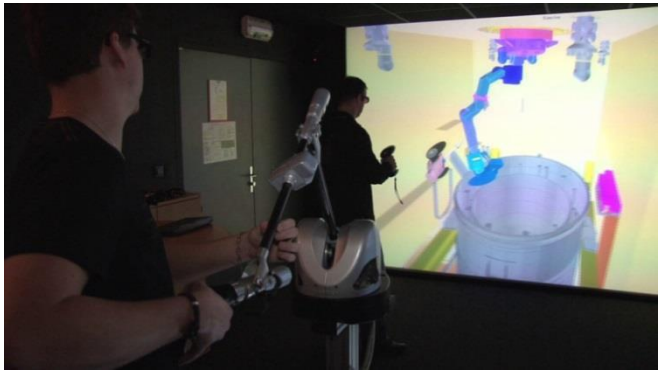
Real reconstitution of inactive cell, for testing remote tele-operated arms

3D simulation (APM Cell 414)



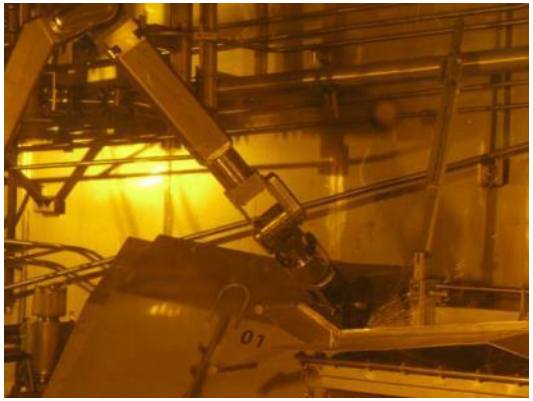


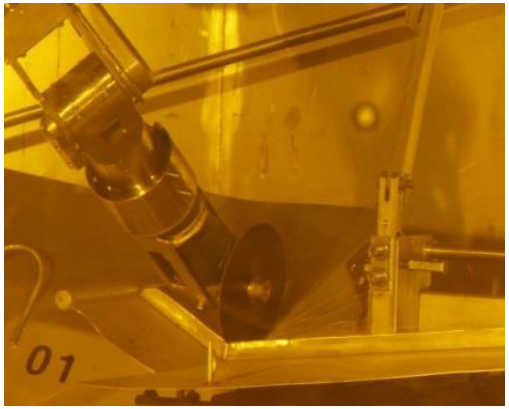
Coupling with virtual reality resources



APM – Use of Maestro arm into shielded cell

MAESTRO transferred on APM in March 2015

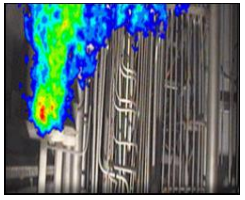


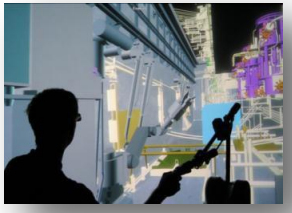


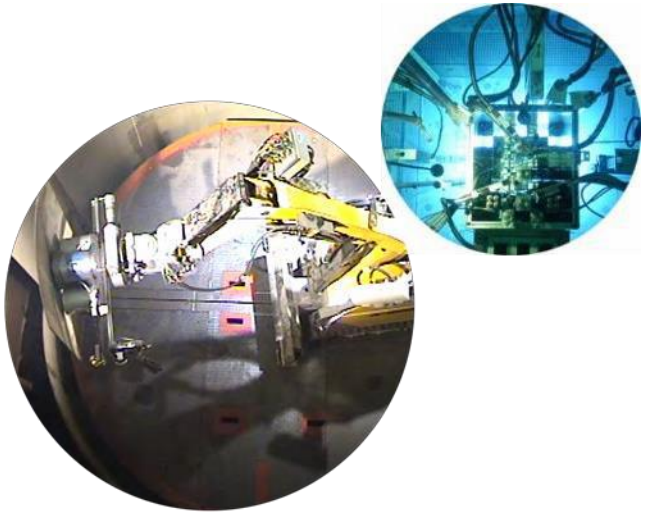
First life sized use : cutting of legacy wastes and equipment into shielded cell

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

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