DE LA RECHERCHE À L'INDUSTRIE

www.cea.fr

*1st International Forum on the Decommissioning of the Fukushima Daiichi NPS*

*10-11th April, Japan*

# Decommissioning and Dismantling at CEA

# "Program, challenges and feedback experience"

**Eric KRAUS**
**Deputy Director**
**Nuclear Cleanup and Decommissioning Directorate**
CEA / Nuclear Energy Division
eric.kraus@cea.fr

# TABLE OF CONTENTS

# TABLE OF CONTENTS

# THE SPECIFITIES OF THE CEA's CIVILIAN D&ER PROGRAM

**580 M€/year**
**815 CEA employees and about 2500 employees from supply chain**

- **Huge range of facilities**
  - **Reactors :** research, fast breeder, gas graphite, etc
  - **Accelerators & irradiators,**
  - **Laboratories, workshops & pilot plant**
  - **Waste treatment facilities, storage facilities**

- **Different sizes**
  - **From research reactors up to NPPs**
  - **From single laboratories to processing facilities**

- **R&D facilities**
  - **Traceability of modifications, history**
  - **Various types of waste, etc**
  - **Contamination level could be high (leaks, etc)**

- **Historical nuclear sites : liabilities**

**No scale nor «series effect»**

# CEA's NUCLEAR ENERGY DIVISION - D&ER PERIMETER

Reactors : ULYSSE, OSIRIS
Laboratory : LHA

Research laboratories : Bulding 18, RM2
Waste Treatment Facili

Fontenay-aux-Roses

Saclay

22 nuclear facilities currently under dismantling

Grenoble

Reactors : SILOE, SILOETTE, MELUSINE
Laboratory : LAMA
Waste Treatment Facility : STED

Reactors : G1, PHENIX*
Plant : APM

Marcoule

Cadarache

UP1
Waste Treatment Facilities, Plants, Laboratories

Reactors : HARMONIE, RAPSODIE*, PHEBUS
Plants : ATPu, ATUE
Waste Treatment Facility : STED

Decommissioned
On going projects
Future works

| Civil | Defense |
|---|---|

*Fast breeder reactor

# TABLE OF CONTENTS

# DECOMMISSIONING AT CEA: ISSUES, OBJECTIVES & STRATEGY

**Issues : scrupulous management of the « back end of the fuel cycle :**

- Immediate dismantling of shutdown nuclear facilities
- Retrieval, characterization, conditioning and storage of legacy waste

**Objectives : carry out the entire D&ER program safely while meeting costs and deadlines**

- Cleanup and decommissioning of nuclear facilities now enclosed in cities
  - Centres of Grenoble & Fontenay aux Roses,
- Dismantling of UP1 processing facility in Marcoule
- Respect end dates (decrees & safety objectives)

**Strategy : fit to the framework of two 2006 Acts (Nuclear Safety and Transparency & Waste Management Acts)**

- Immediate and total decommissioning when feasible.
- Continued technical and economical optimization
- End state : Removal of all hazardous material (in particular radwaste).
  - If impossible : decommissioning with remaining constraints (brown field)
- Solid and liquid waste : minimization, decategorization (long life ➔ short life), on line shipment

# Example 1 : TOTAL CLEANUP OF A SITE (Grenoble)

## A UNIQUE EXAMPLE OF CLEANUP AND DISMANTLING OF AN ENTIRE SITE

**2001-2013 dismantling**
**Around 350 millions euros**
**6 nuclear facilities decommissioned :**
**3 research reactors, 1 Laboratory**
**2 radioactive effluent and waste treatment facilities**

SILOE

LAMA

Total dismantling

Future use

# Example 2 : DISMANTLING OF MARCOULE (UP1 PROGRAM)

## Dismantling of spent fuel processing plant : the largest CEA's D&ER program

North zone storage pits and vaults

Industrial processing plant

Vitrification facility

Pilot processing plant

South zone storage bunkers

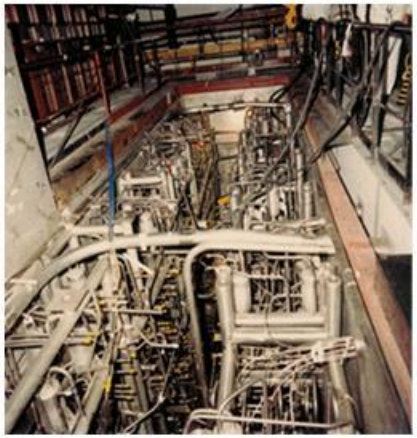

Spent fuel Decladding units Gas cooled reactor

# TABLE OF CONTENTS

# 1st CHALLENGE : HOW TO TREAT LEGACY WASTE ?

Lack of trusted knowledge on chemical and radiological condition of waste (Mg, sludges, bitumen, mix hazardous waste,..)

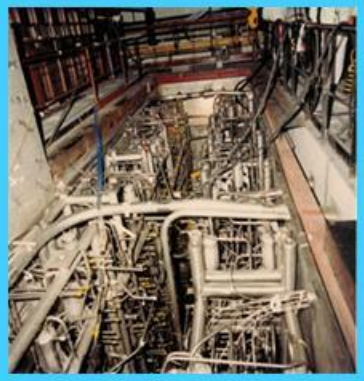
- Main difficulties
  - Retrieval (Air & water)
  - Characterization
  - Packaging
  - Storage
  - Disposal



# 2nd CHALLENGE : HOW TO MANAGE THE SOURCE TERM ?

- **The main driver is to reduce the Source Term,** with regard to the risk of release outside buildings

- Level of radioactivity ?
- Type of emission (α, β, γ, n) ?



- **Packaging or bulk ?**



- **Question :**

**Without D&ER activities, risk of having an environmental impact (Sv/an), taking into account several scenarios ?**

# 3rd CHALLENGE : KEEP THE FINAL COST UNDER CONTROL

## 6 main reasons to update the final cost of D&ER

**1 - Evolution of final end state definition**

**2 - Safety requirements, regulation evolutions, authorization process duration**

**3 - Lack of trusted initial state knowledge**

**4 - Evolution of waste disposal costs and storage specifications (WAC)**

**5 - Annual upper limit of the financial resources**

**6 - Project management and technical issues**

# R&D IS THERE TO OVERCOME THE CHALLENGES

## A strong R&D program in support of decommissioning activities is part of the solution

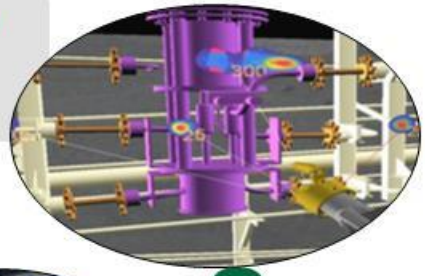
- Optimising R&D activities in support of cleanup and dismantling programs
  - To reduce cost, work duration, doses uptake, waste volume produced
  - To improve the safety and security of dismantling worksites
  - To minimize hazards
  - To define new matrix suitable to a widest categories of legacy waste

- Developing and promoting R&D and expertise
  - To share R&D developments
  - To provide expertise
  - To develop industrial partnerships
  - To promote operating experience

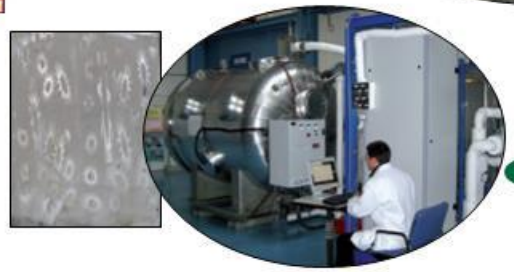
# CEA D&ER R&D THROUGH 6 MAIN AXIS

## R&D actions : a dedicated program / 6 main fields

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

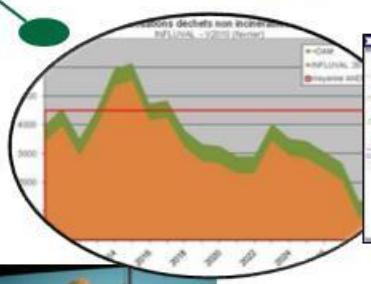


***Waste characterization***
- *Non destructive analysis*



***Work in hostile environments***
-*Remote technologies*

***Liquid and solid waste treatment***
- *Embedding with geopolymer*
- *Metal melting incineration*



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

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

# TABLE OF CONTENTS

## Developing and promoting partnership with local and national entities

- Partnerships and contracts with commercial companies “from research to industry”
  - Robotics
  - Liquid treatment, structure decontamination, etc
  - 3D simulation & virtual reality for nuclear dismantling
- Partnerships with others main nuclear French operators
- Education and training
  - Partnerships CEA-Universities

**Creation of innovation & excellence pole at Marcoule : PVSI**

PVSI
PÔLE DE VALORISATION DES SITES INDUSTRIELS

# CONCLUSION

- CEA has a lot of feedback experience in performing and managing large and complex D&ER operations, covering different size and kind of facilities and laboratories
- Costs, schedule, safety, deadlines are always taken into account as main drivers
- R&D is important to help overcome the main challenges raised by complex operations

*Even if the D&ER of Fukushima Daiichi is the most complex endeavour ever attempted in this field, we think that our experience can be fruitful on many subjects. We already share this experience with NDF and TEPCO*

**Thank you for your attention**