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2nd International Forum on the Decommissioning of the Fukushima Daiichi NPS

2-3 July, 2017 - Japan

WASTE MANAGEMENT STRATEGY

"French Experience in Legacy Waste Management"

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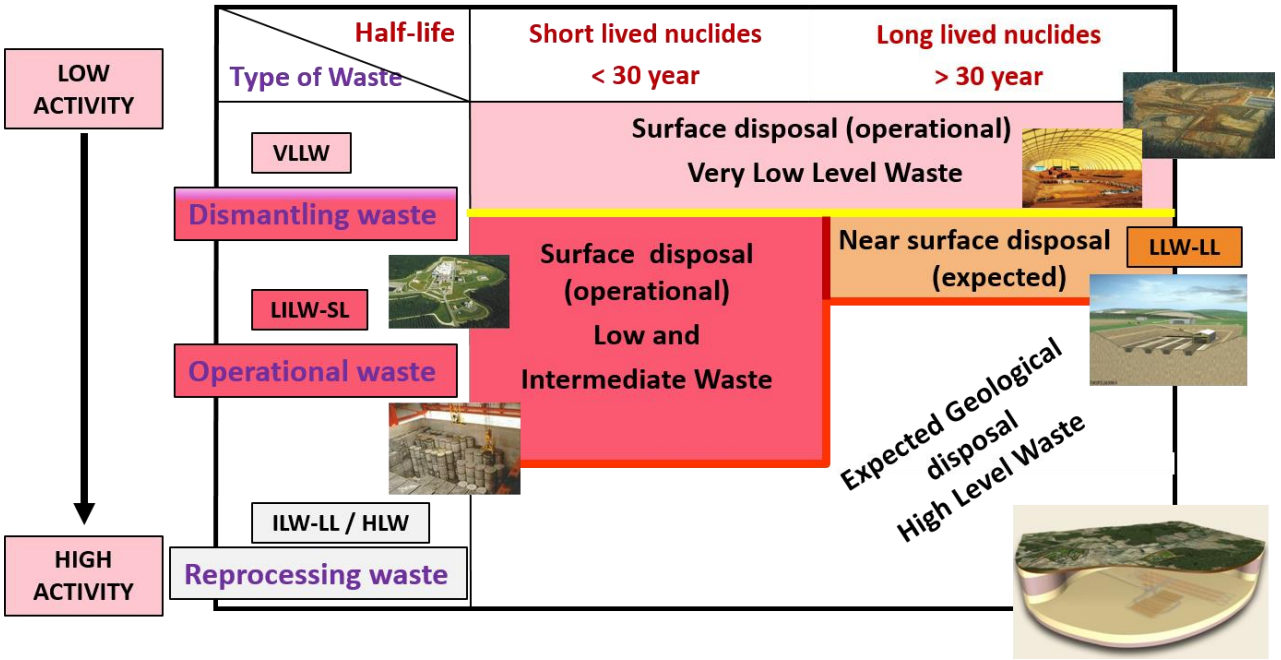
TABLE OF CONTENTS

TABLE OF CONTENTS

Waste classification principle

- 5 waste categories
  - In France waste is classified according to two main criteria
    - Its radioactivity level
    - Its lifetime : “short-lived” waste (half-life ≤ 31 years) and “long-lived” waste (half-life > 31 years)

	Bq/g
VLLW	< à 100
LILW-SL	100 to 1 000 000
LLW-LL	10 to 100 000
ILW-LL	1 000 000
HLW	1 000 000 000



DISPOSAL FACILITIES OPERATED AND STUDIED BY ANDRA

VL-LW
« Cires »

Short and long-lived

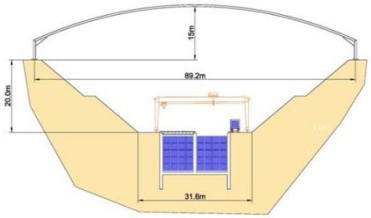
CEA : ~ 10 000m³/y

LLW
“Centre de l’Aube »

Short-lived

CEA : ~ 4 000m³/y

LLW
Under study

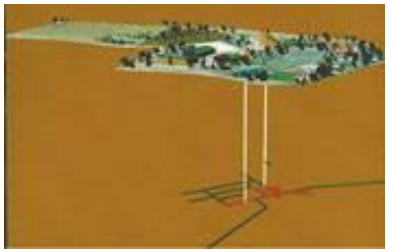


Long-lived

- Graphite (UNGG Reactors)
- Bitumen drums,
- Radium-bearing waste

ILW & HLW
Under study
CIGEO project

Long-lived



General principle for waste management at the CEA

- Characterization of
  - Legacy waste
  - D/D waste
  - R&D waste

- Liquid and solid waste treatment

On line evacuation

Waste management

- if storage site exists ➔National storage
- If not ➔intermediate storage on CEA site

- Dedicated R&D program in support of waste management
  - To develop efficient waste treatment
  - To define new matrices for specific waste
  - To optimize the categorization of the waste

CEA DEN FACILITIES FOR LIQUID WASTE TREATMENT

Liquid waste treatment facility

SACLAY

STELLA

Surface disposal

MARCOULE

STEL

CADARACHE

AGATE

Surface disposal

Intermediate storage

CEA DEN FACILITIES FOR SOLID WASTE TREATMENT

SACLAY

INB 72

Short-lived waste

Surface disposal

MARCOULE

CDS

Sludge cementation unit

Mg cementation unit

Short-lived waste

Surface disposal

CADARACHE

Long-lived waste

INB 37

Intermediate storage

Specific Conditioning Unit for dedicated waste

Facility for various types of waste from R&D and D&D program

Specific case of Long-Lived Waste (LL and IL)

Low-level, long-lived waste

Intermediate-level, long-lived waste

→ **defined matrix (cement matrix, bitumen matrix)**

CEDRA (Cemented waste packages)

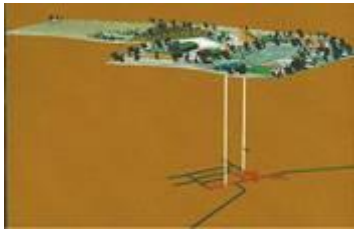
EIP (Bitumen drums)

Non defined matrix

Deactivation

DIADEM

Surface disposal Short-lived waste



defined matrix

Intermediate storage

Geological disposal

CEA INTERMEDIATE STORAGE FACILITIES

SACLAY

INB 72

Short-lived and long-lived waste

FONTENAY

CADARACHE

MARCOULE

EIP (Bituminized drums)

Long-lived waste

HLW

AVM (Glass canisters)

DIADEM

Long-lived waste

CEDRA (Cemented waste packages)

TABLE OF CONTENTS

LEGACY WASTE RETRIEVAL PERIMETER

HA4- Organic liquid tank

INB 72

INB 35

INB 166

Fontenay-aux-Roses

Saclay

CIRCE – Radioactive liquid tank

Legacy waste retrieval, characterization & repackaging

Solid waste

Mg waste - UP1

Grenoble

UP1 : retrieval and conditioning of legacy waste

PHENIX

Cadarache

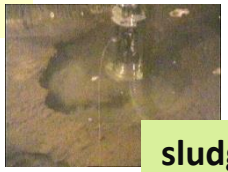
RCD 56

Marcoule

PEGASE

Bituminized waste drums

PEGASE Pool



sludge

Vitrification facility
Legacy waste (glass containers)

Liquid waste (including organics)

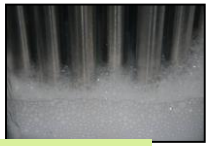
Legacy solid waste

Spent fuel

TABLE OF CONTENTS

R&D actions

- Liquid and solid waste treatment and conditioning
  - R&D on specific waste and effluent issued from D&D and legacy waste from laboratory scale through to industrialization phases
    - To develop efficient waste treatment (plasma torch incineration for organic halogenous liquids, decontamination foams,…)
    - To define new matrices for specific waste (geopolymer for Mg)



Gel foams

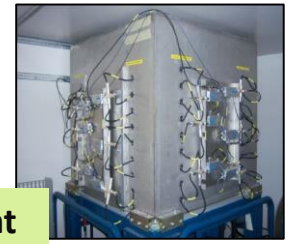
Geopolymer matrix

  - Vast range of waste
    - Mercurials, sodics, Mg from decladding, powders, sludge, ash, filters, resins

Mg

sludge

- Waste characterization
  - R&D to optimize quantities and waste categorization
    - Passive and active neutronic
    - γ and α imaging, γ spectrometry



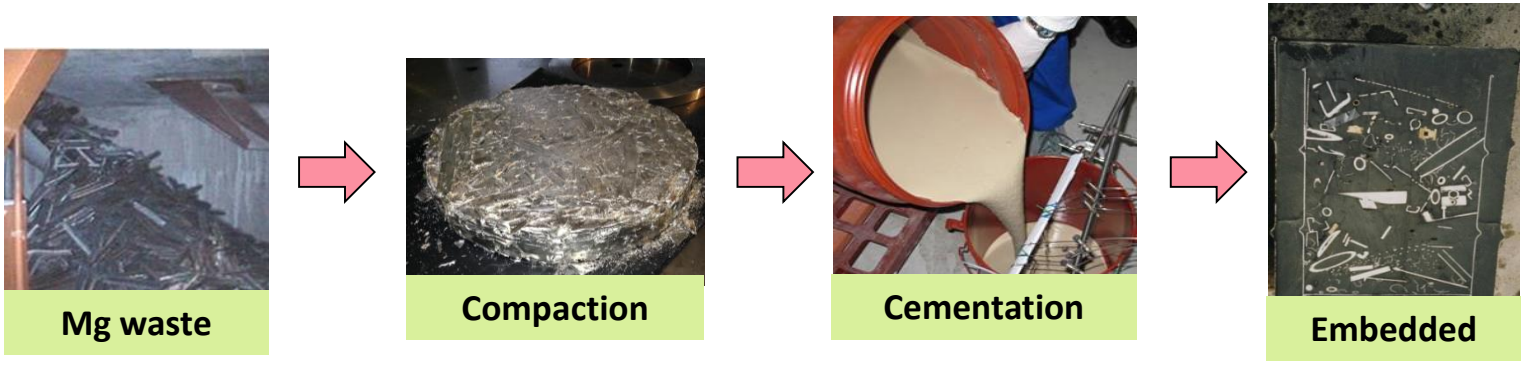
Passive neutronic measurement

Example : Cement matrix

- At stake
  - To define new matrices suitable for a large variety of waste (Legacy waste, current and future waste of exploitation)
  - To improve the performance of the matrix (Rate of incorporation,…)

- Development
  - Packaging of reactive metals : Magnesium, aluminium,…
  - ➔ Embedding with geopolymer
  - ➔ *Process tested and approved in inactive at scale one for Mg*

  - Other types of waste : Sludge, resins, powder
  - ➔ Development of cementing formulations underway

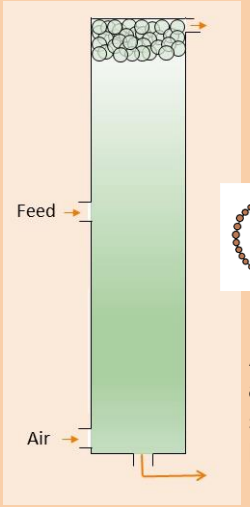


Example : solid waste treatment

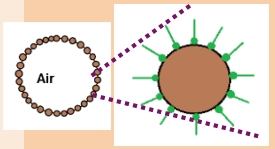
- At stake
  - To reduce uptake doses
  - To optimize waste categorization by increasing decontamination efficiency
  - To reduce the amount of secondary waste produced

- ***GELS***

- ***FOAMS***



Foam with ^{137}Cs



Active agent adsorbed on surface by bubbles

Decontamination foams

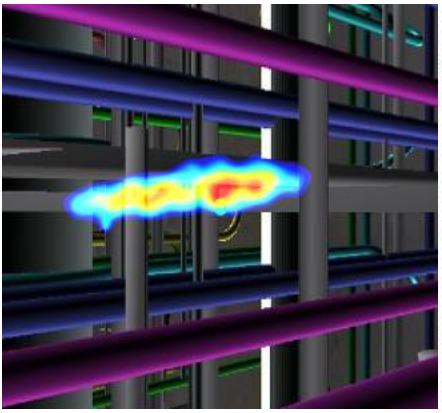
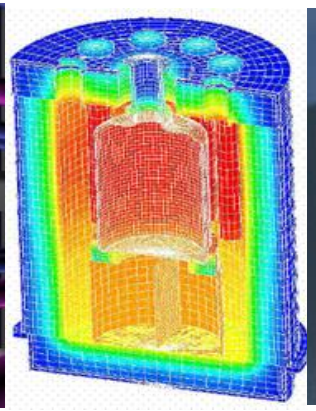
Decontaminated soil

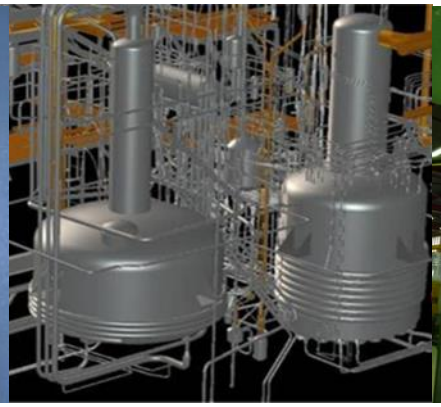
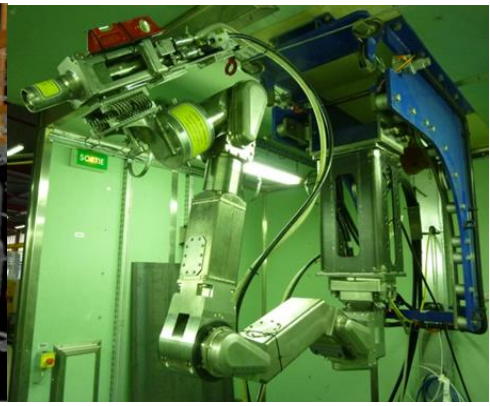
Floating foams

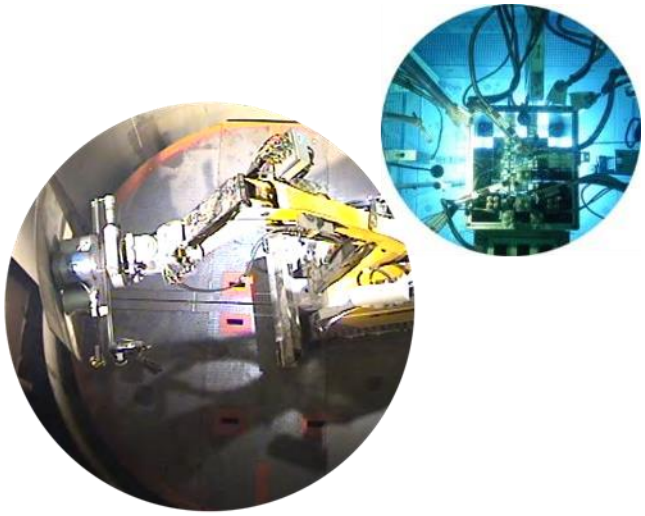
TABLE OF CONTENTS

CONCLUSION

- Specificity of the CEA in waste management due to a vast range of waste
- Special R&D role
  - To develop efficient treatments for complex radioactive waste
  - To develop new matrices in particular for long-lived waste
  - To develop treatment and matrices for a vast range of waste
  - To characterize waste



Thank you for your attention

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