

DE LA RECHERCHE À L'INDUSTRIE



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

10-11th April, 2016 - Japan

WASTE MANAGEMENT STRATEGY

“French Experience in Legacy Waste
Management”

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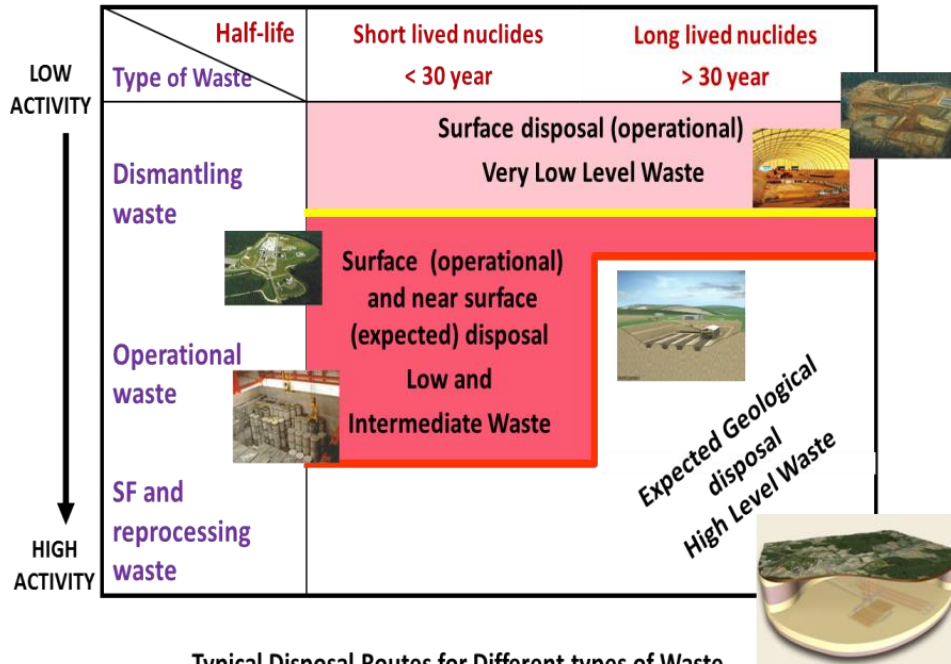
1. Nuclear waste management at CEA
2. Legacy waste : CEA D&D Perimeter
3. Legacy waste : Technologies and processes
4. CEA Cooperation

1. Nuclear waste management at CEA
2. Legacy waste : CEA D&D Perimeter
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- Characterization of
 - Legacy waste
 - D/D waste
 - R&D waste



- Liquid and solid waste treatment and conditioning



Disposal routes

- if disposal site exists
→ **ANDRA National final disposal**
- If not
→ **interim storages on CEA's sites**

DISPOSAL FACILITIES OPERATED & STUDIED BY ANDRA

VL-LW

« Cires »



Short and long live



CEA : ~ 10 000m³/y

LLW

«Centre de l'Aube »



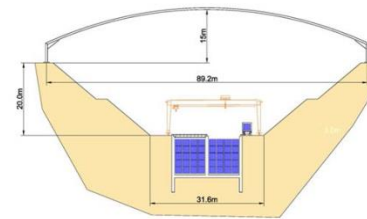
Short live



CEA : ~ 4 000m³/y

LLW

Under study



Long live



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

ILW & HLW

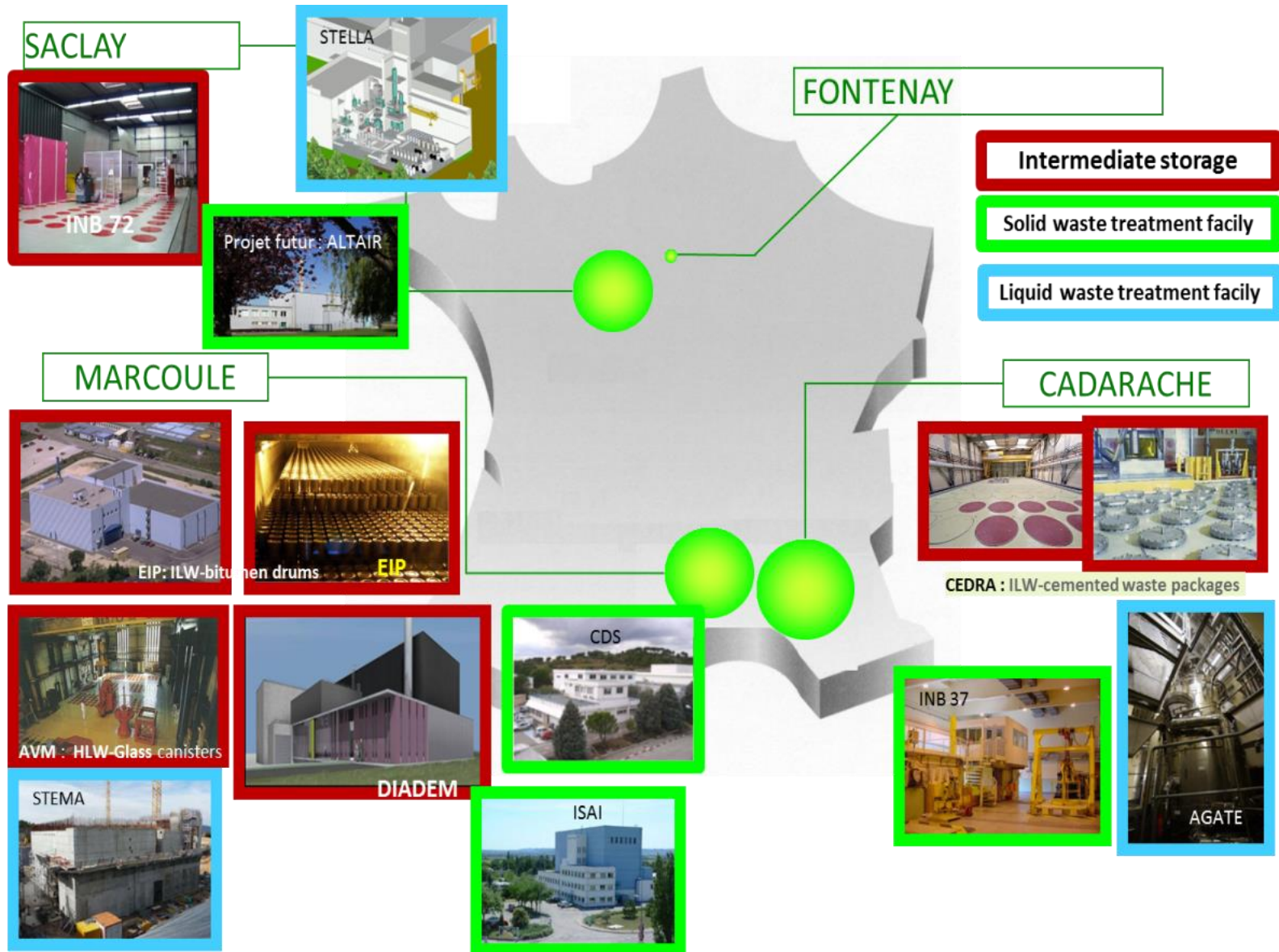
Under study
CIGEO project



Long live



CEA WASTE MANAGEMENT FACILITIES TREATMENT AND INTERMEDIATE STORAGE



MAIN TYPES OF WASTE PACKAGES ARISING FROM CEA R&D AND D&D ACTIVITIES

VLLW



ILW



Cemented wastes



Cemented Drums



Cemented Drums



Bitumen Drums

LL-ILW



HLW



PIVER Glass



AVM Glass



R7T7 Glass



Hulls

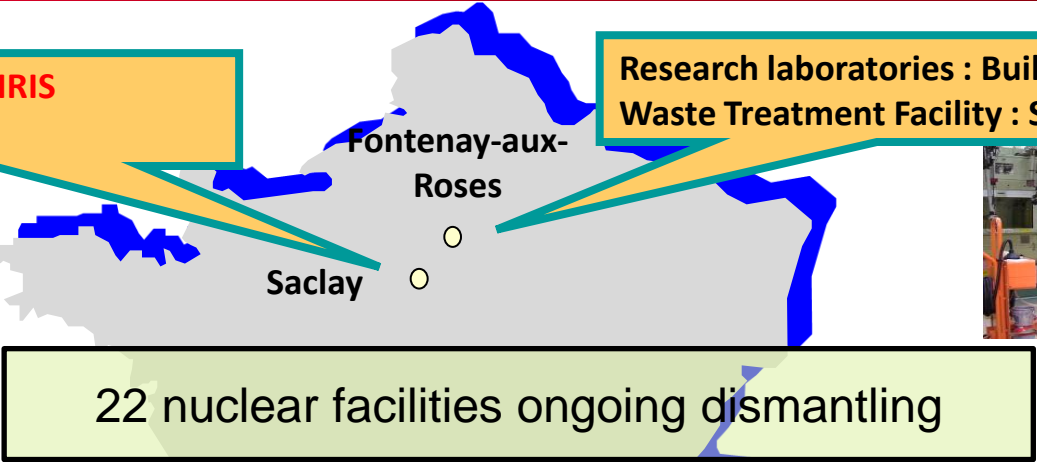
- Optimized Categorization (VLLW, ILW, LL-ILW & LL-HLW)
- Minimization in order to optimize the volume
- On line Evacuation to Available final Disposal and intermediate Storage Facilities
- Stock reduction of the legacy Wastes
- Waste management control
- Dedicated R&D program to optimize waste quantity into containers and drums and for safety storage.

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Reactors : **ULYSSE, OSIRIS**
Laboratory : LHA



Research laboratories : Building 18, RM2
Waste Treatment Facility : STED



Reactors : **G1, PHENIX***
Plant : APM



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

Grenoble

Marcoule

Cadarache



UP1
Waste Treatment Facilities, Plants, Laboratories

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



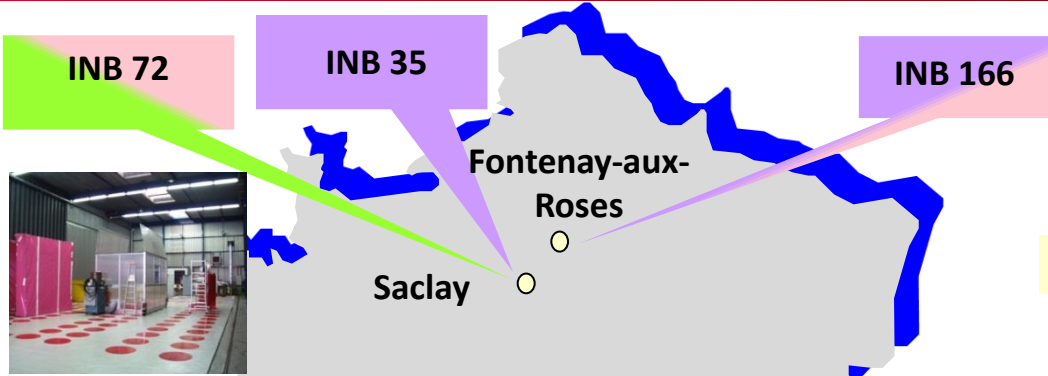
Decommissioned
On going projects
Future works



Civil Defense

*Fast breeder reactor

LEGACY WASTE RETRIEVAL : D&D PERIMETER



HA4- Organic liquid tank



CIRCE - Radioactive liquid tank



Legacy waste retrieval, characterization & repackaging



Solid waste



Mg waste - UP1

UP1 : retrieval and conditioning of legacy waste

PHENIX

Grenoble

Cadarache

RCD 56

Marcoule

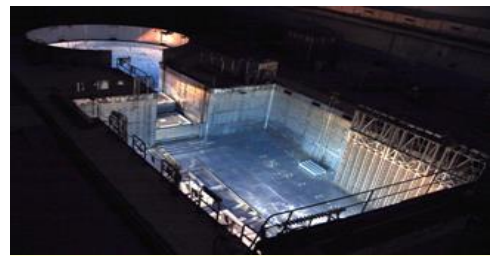
PEGASE



Bituminized waste drums



PEGASE Pool

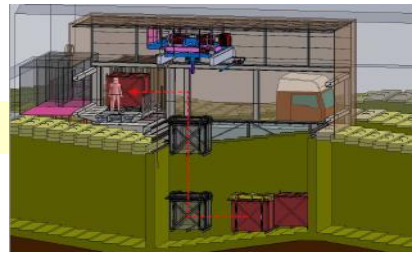


Liquid waste (including organics)

Legacy solid waste

Spent fuel

Retrieval of legacy waste



LEGACY WASTE RETRIEVAL : Example

- Bituminized waste drums stored in bunkers in the south zone of Marcoule



- Mg waste stored in the decladding units of Marcoule



- Powders, sludge, ashes, resins, filters, graphite and fine-grained products stored in the north zone or in the UP1 Plant



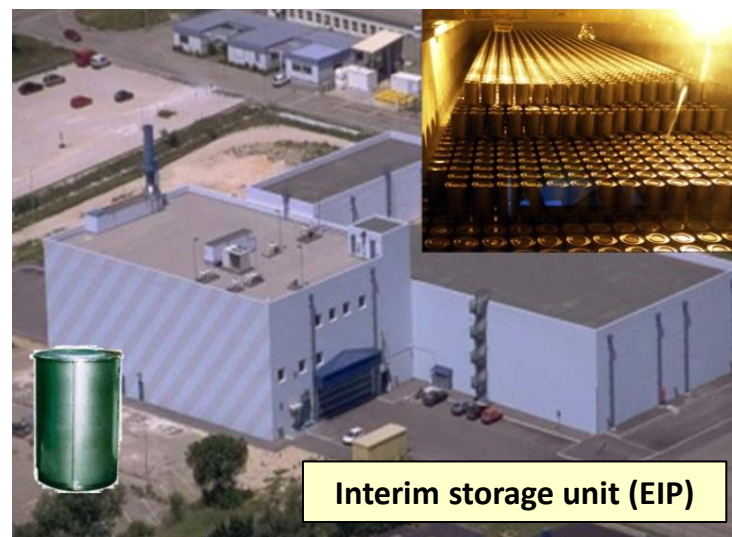
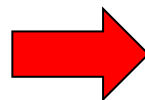
- Pieces of glove-boxes, tools, drums,... in pits or in trenches (Cadaraache)



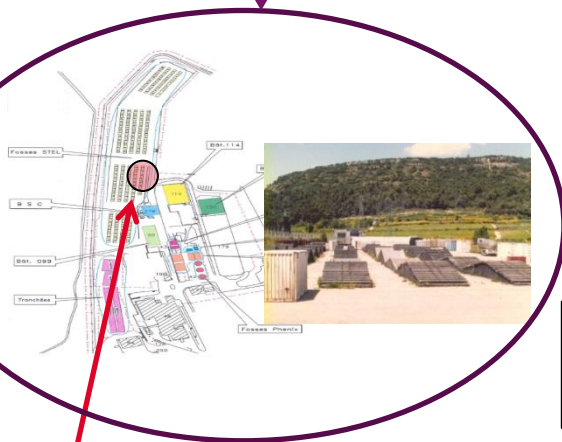
Example : retrieval and conditioning of bituminized waste drums



- More than 60,000 drums
- Each drum is characterized and repackaged in a dedicated stainless steel overpack and then replaced in an Interim Storage Unit (EIP) commissioned in 2000, pending final disposal by ANDRA (before, demonstration is made / long-term behavior, risk of fire, etc)
- About 10,000 drums have been already repackaged



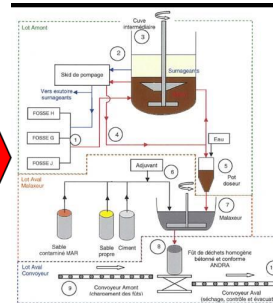
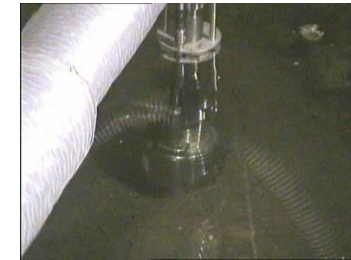
Example : retrieval of waste packages



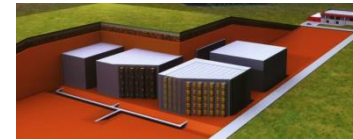
Pit n°94
resins in drums

**Extraction
And
repackaging**

- More than 6,400 objects (drums, bulk waste, deactivation waste,...) in pits and vaults
- About 6000 bituminized waste drums ; all of them are already characterized and repackaged and placed in an Interim Storage Unit (EIP)

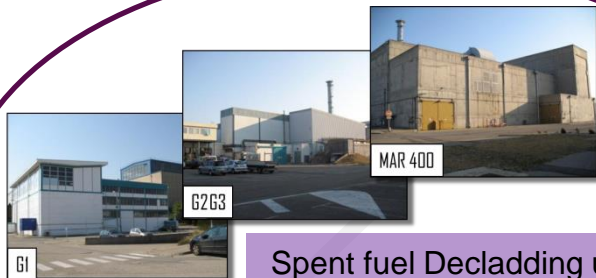
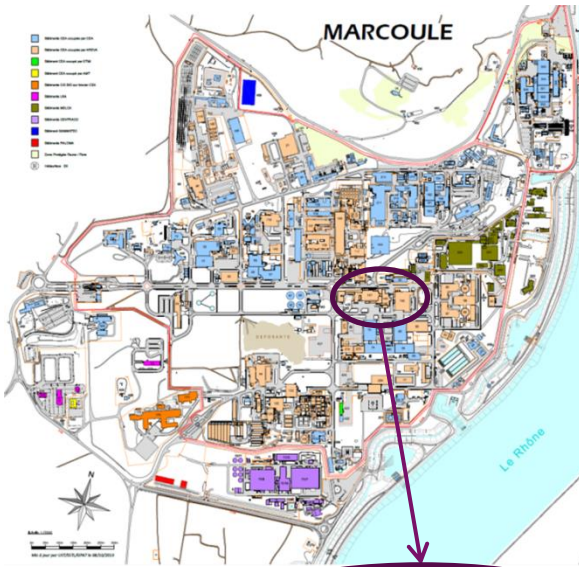


**Cementation
unit**

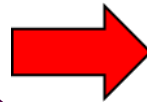


**Surface disposal
for IL-SL waste**

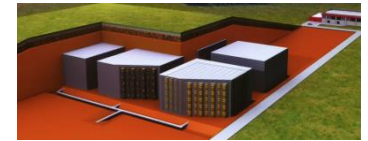
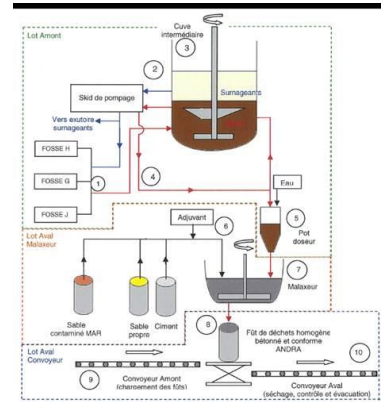
Example : retrieval and conditioning pits liquid muds



Spent fuel Decladding units
G1/G2/G3, MAR 400
Sludge in pits



Cementation
unit



Surface disposal
for IL-SL waste

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Example : cementing matrix

- At stake
 - To define new matrixes suitable to a large wide 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 type of waste : Sludge, resins, powder
 - Development of cementing formulations under way



Mg waste



Compaction



Example : liquid waste treatment

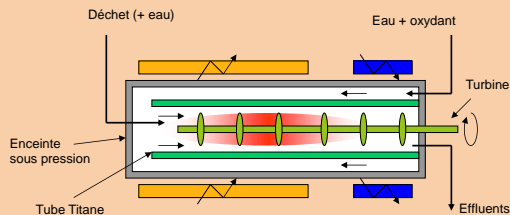
■ At stake

- To increase decontamination efficiency
- To minimize secondary waste volumes
- To be compatible with existing waste treatment and storage
- Eco-friendly processes (energy, water,...)

Filtration

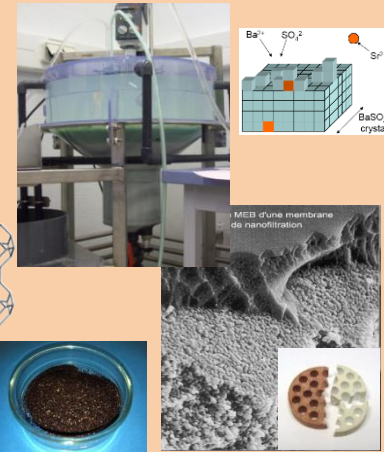
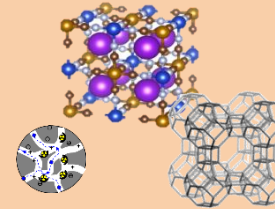


Destruction of organic compounds



Coprecipitation

Adsorption

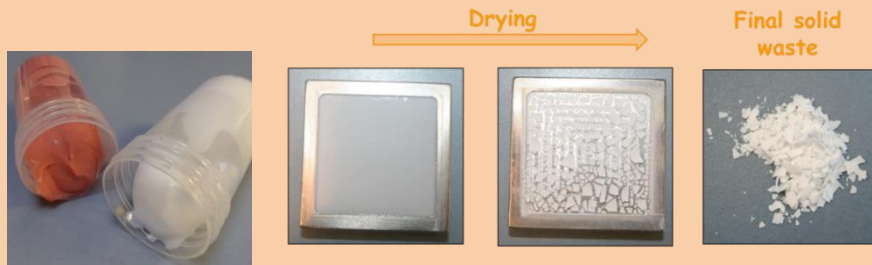


Example : solid waste treatment

■ At stake

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

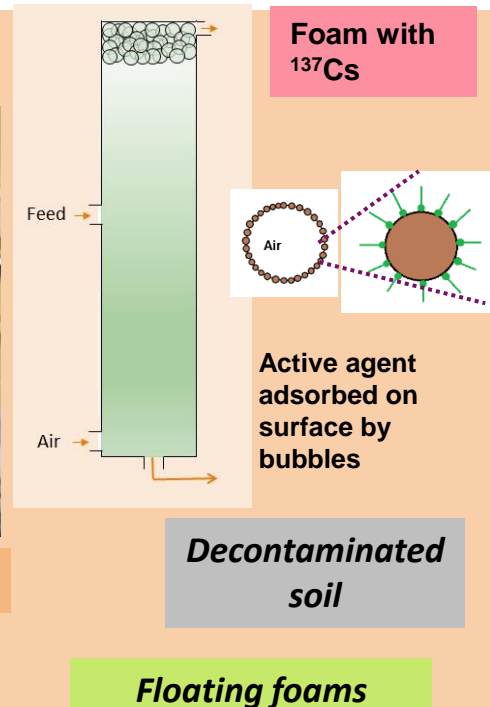
● GELS



● FOAMS



Decontamination foams



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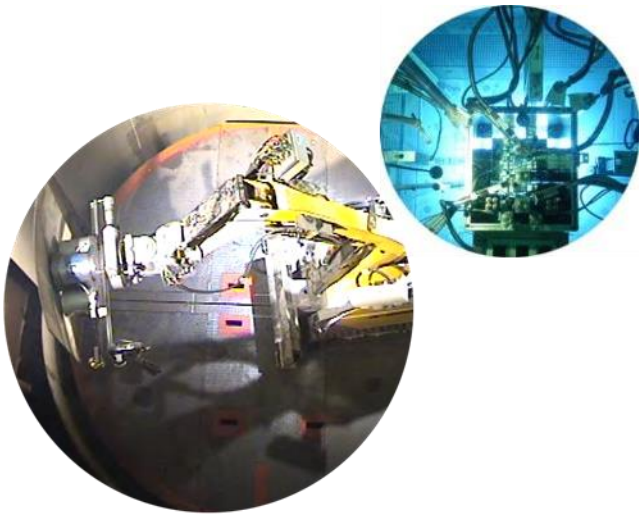
- ❑ In February 2015 a Memorandum of Understanding has been signed between NDF and CEA to exchange information namely on the waste management field to help NDF in its mission to develop a policy for storage management, treatment and disposal from a mid-to- long-term perspective.
- ❑ In September 2015 a Memorandum of Understanding has been signed between TEPCO and CEA to share experiences and information concerning managerial and technical issues on the dismantling, decommissioning and waste management fields.
- ❑ In continuity with the previous agreement, a framework arrangement between CEA and JAEA for cooperation in the field of nuclear research and development has been signed in November 2015 including new fields as : waste management and decommissioning, Fukushima cooperation and remote technology. In 2014, a specific arrangement, so called MCCI, was also signed concerning fuel debris characterisation and retrieval. Exchange or secondment of staff is ongoing in Marcoule and Cadarache CEA centers.

Japan is facing a tremendous task, the one of dismantling and decommissioning in a steady and safe way the Fukushima Daiichi site.

CEA, as a nuclear research center has on its side a large experience of decommissioning and dismantling old facilities, like reactors, hot labs, reprocessing plants, and also to recover legacy wastes in different forms and quantities.

Sharing this experience with the Japanese actors can be a valuable input. The D&D programs are extremely complex, long term endeavors, that require a high level of technology, know how, and also financial commitment in the long run.

CEA is proud through these cooperation agreements to be engaged in a long term by your side, and hopes to share its experience, while learning a lot through the different steps of the decommissioning of Fukushima Daiichi site.



Thank you for your attention

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