WASTE MANAGEMENT STRATEGY

“French Experience in Legacy Waste Management”

Chantal Mergui
CEA / Nuclear Energy Division
chantal.mergui@cea.fr
1. Nuclear waste management at CEA
2. Legacy waste : CEA D&D Perimeter
3. Legacy waste : Technologies and processes
4. CEA Cooperation
## TABLE OF CONTENTS

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

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

Typical Disposal Routes for Different types of Waste
DISPOSAL FACILITIES OPERATED & STUDIED
BY ANDRA

**VL-LW**
« Cires »

**LLW**
“Centre de l’Aube »

**LLW**
Under study

**ILW & HLW**
Under study
*CIGEO* project

Short and long live

Short live

Long live

CEA : ~ 10 000m³/y

CEA : ~ 4 000m³/y

- Graphite (UNGG Reactors)
- Bitumen drums,
- Radium bearing Wastes
MAIN TYPES OF WASTE PACKAGES ARISING FROM CEA R&D AND D&D ACTIVITIES

VLLW
ILW
LL-ILW
HLW

Cemented Drums
Cemented wastes
Bitumen Drums

PIVER Glass
AVM Glass
R7T7 Glass
Hulls
GENERAL PRINCIPLES FOR WASTE MANAGEMENT AT CEA

- 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.
1. Nuclear waste management at CEA
2. Legacy waste : CEA D&D Perimeter
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4. CEA Cooperation
Decommissioned
On going projects
Future works

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

Reactors: **SILOE, SILOETTE, MELUSINE**
Laboratory: LAMA

Reactors: **HARMONIE, RAPSODIE*, PHEBUS**
Plants: ATPu, ATUE

Waste Treatment Facilities, Plants, Laboratories

Reactor: **PHENIX***
Plant: APM

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

22 nuclear facilities ongoing dismantling

**CEA D&D PERIMETER**
LEGACY WASTE RETRIEVAL : D&D PERIMETER

Legacy waste retrieval, characterization & repackaging

HA4 - Organic liquid tank
CIRCE - Radioactive liquid tank
Solid waste

Mg waste - UP1

Bituminized waste drums

Retrieval of legacy waste

PEGASE Pool

Liquid waste (including organics)

Legacy solid waste

Spent fuel
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 (Cadarache)
LEGACY WASTE RETRIEVAL IN MARCOULE

North zone storage pits and vaults

Vitrification facility
Legacy waste (glass containers)

Spent fuel Decladding units G1/G2/G3, MAR 400
Legacy waste (Mg, sludge, ...)

Processing plant
Legacy waste (sludge)

Pilot processing plant
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

- More than 6,400 objects (drums, bulk waste, deactivation waste,...) in pits and vaults
- About 6,000 bituminized waste drums; all of them are already characterized and repackaged and placed in an Interim Storage Unit (EIP)
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
1. Nuclear waste management at CEA
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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
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
At stake

To reduce uptake doses
To optimize waste categorization by increasing decontamination efficiency
To reduce the amount of secondary waste produced
1. Nuclear waste management at CEA
2. Legacy waste : CEA D&D Perimeter
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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