



CIGEO project

(Industrial Geological Repository Project)

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Programmes Direction

Blue Ribbon Commission Visit - 22 feb. 2011

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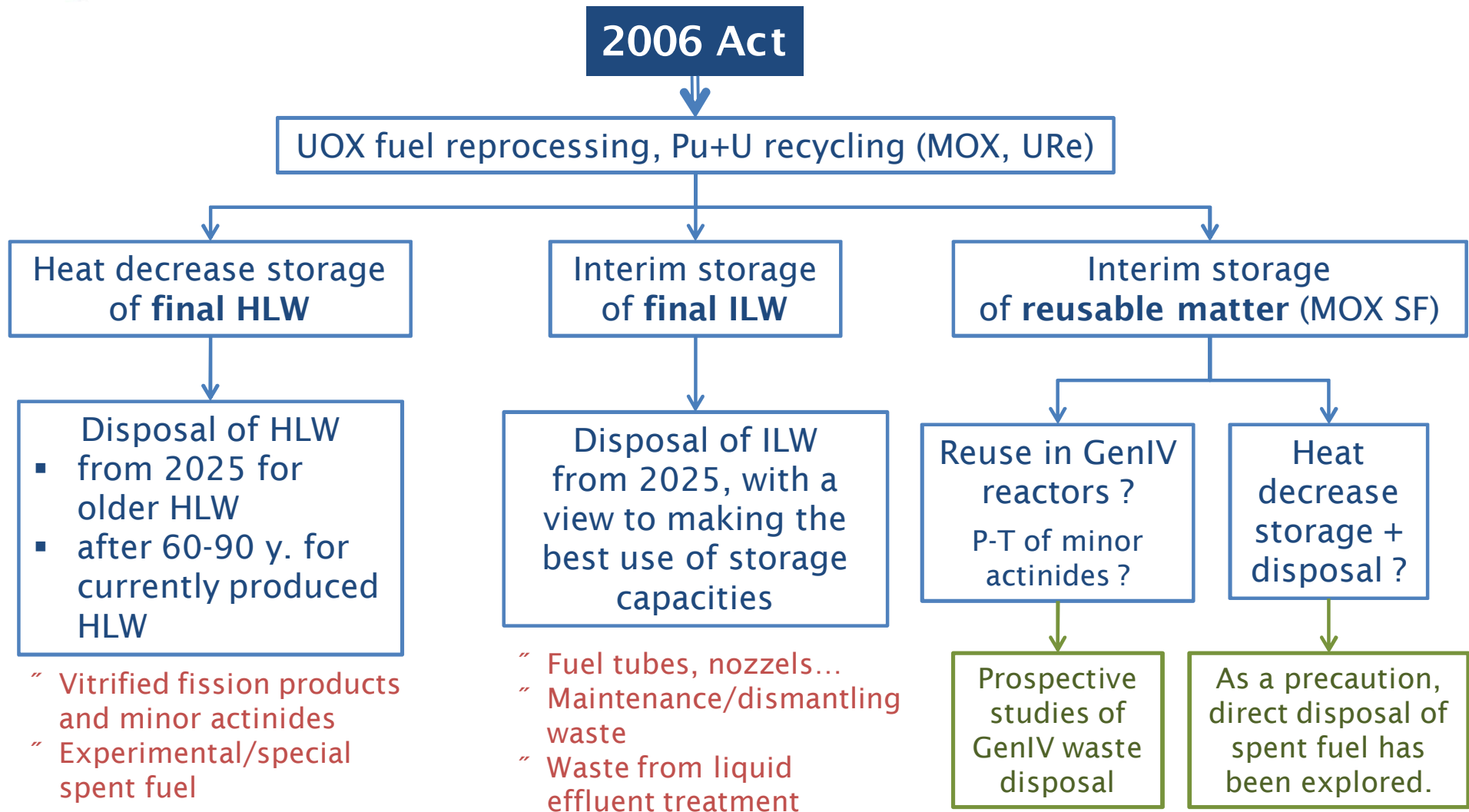


The 1991 Waste Act

- » Creation of « Andra » as a public independent body
- » 3 research areas for High Level Long-lived Waste: partitioning/transmutation; long term storage; geologic disposal
- **2005: Feasibility assessment of safe geological disposal in Meuse/Haute-Marne clay layer (URL)**

The 2006 Programme Act: Reduce/avoid the burden on future generations

- » Reduce volume and harmfulness of wastes
 - ⇒ SF reprocessing + waste treatment and conditioning
- » Reference option for final waste that can no longer be treated: geological repository with respect to reversibility (100 y at least)
- » Application: 2015; Operation: 2025
- » Continue research on partitioning/transmutation (CEA) and interim storage (Andra) on a complementary basis.

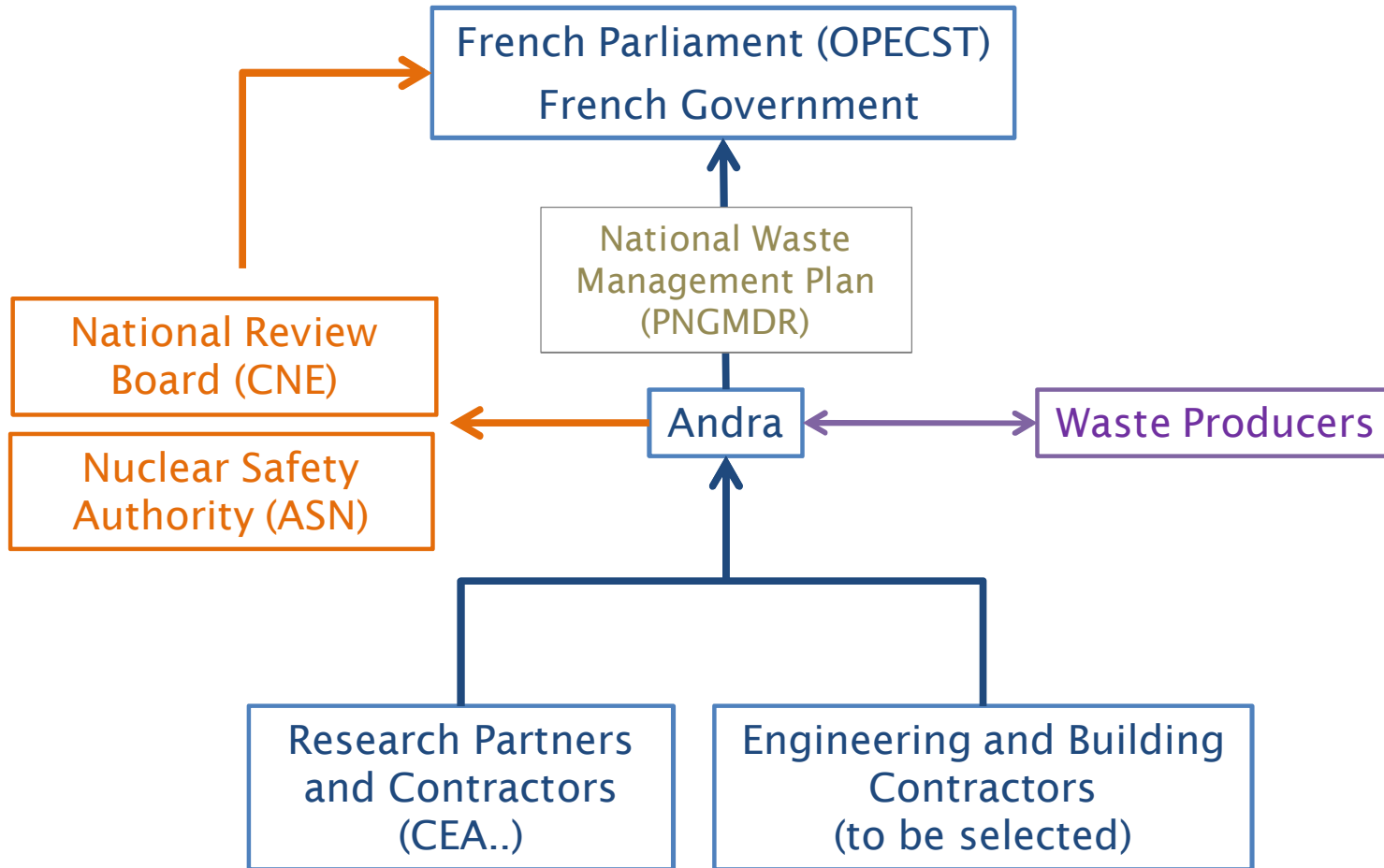


Long term passive safety functions to protect Man and Environment from waste induced hazards:

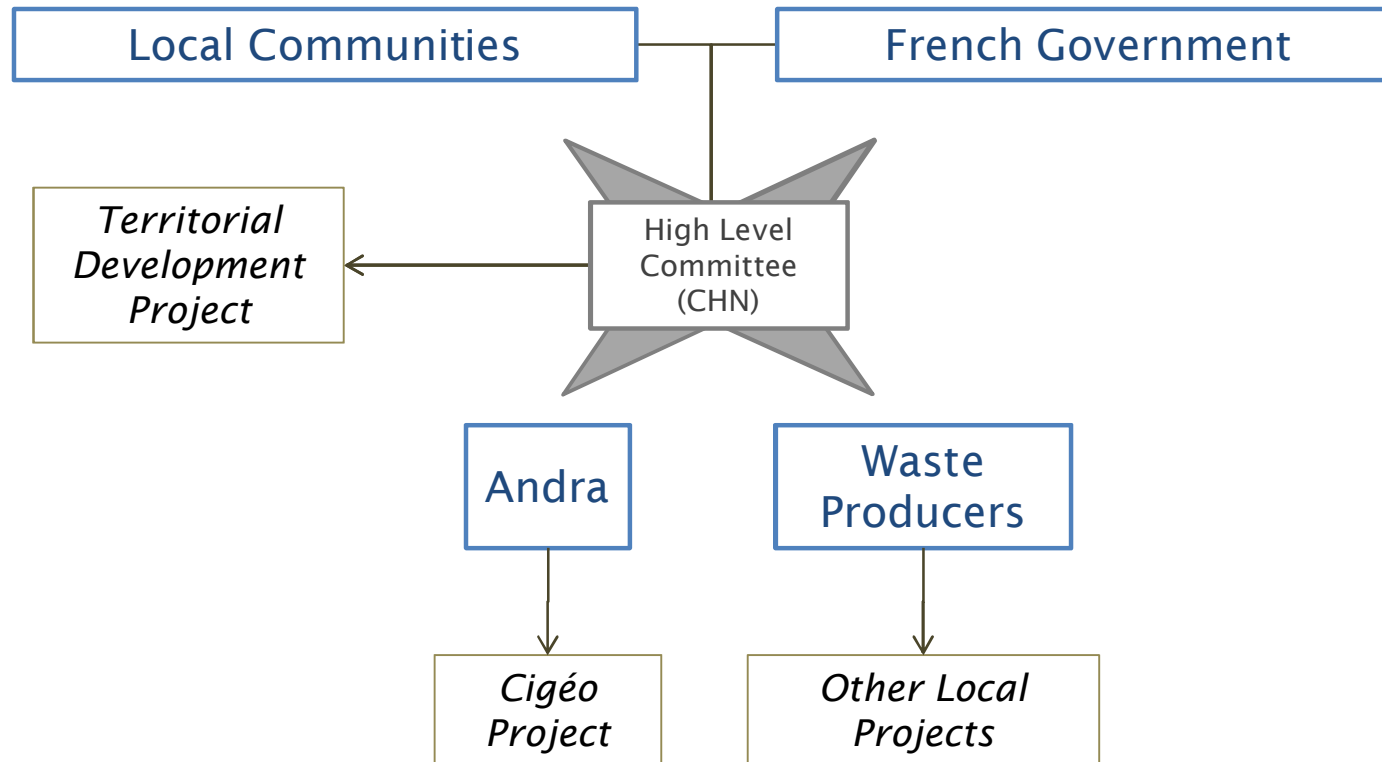
- Waste isolation from surface evolution and human intrusion
 - ▶ Depth ≥ 200 m (*French Safety Guide*)
 - Prevent groundwater flow; limit radionuclide release and immobilize them within repository; retard and mitigate radionuclide migration
 - Resist human activity and natural events
 - ▶ Site control and survey, long term memory, design robustness
- **The repository is designed to be closed.**
- **Post closure safety is mainly based on the host clay layer:**
- Provisions for site selection, geological survey and URL;
 - Repository designed to **limit induced disturbances**;
 - **Higher confidence** in long term safety demonstration.
- ▶ Low permeability;
 - ▶ Depth and thickness;
 - ▶ Favourable geochemistry;
 - ▶ Geodynamic stability.



Project Governance: Project Management; Waste Management Planning; Reviewing; Industrial Coordination



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Concertation Bodies:

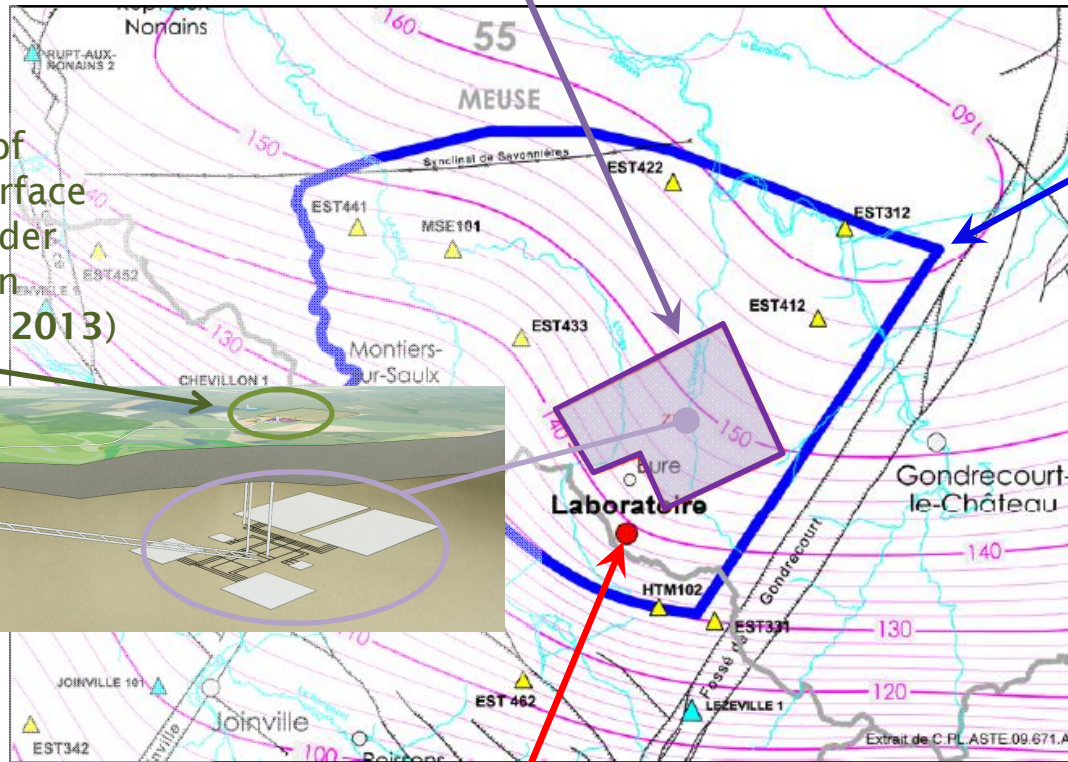
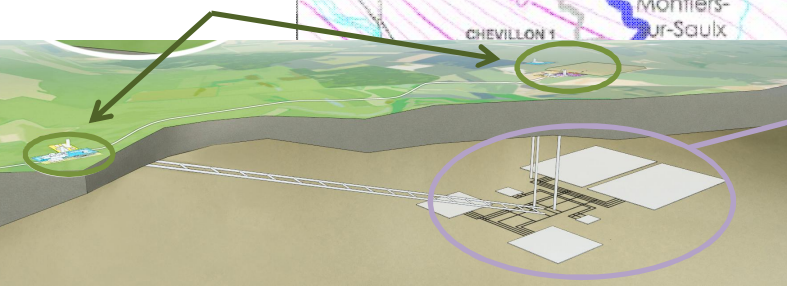
- Local Information Committee (CLIS) → Local
- National Public debate Commission (CNDP)
- Nuclear Transparency/Information High Committee

} National

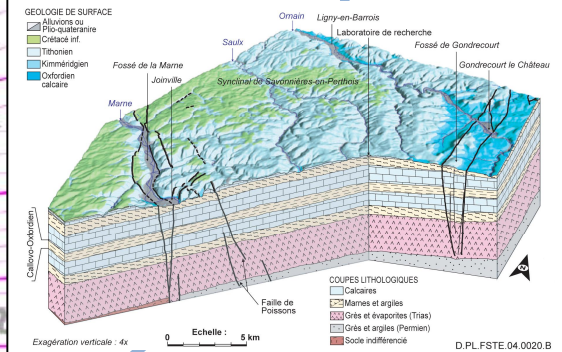
Stepwise siting has combined geology / industrial criteria and local integration on a concertation basis

Area defined after local consultation (2009) for location of repository U/G facilities and detailed geological survey from the surface

Location of repository surface facilities under discussion (public debate: 2013)



Transposition zone of URL results (proposed 2005)



Siting started in 1992; URL licensed 1998

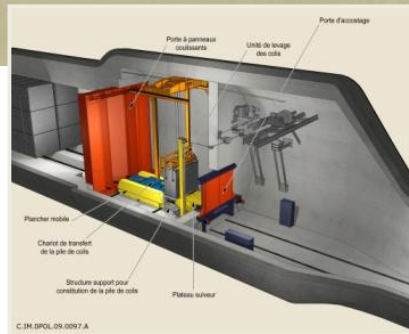
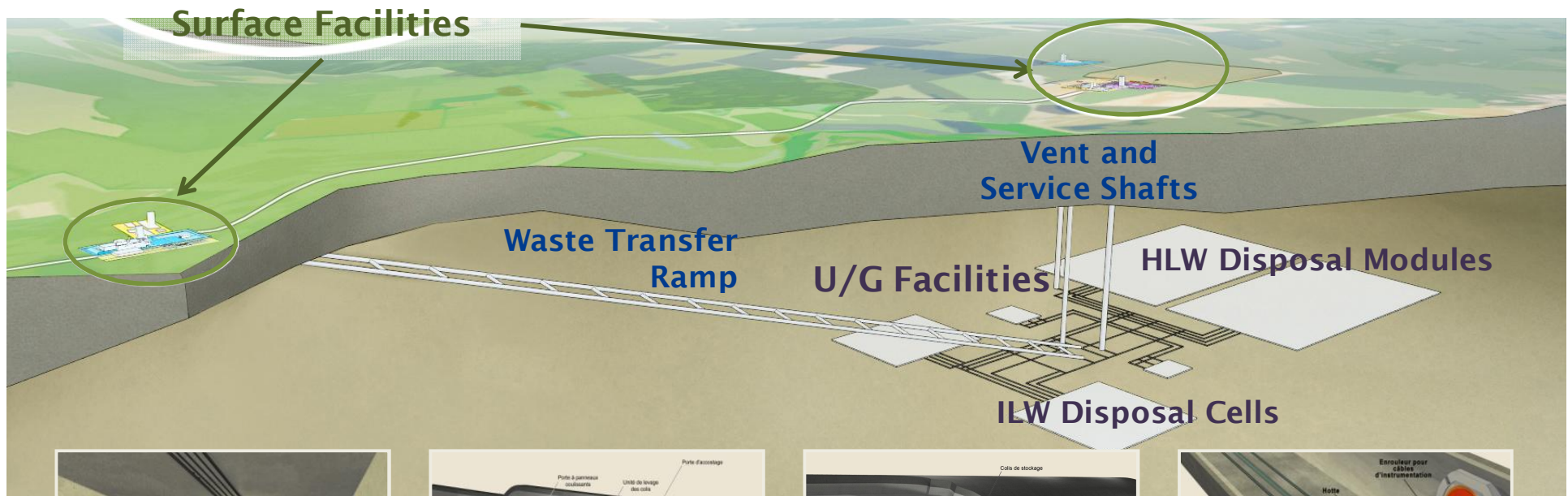
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Next milestones:

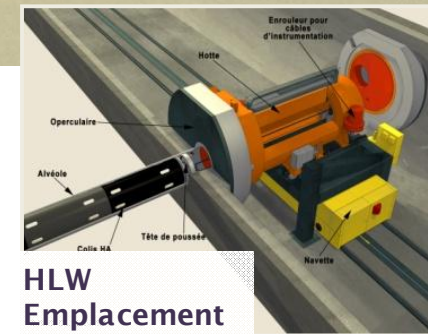
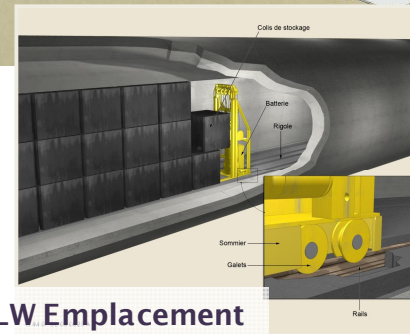
2013 Public Debate

2015 Application

2025 Operation



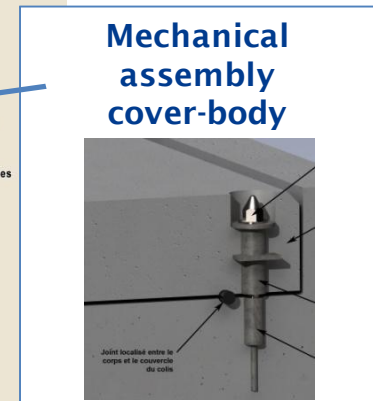
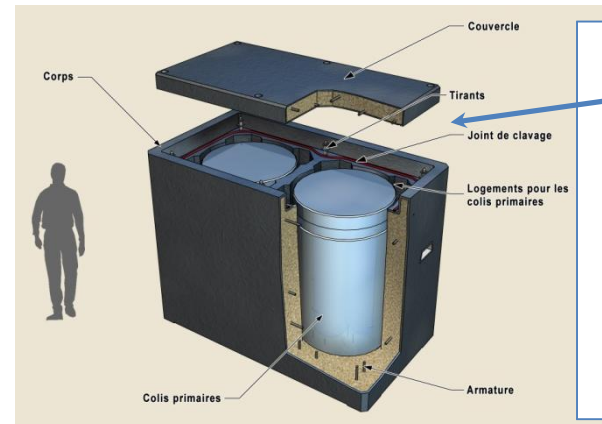
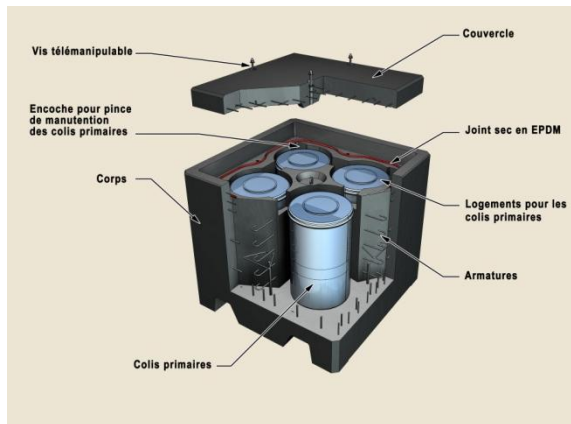
ILW Emplacement



HLW Emplacement

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Before emplacement, ILW will be grouped into precast concrete rectangular robust containers:



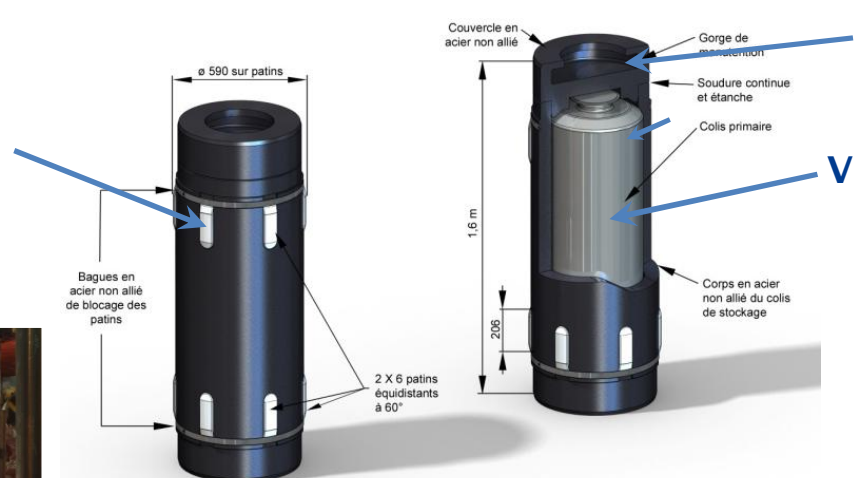
Prototype Manufacturing



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HLW will be placed in thick steel overpacks to prevent glass leaching during the thermal phase:

Ceramic skids for easy handling



Gripping Interface

Vitrified HLW Stainless Canister

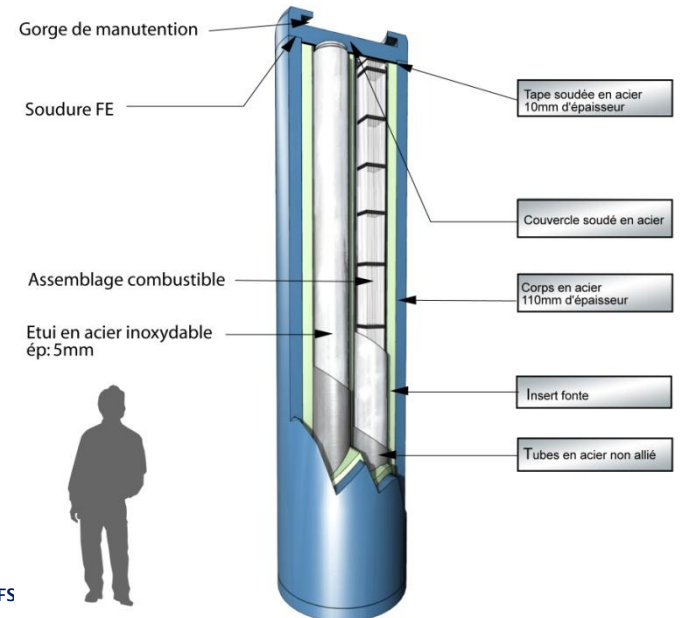


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Réalisée depuis la maquette 3D CPL/ASTE.08.0602.B



To explore the direct disposal option, steel containers were also studied and prototyped for Spent Fuel (Andra/CEA/EDF 2005)



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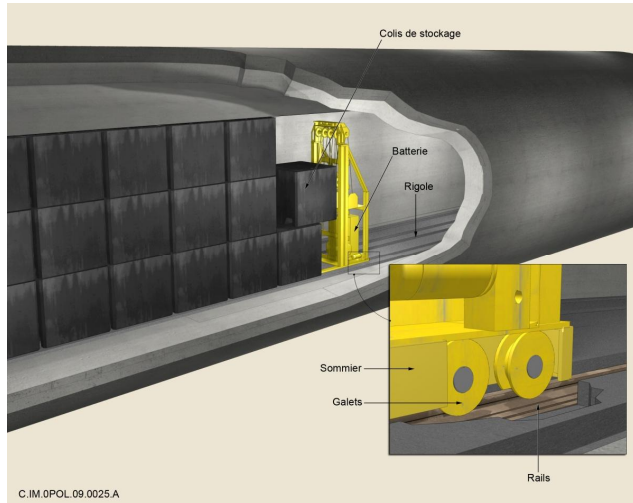
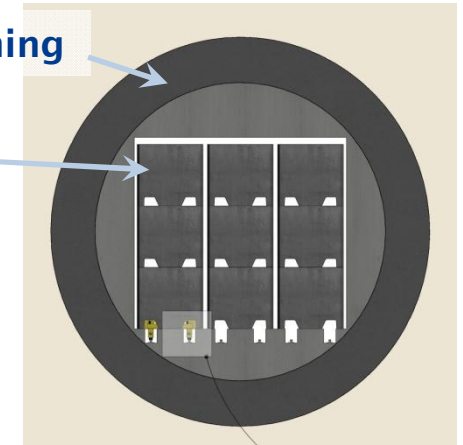
ILW disposal cells are horizontal tunnels located at the median of the host clay layer:

- » Thick concrete lining to limit long term deformations;
- » Ventilation of ILW repository cells as long as they are not closed.

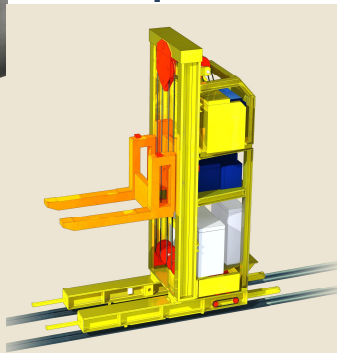
Emplacement/retrieval processes and equipments are being developed and prototyped:

Concrete Lining

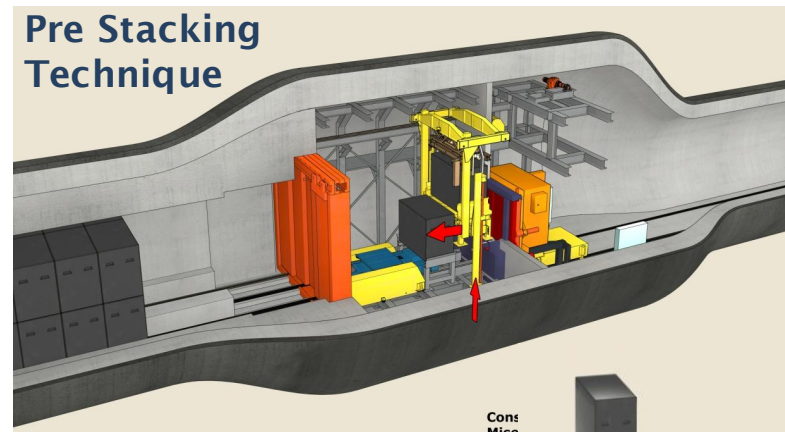
ILW Disposal Package



Trolley Stacker Technique



Pre Stacking Technique



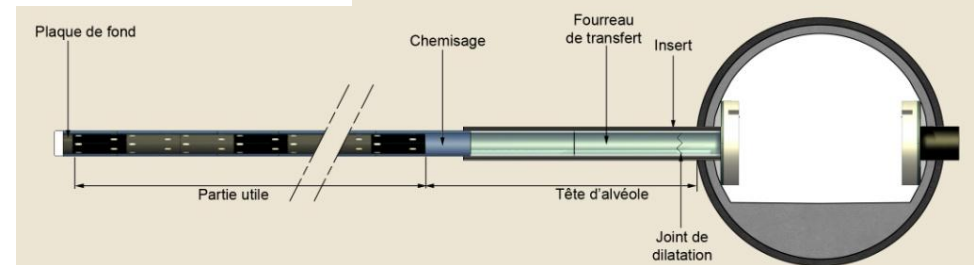
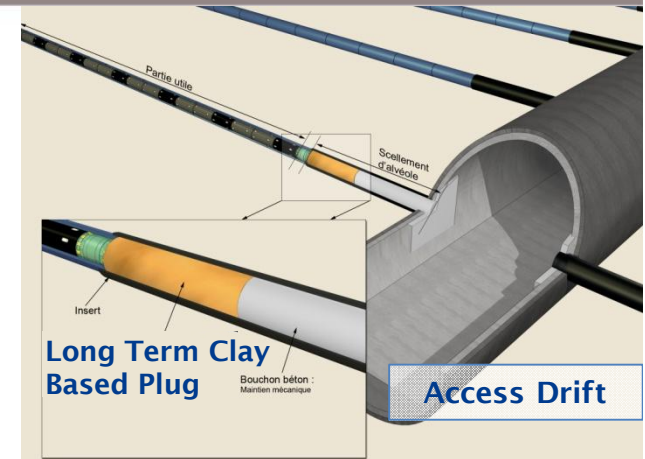
Cons
Mise



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HLW will be disposed of in lined horizontal micro-tunnels:

- » Heat conduction in clay
 - max. temp in clay rock: 90 °C
- » Steel liner
- » Cell length to be optimized with regard to technological limits and cost
- » Emplacement/retrieval equipments tested in worst conditions.



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- Disposal of reprocessing waste from French existing NPPs [without MOX SF]:

- ❖ 40 y PWR operation → HLW: 6,330 m³ (WDP: 14,550 m³)
+ Ends & Hulls: 8,000 m³

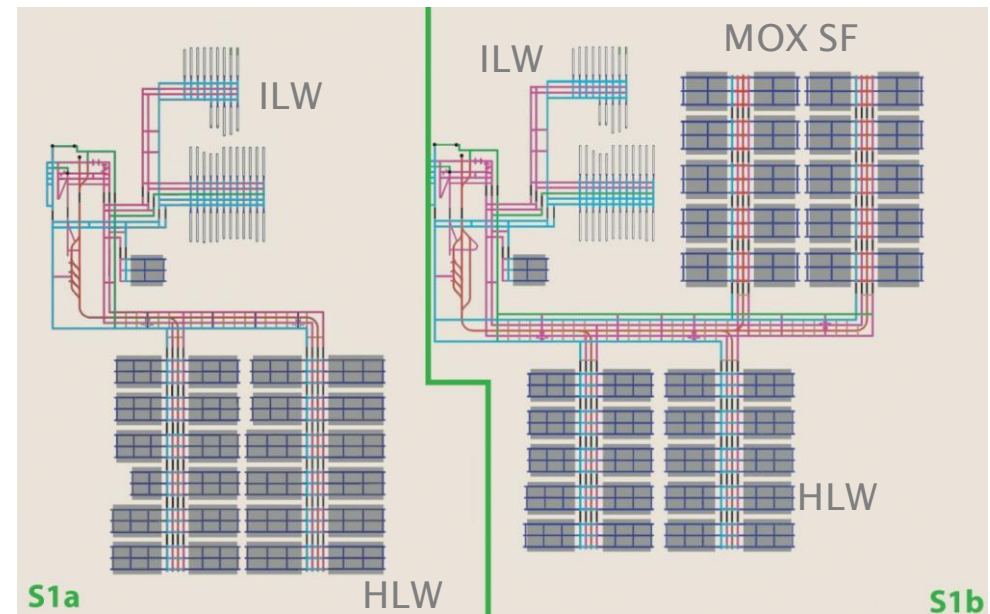
- 5.5 km² (60 to 70 y heat decrease storage)
 - 4 km² (app. 100 y heat decrease storage)

- Disposal of reprocessing waste from existing NPPs + MOX used fuels:

- 9.2 km² (60 to 70 y)

- Disposal of spent fuel from existing NPPs without reprocessing (academic case):

- ❖ 40 y PWR operation
→ SF: 45,000 m³ (WDP: 139,000 m³)
➤ 14 km² (60 y)



Reversibility: legal requirement in France (at least 100 y), social & political request

→ Scientists are in charge of proposing concrete responses in view of a new law that will define the conditions of reversibility (around 2016).

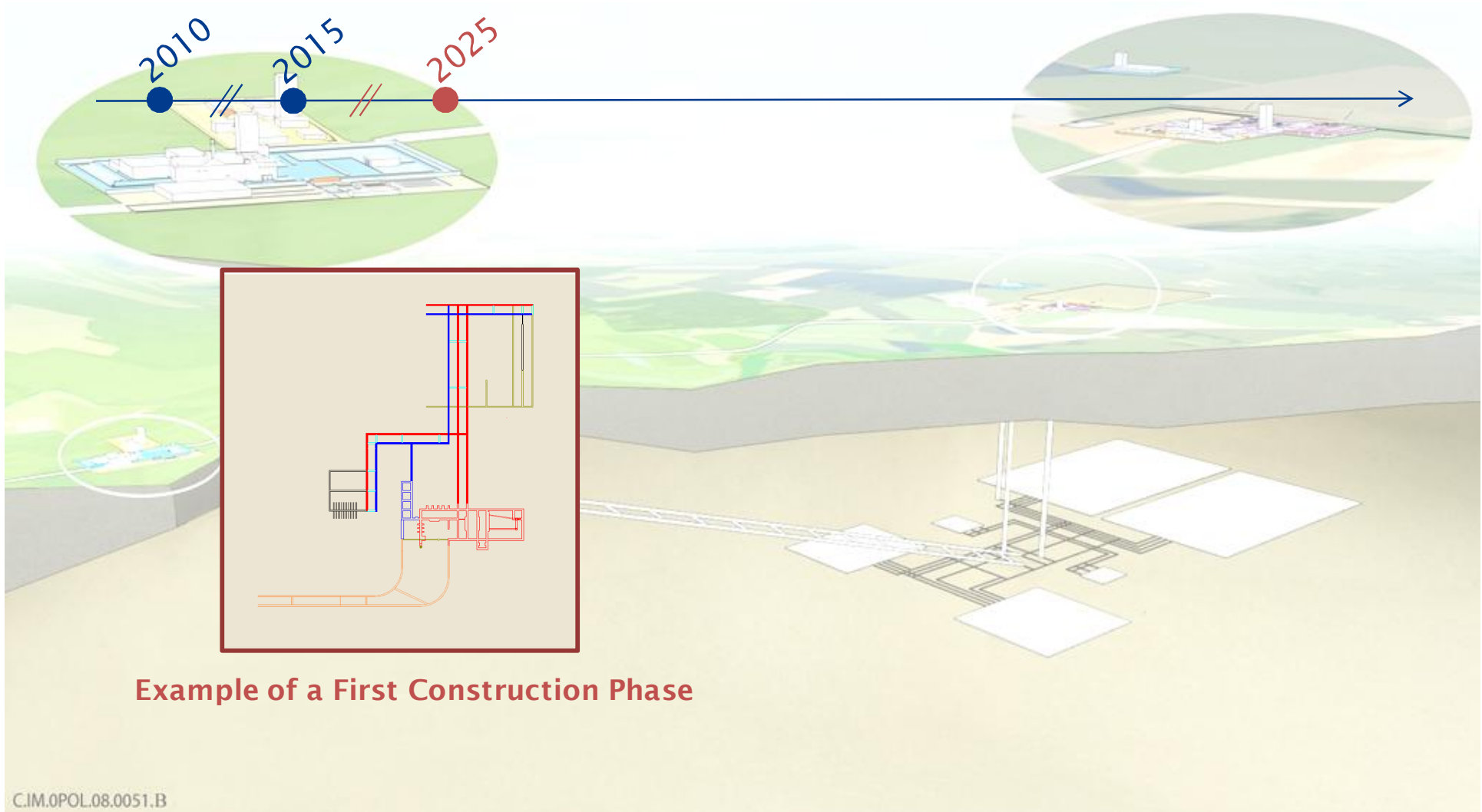
Andra's current proposals:

- 1) **Stepwise decision making process** to control disposal progress (Governance);
- 2) Technical features to **enhance waste package retrievability**, included in repository engineering.

No compromise between reversibility+retrievability and safety.

Proposals for stepwise decision making with regard to reversibility

Repository development will be progressive.



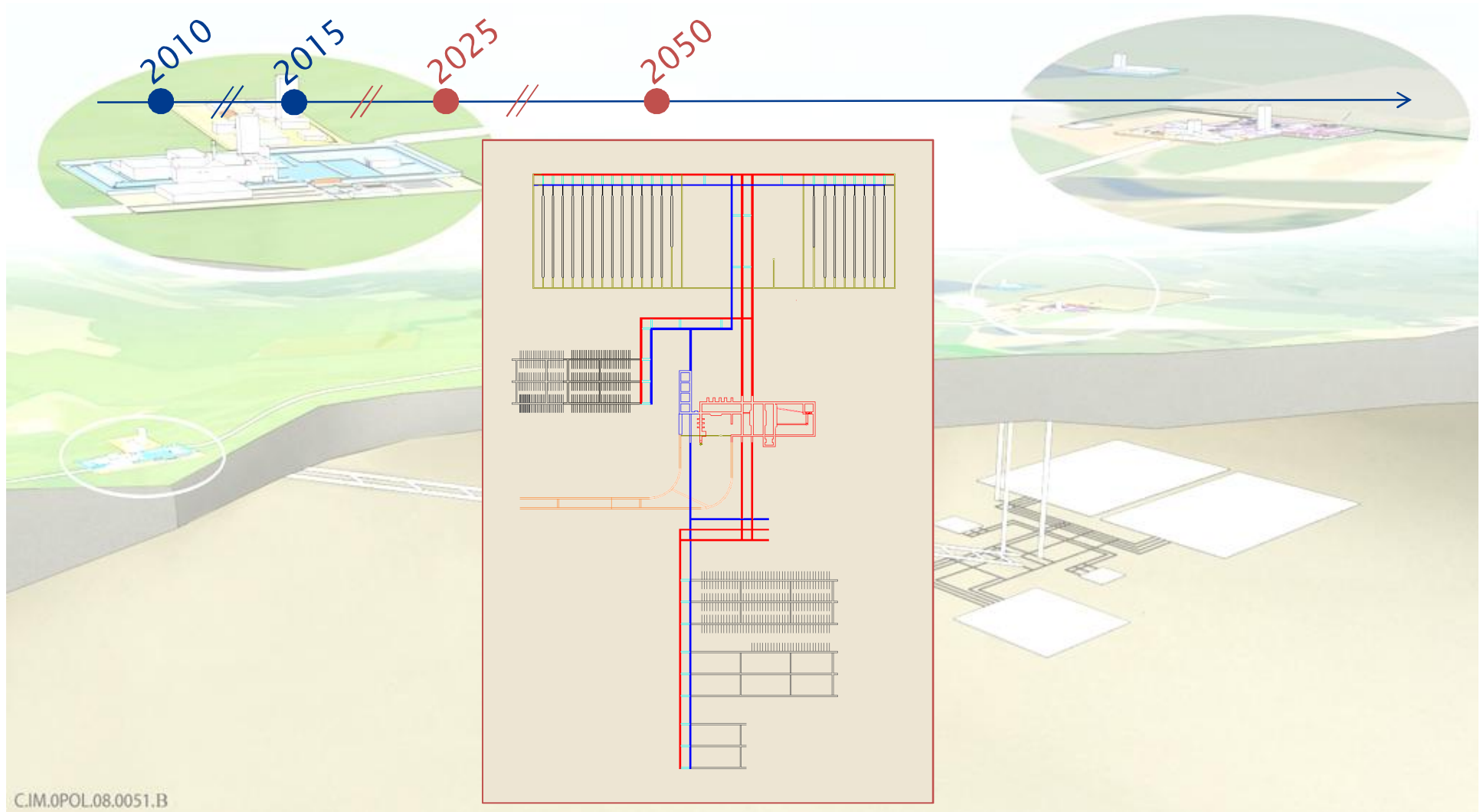
Example of a First Construction Phase

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Proposals for stepwise decision making with regard to reversibility

Repository development will be progressive.



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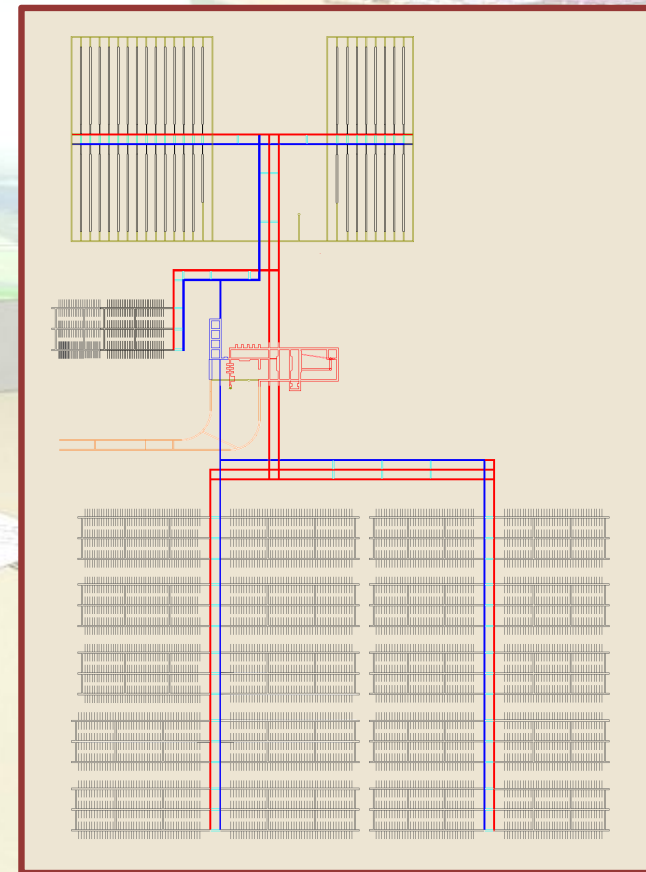


2010 // 2015 // 2015 // 2050 // 2110

Successive construction phases can be associated to intermediate review and decision milestones.

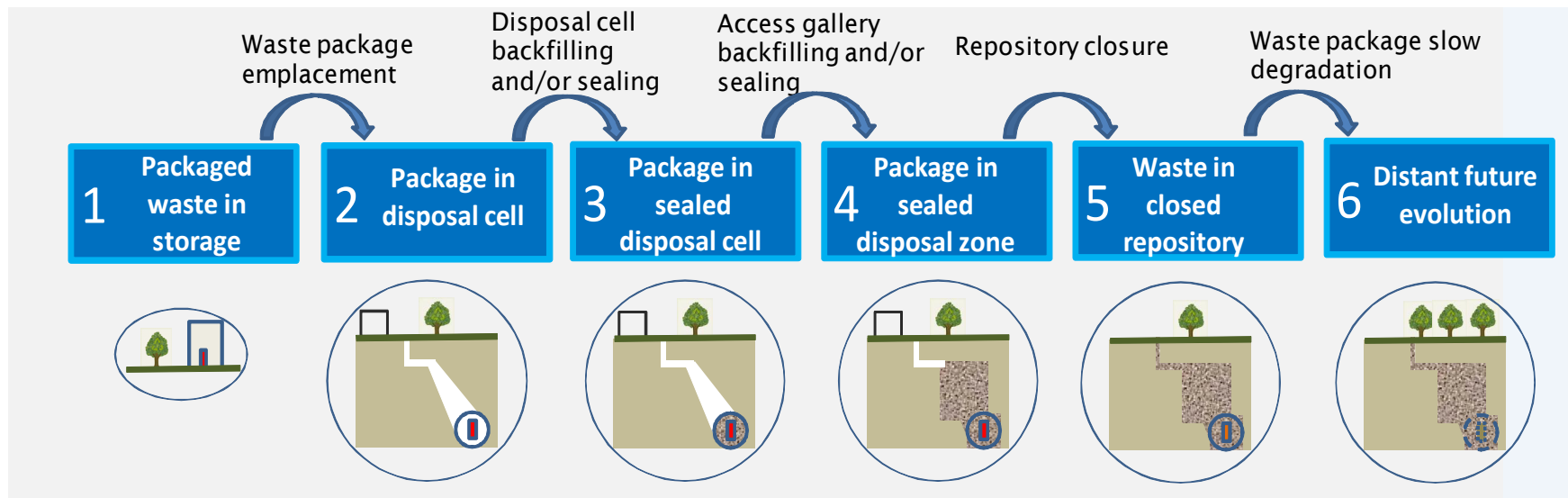
⇒ **Modular and adaptive design** to benefit from:

- ✓ Feedback from previous phases;
- ✓ Broad scientific and technical progress.



Intermediate decision-making milestones can be planned to control disposal progress:

- » Create new repository modules;
- » Prolong observation;
- » Close part of repository.



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