Current status of the CIGEO project,

Richard Poisson

November 13th, 2015

DINT/15-0203c

Contents

Contents

Project follow-up actions

In order to take account of the opinions and expectations expressed during the public debate, and to continue the stepwise approach initiated by the Law of 1991, Andra pursued the Cigeo project with:

Four changes to the project following the public debate

- The integration of a pilot industrial phase at facility start-up
- The establishment of a regularly revised master plan for disposal operations
- Changes to the timetable
- The involvement of civil society in the project

A proposal regarding reversibility

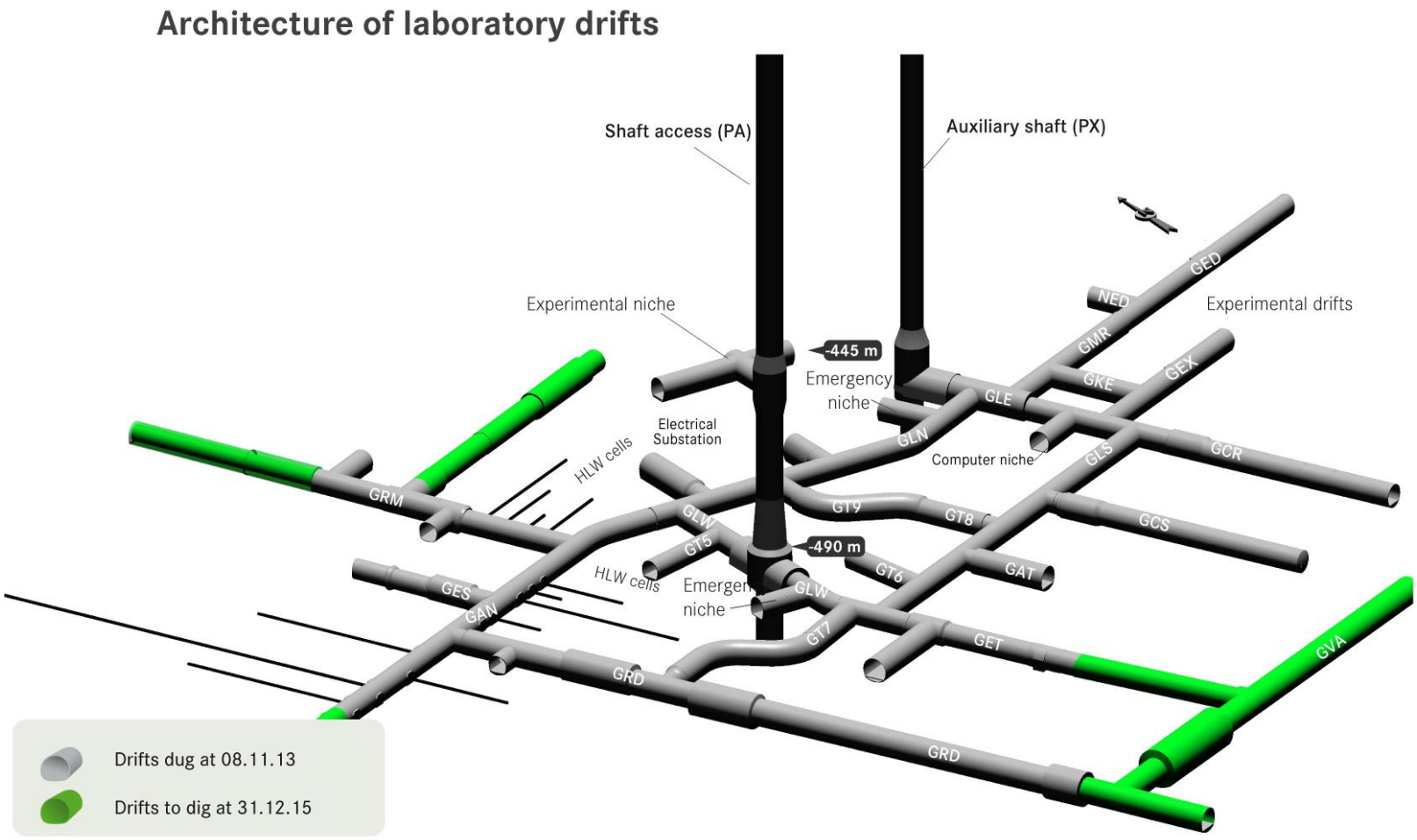
- Definitions regarding reversibility and retrievability, phased approach

Three commitments

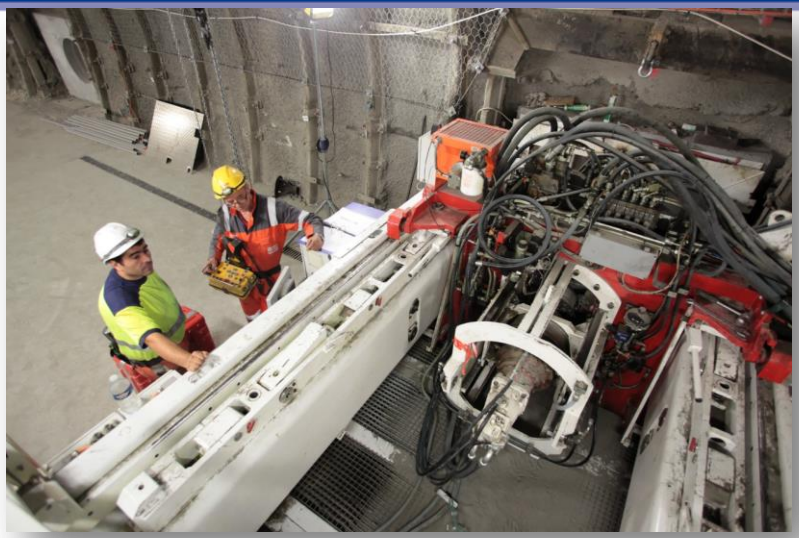
- To ensure safety as the top priority
- To preserve and develop the local area
- To control costs

Contents

Currently, a valuable underground laboratory



Technology demonstration



A progressive and converging approach

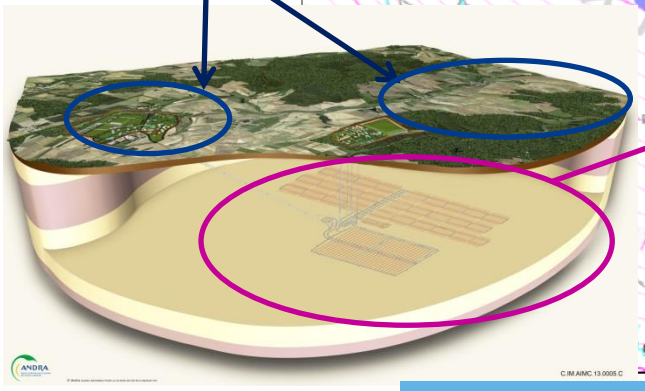
3- Area defined for location of repository U/G facilities after local consultation (2009) and detailed geological survey from the surface – 30km²

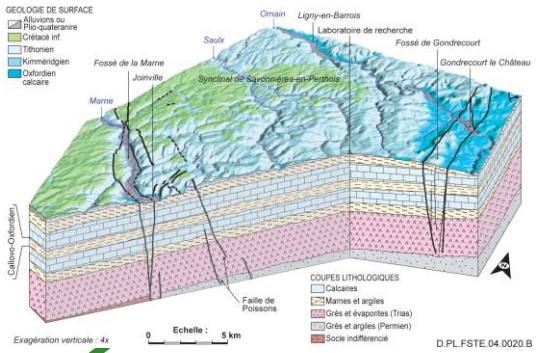
Detailed survey in 2010

Additional above-ground geological survey 2007-2008

2- Transposition zone of URL results (proposed 2005) - 250 km²

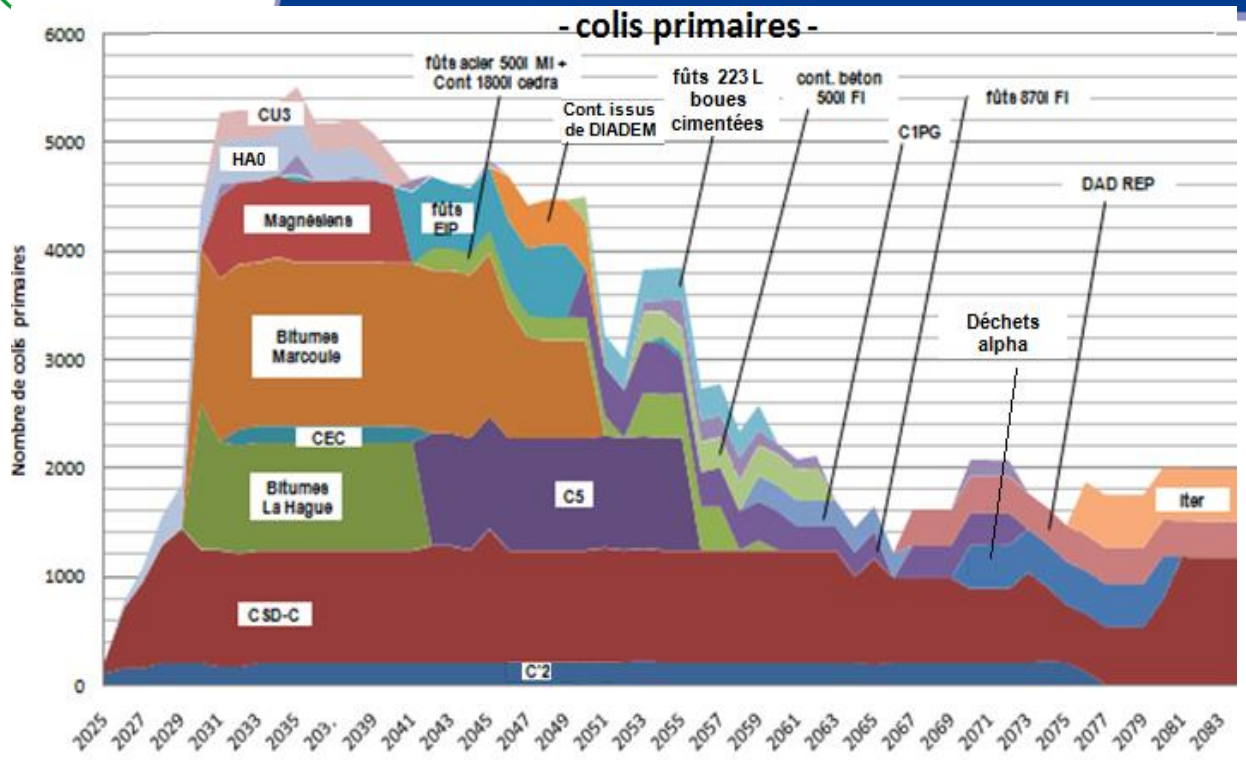
4- Location of repository surface facilities presented during the Public Debate

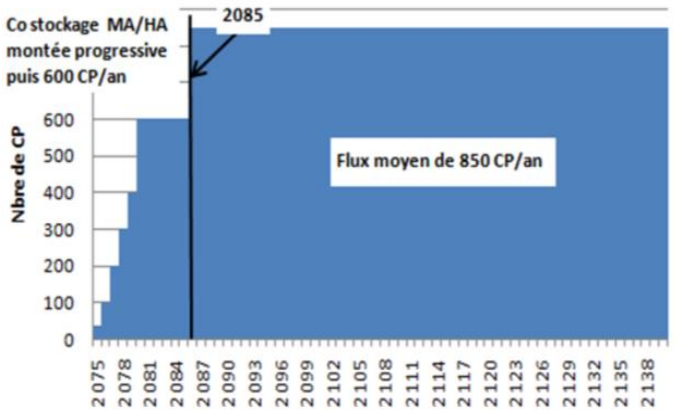




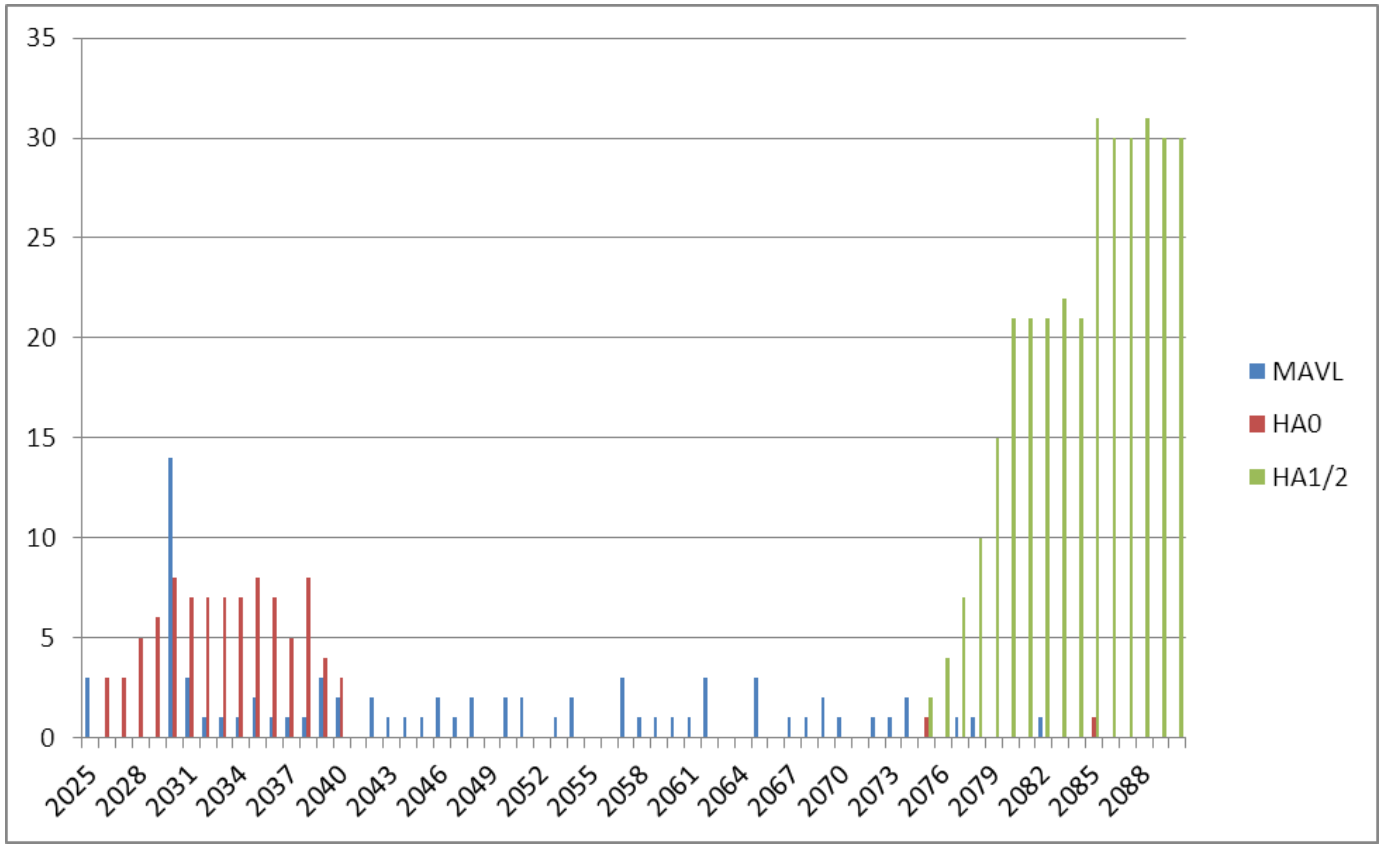
1- Siting started in 1992 with a National call for volunteering; URL licensed 1998

The waste delivery schedule





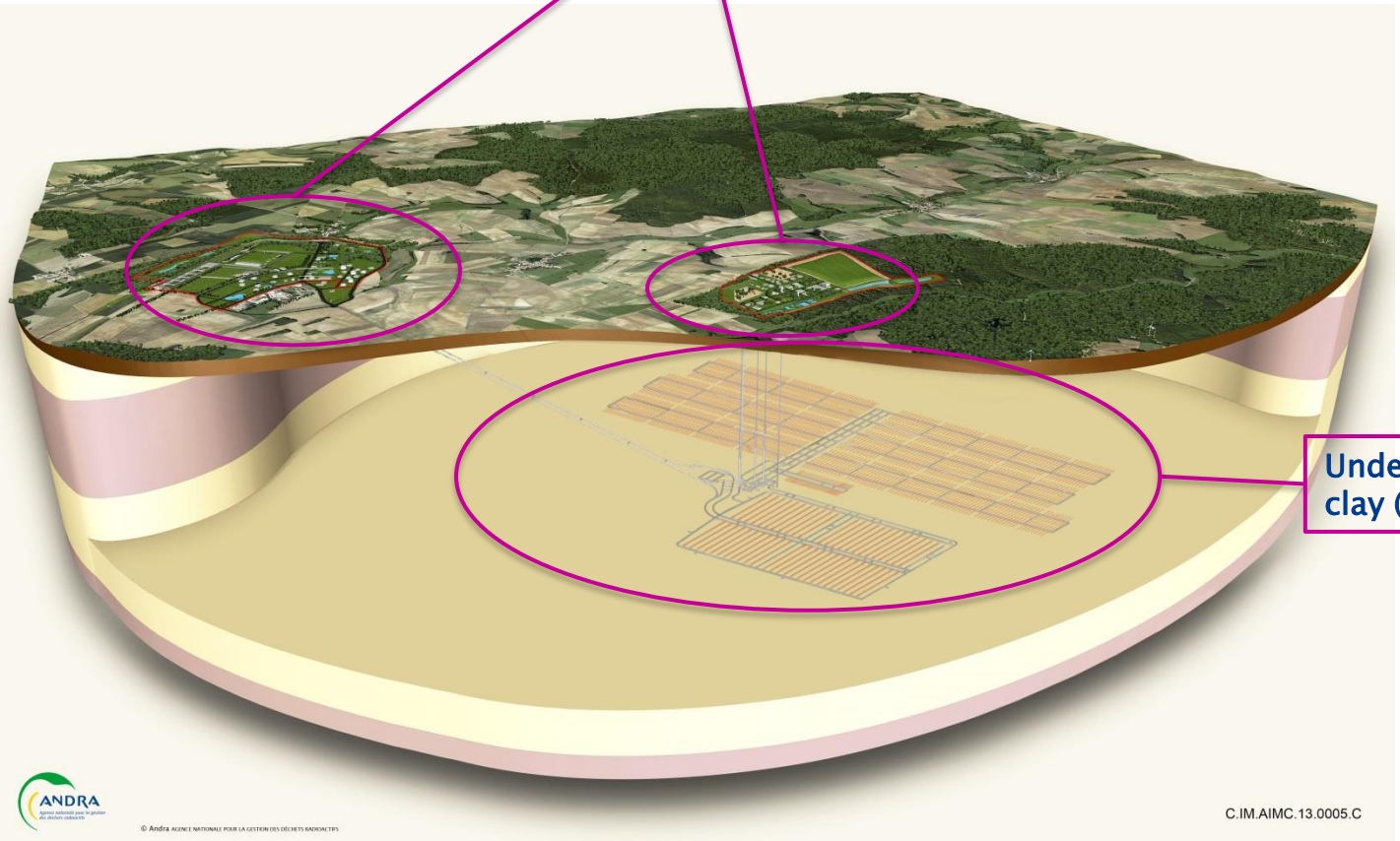
Vaults needed



Cigéo facilities

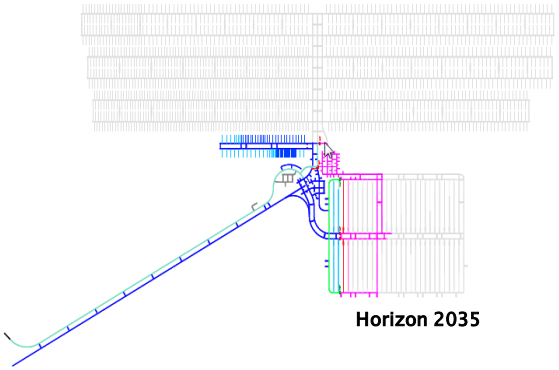
2 surface facilities:

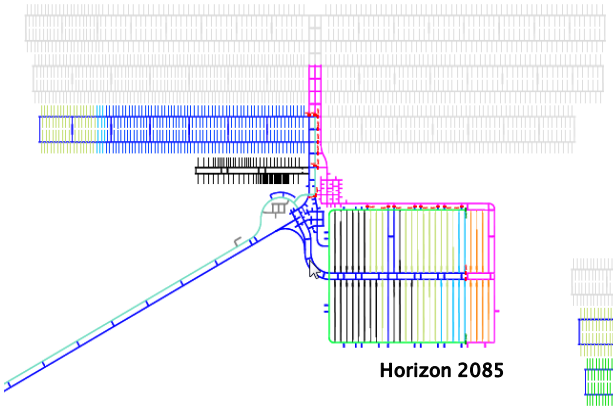
- **Nuclear**: Receiving, inspecting, and preparing packages
- **Non Nuclear**: Shafts for construction work

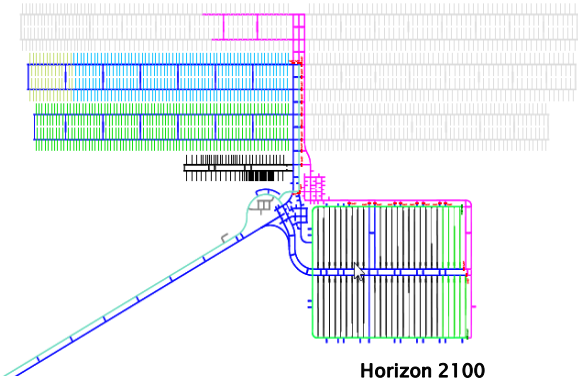


Underground facility in clay (500m depth)

The successive states of the repository







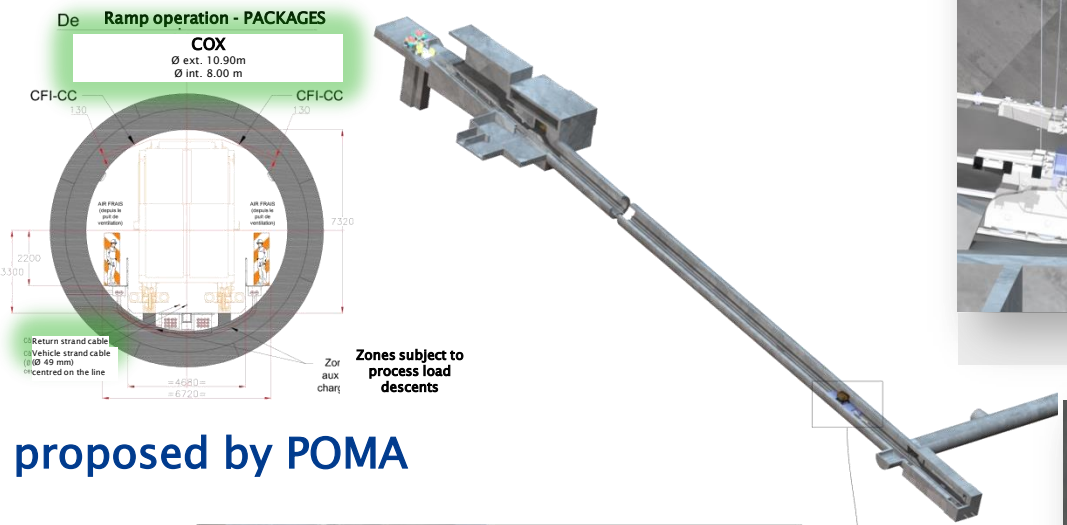
Nuclear area
Nuclear ventilation
Construction area
Closed area

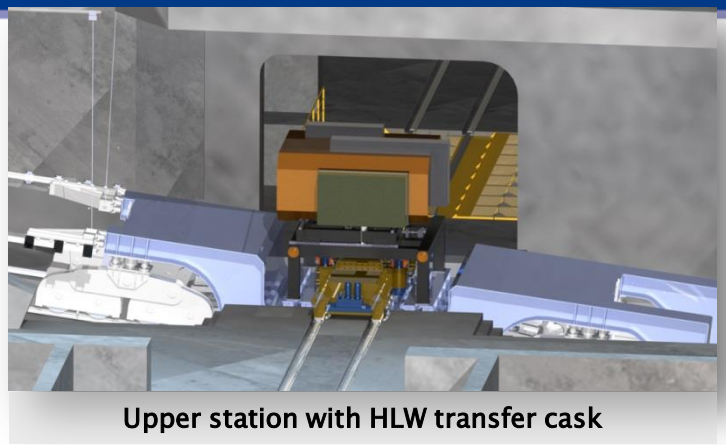
Surface installations

Reception Area (100 Ha)
(nuclear)

Digging area (200 Ha)
(non nuclear)

Waste packages transfer

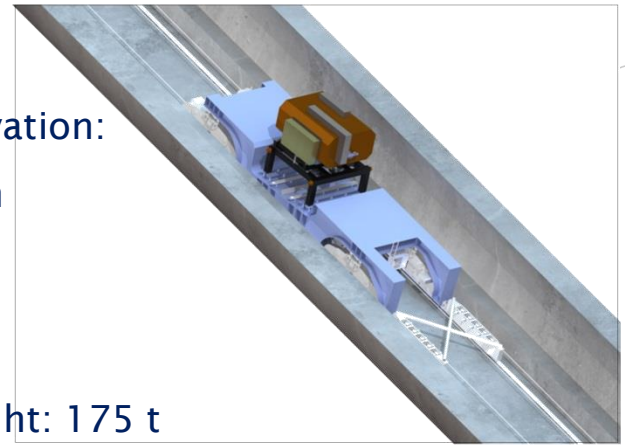


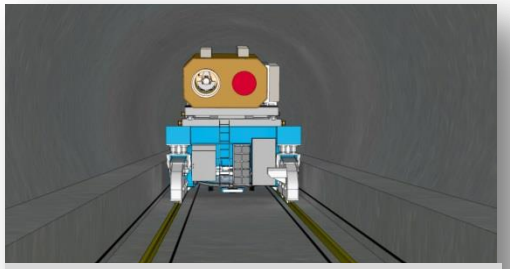


Upper station with HLW transfer cask

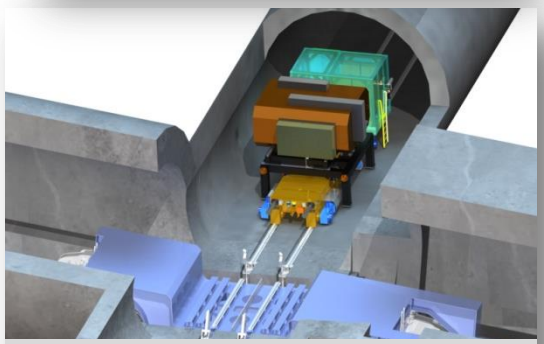
Funicular proposed by POMA

- Length: 4.2 km
- Difference in elevation: more than 500 m
- Slope: 12%
- Payload: 130 t
- Total rolling weight: 175 t
- Pulley effort required: 750 kW



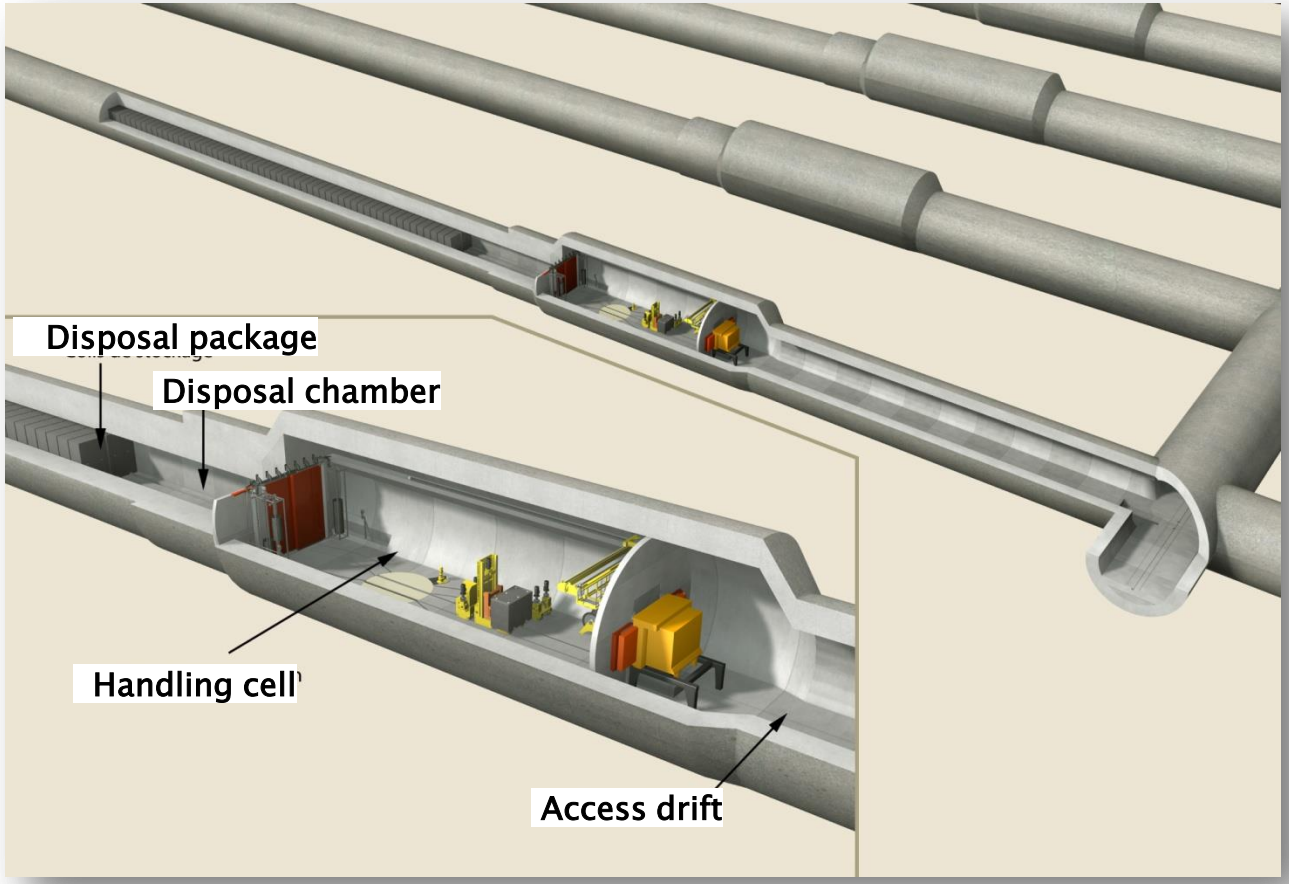


Ramp Funicular



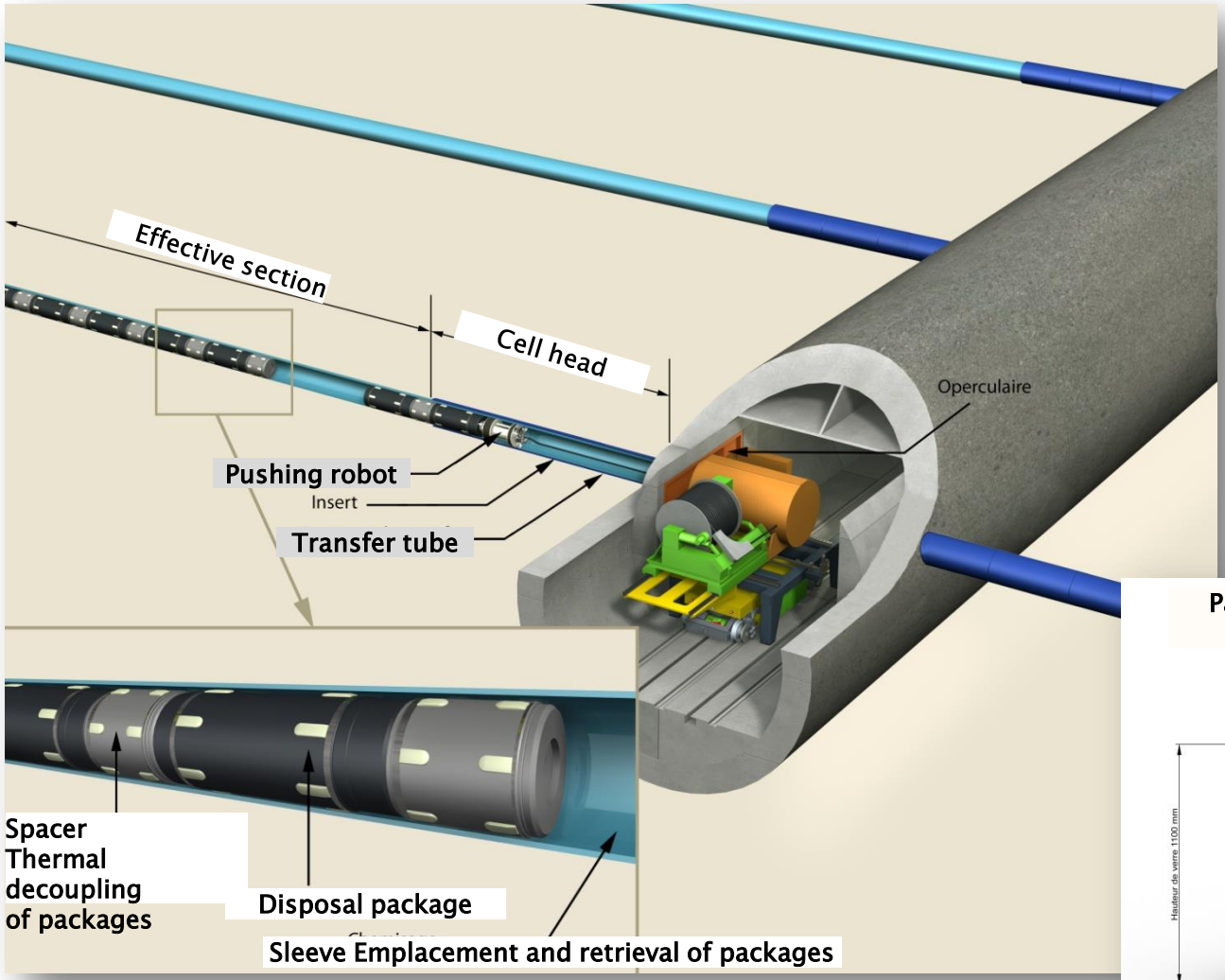
Lower station with HLW transfer cask

Zoom on the IL-LLW disposal cell



- Length: ≈400 m
- Excavated diameter: 9 m
- 2x2 or 3x3 packages
- No. of containers: 800-1,900

Zoom on the HLW disposal cell



- Length: 100 m
- Diameter: 70 cm
- No.of containers: 7-20

High level waste packaging

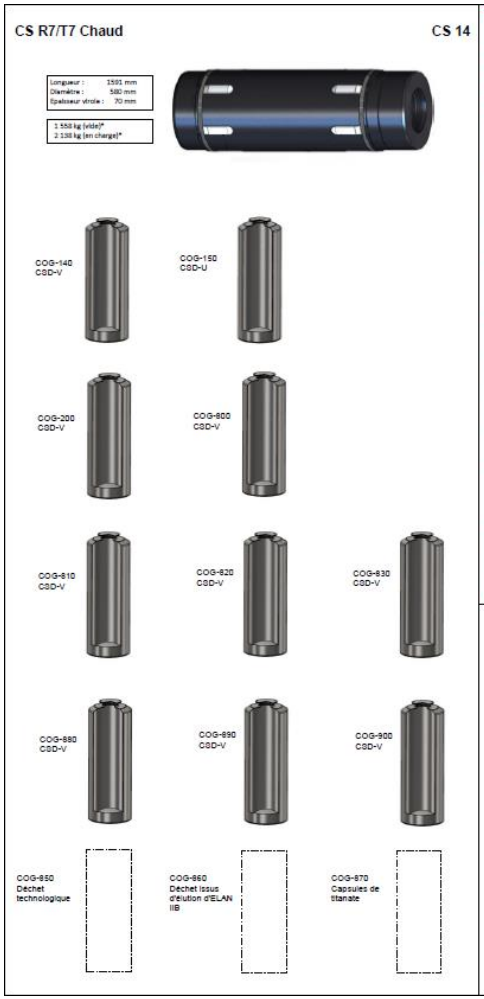
6 modèles de conteneurs suivant PIGD

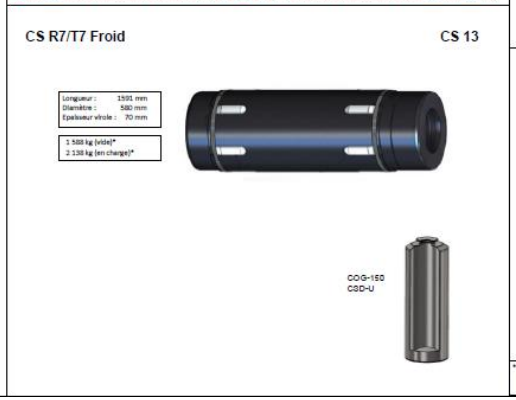
HA0=2030-2039
HA1/2=2079-2144

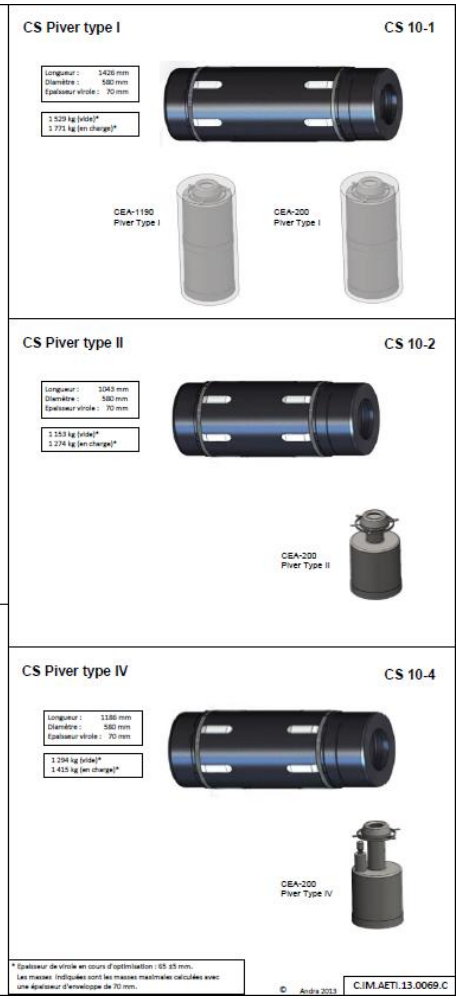
55 000 conteneurs HA :

≈ 4 000 (2028-2038)
≈ 51 000 après 2070

Masse unitaire d'acier de 1 200 à 2 500 kg







Low level waste packaging

7 modèles de conteneurs

6 variantes de noyaux pour réservations

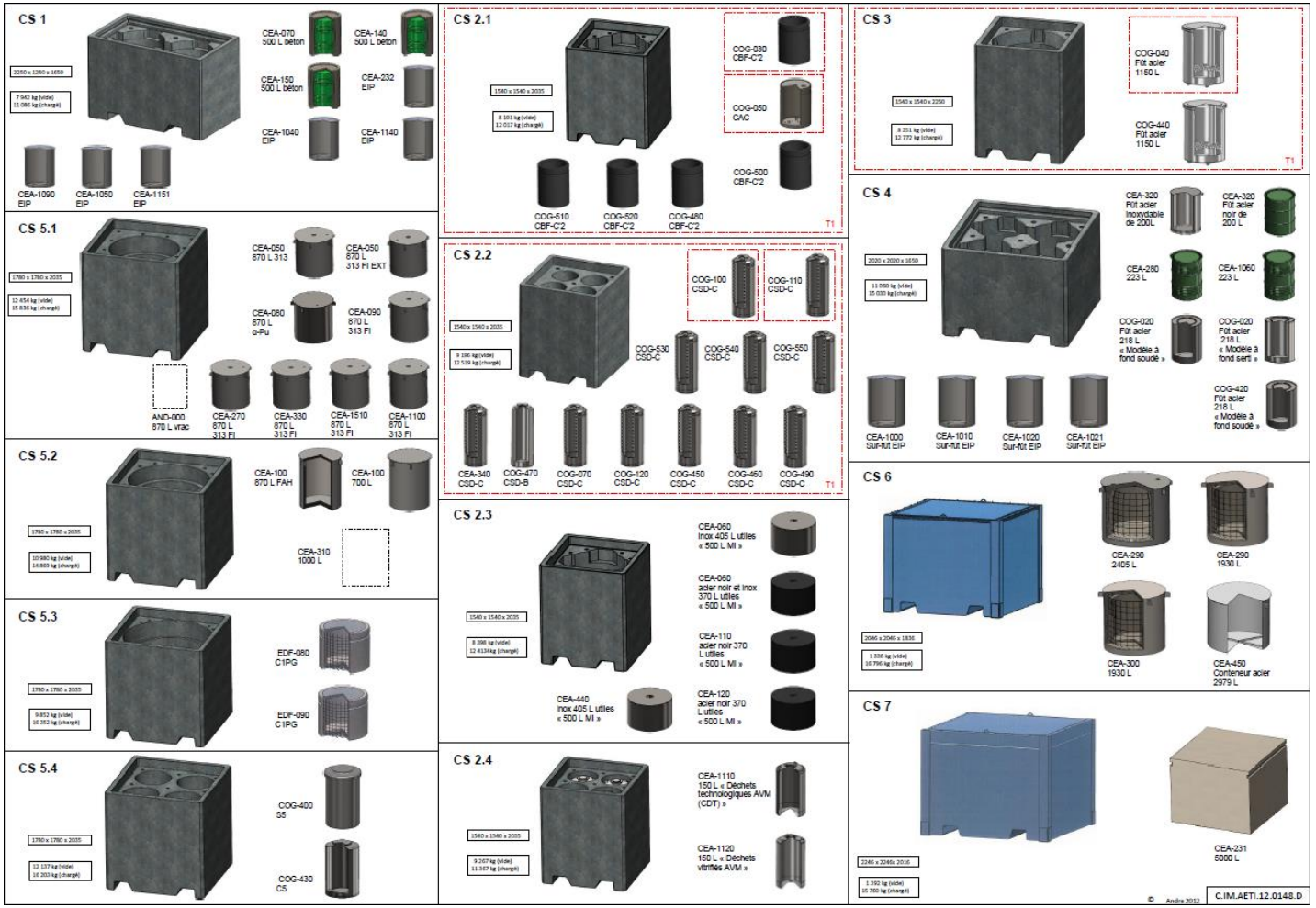
6 variantes de couvercle

De l'ordre de 72 000 conteneurs en béton (2029-2099)

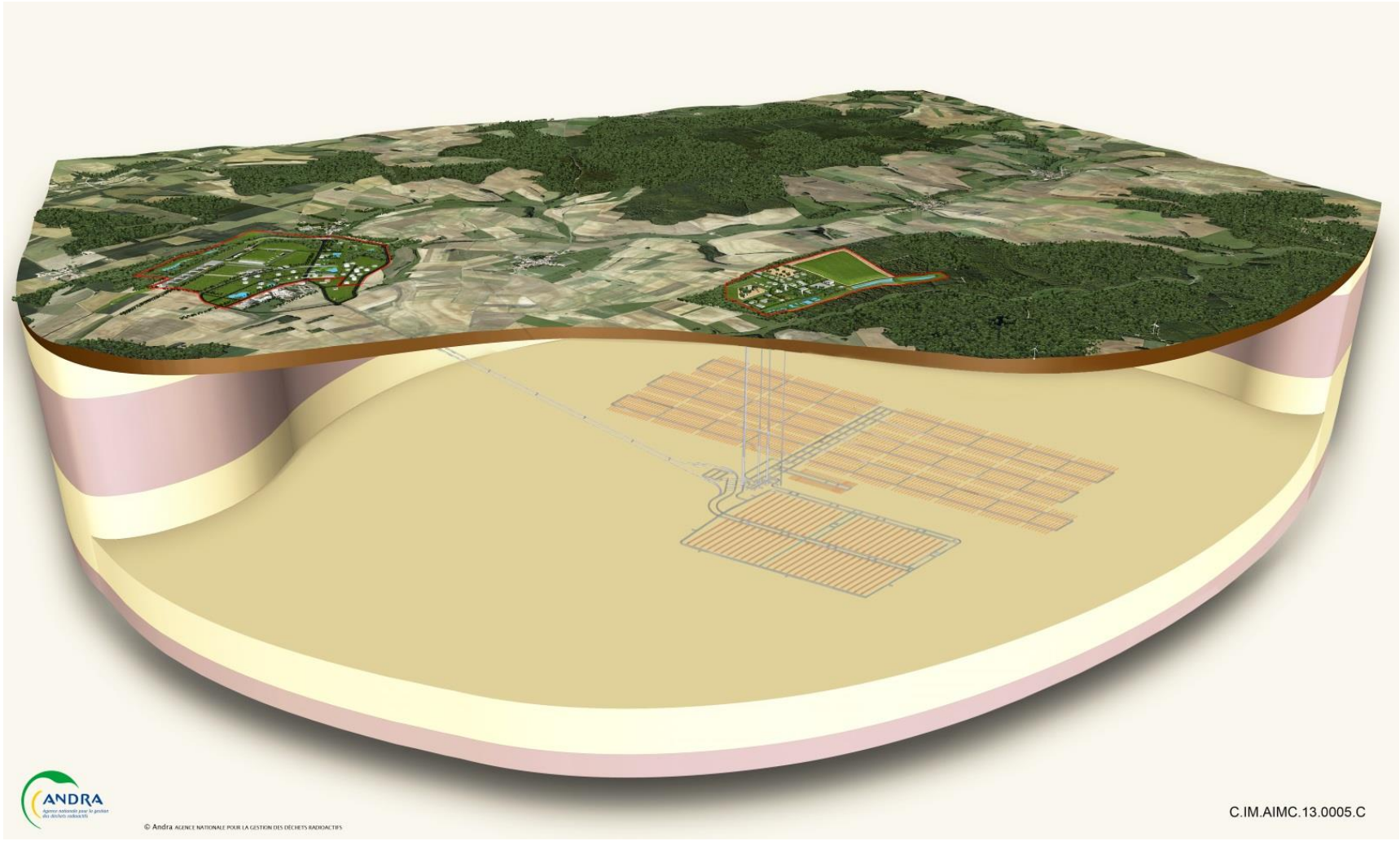
Masse unitaire de 8 000 à 12 500 kg*

Masse d'armature de 400 à 800 kg*

* À l'exception des CS6 et CS7 (conteneurs acier)



CIGEO at the end of 120 y of operations



Contents

Updated vision on “reversibility”

The Public Debate in France followed by Andra’s proposals

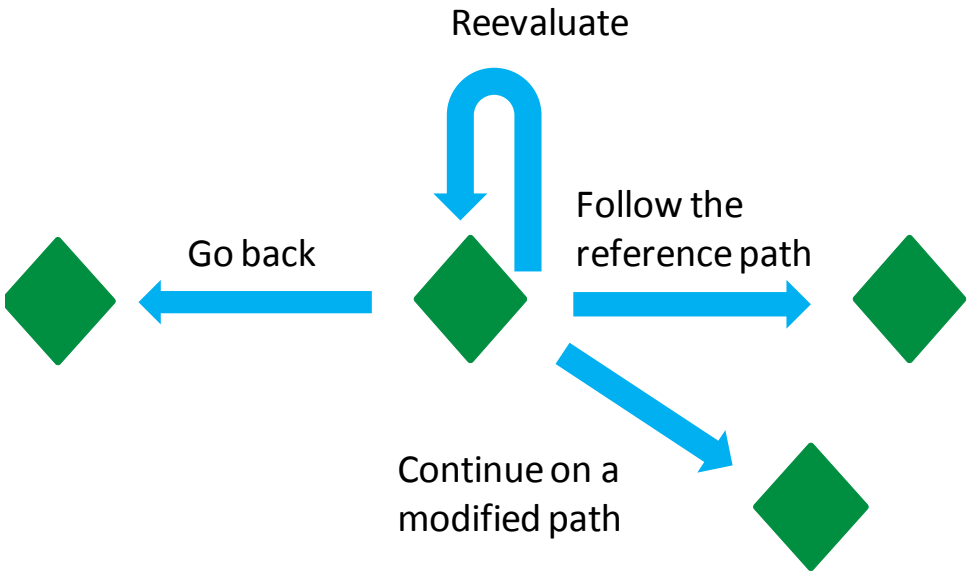
- Take a decision which commits the society for120 years (4 generations!) is not reasonable
- It is therefore necessary to make the decision progressive in order to make it possible

- The concept of reversibility is moving towards a *Governance approach*, for which technologies provides tools

- In such a context it becomes possible
  - To allow a learning phase
  - To give way to technical progress
  - To enable the next generation to redirect choices made before or to go back: *every generation decides for itself, leaving open the option for the following*

Meeting the expectations regarding reversibility

- Reversible disposal may be defined as a progressive process, where freedom of choice is left at each step



So that:

- The process may be controlled
- Alternative waste management options may be chosen if relevant
- In case of undesired repository evolution, corrective actions may be implemented
- If waste becomes a resource, it may be retrieved.

Choose the closing schedule of the geological disposal facility

Cigéo is designed to be closed

- Ensure the "passive" safety of the repository, without requiring human action
- Will nevertheless complicate the possibility of retrieving the waste packages

The decision to move to a new stage of disposal returns to subsequent generations

- Disposal adapted to be closed gradually
- Each step of closing will be subject to a specific authorization

Preparation of an industrial sealing test of a gallery

Parliament has already decided that only a law could allow the permanent closure of Cigéo

Implementation of the principle of reversibility

To implement the principle of reversibility, a TOOLBOX is needed

The toolbox will contain

- G Continuous improvement of knowledge, from continued R&D and from the monitoring and oversight programme
- T Progressivity of construction and incremental development of the underground disposal facility
- T Flexibility of operations and schedules
- T Flexibility and adaptability of installations
- T Retrievability
- G Transparency, knowledge management and transmission
- G Involvement of society
- G Control by State and assessing bodies

G: Governance measure T: Technical measure

A geological disposal under the control of society

To regularly review the operation of disposal and decide together the next steps

- Regular appointments with all actors**:** residents, communities, reviewers, State ...
- Consultation on the basis of**:**
  - The results of safety reviews
  - The industrial, monitoring, socio-economic impact feedback
  - Technical developments and advanced searches
- 1st appointment proposed 10 years after commissioning

Retrievability is a tool for reversibility

- Retrievability can't be demonstrated indefinitely

  - Retrievability can only be a tool for reversibility, not an objective and an end by itself

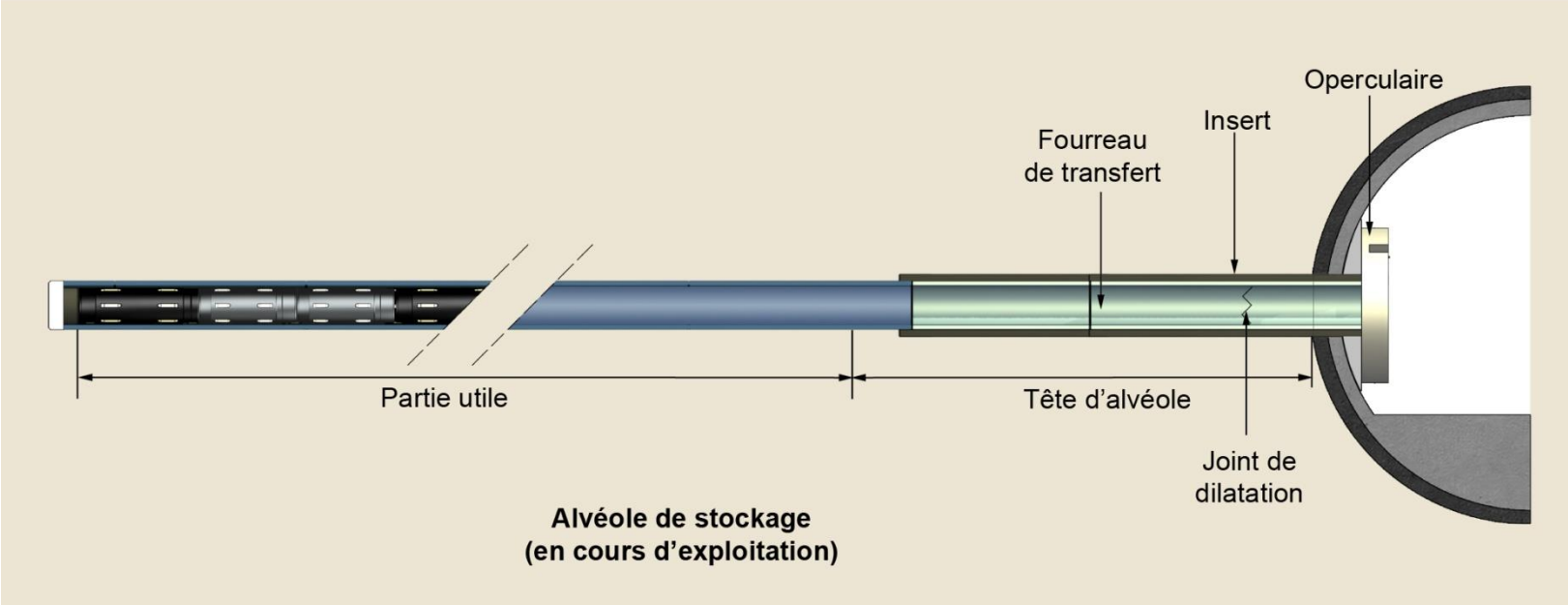
- COST linked to retrievability
  - Retrievability does not imply high costs if it is considered at the design phase and thus be intrinsic to the disposal design
  - Taking account of retrievability from the early design stages is estimated to be at the level of a few % of the total cost (2 to 10)
  - The cost for retrieving will have to be supported by the generation making the decision for; it does not need to be provisioned by the present generation

Design features supporting retrievability

HLW

The waste packages are emplaced into disposal cells

- The liner maintains a gap around the packages, making retrieval easy if decided
- In order to limit corrosion, specific features are studied for tight assembling of the liner and for a low change of air after waste emplacement

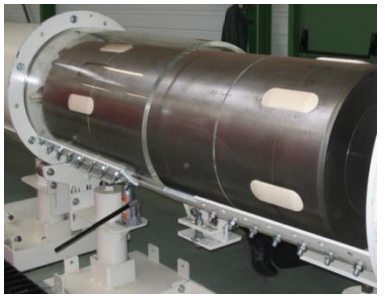


Be able to retrieve the disposed of waste packages

During more than a century of operations

- Machineries designed to remove packages
- Design and layout of packages to facilitate removal (packages dimensionally stable, sufficient space between packages ...
- Durability of structures to avoid distortion
- Precise knowledge of the location of the waste packages and of their disposal conditions

Test to retrieve an IL-LL waste package



HL waste disposal package

Tests of retrievability of waste packages

- Prototypes already built and tested
- Tests to retrieve waste packages from the Cigéo disposal facility before the license for operation
- Periodic tests during the operation time of the Cigéo disposal facility

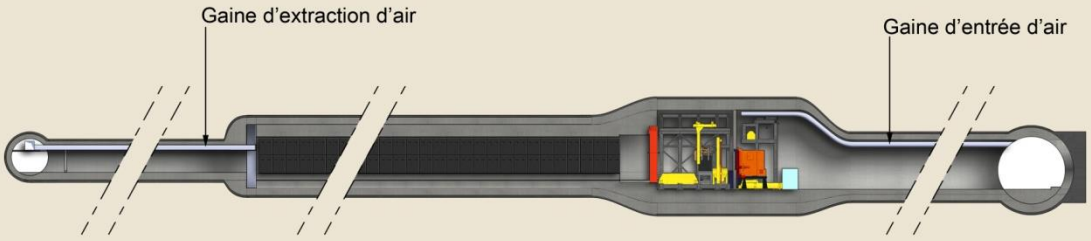
Test to retrieve a waste package from a distorded disposal cell

Design features supporting retrievability

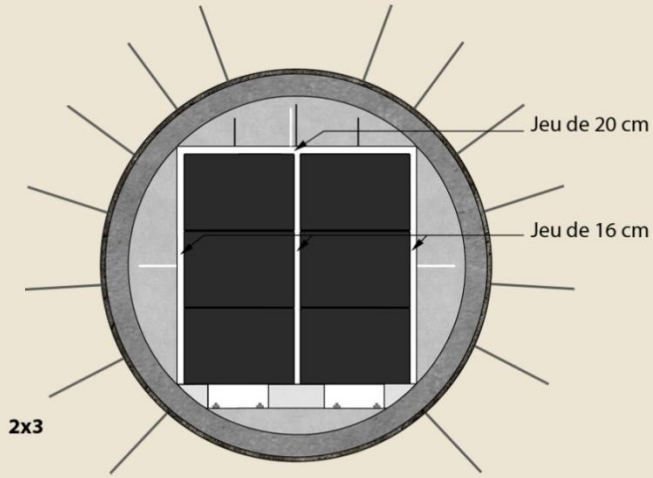
IL-LLW

The WDPs are transferred into the emplacement cell

- The disposal chamber is suited to the waste packages geometry
- Mechanical and chemical durability requirements
  - The thickness of the concrete lining is defined according to the longest duration class (Eurocode)
  - Durability of the concrete is increased by its low porosity and by the dry ambient conditions as long as the cell is ventilated



ILLW emplacement cell (in operation)



Contents

Basic to detailed design

Since the start of the industrial phase, the project for realising the facility is phased: Concept an feasability, basic design, detailed design and realisation.

The feasability phase ended in 2013, the basic design was finalised beginning of this year, Andra organised an external review and detailed design will start early 2016, and last 2-3 years.

This detailed design will be the one on which is based the license application and will concern the whole of the facility, including closure, with assumptions for the reversibility issue.

Realisation of the facility itself will commence once the licence “to create” is obtained.

Contents

Documents leading up to the license application (I)

Four documents will be produced now leading up to the 2018 license application:

- DORec: The goal of this document is to show how Andra technically declines the goal of leaving the possibility, during the operational period of a hundred years, of removing the waste packages from their disposal locations, taking particular account of the state of closure of the alveoli (recoverability levels II, III and IV of the NEA scale). Withdrawal operations after passing to Level V (permanent closure), that only a law may permit, are not addressed in the DORec. It is considered that the final closure will end the reversibility period.

Documents leading up to the license application (II)

Four documents will be produced now leading up to the 2018 license application:

- DOS-AF presents:
  - The regulatory, normative and technical framework used as well as national REX (REX underground laboratory) and international REX (eg literature review on human intrusion)
  - The safety objectives set by reference in particular to the ASN safety guide and international forums on the subject of geological disposal, inventory of waste to be stored and the assumptions made for their long term evolution,
  - The performance of components of the disposal system participating in safety functions after closure (waste packages, engineered barriers - including seals - host rock) and also of the overall architecture,
  - The principles of system monitoring (including on disposed waste packages) during the operations phase to meet the security requirements after closure (link DOS-Expl)
  - an initial assessment of the radiological impact to the disposal on the environment and on humans, for the main scenarios considered at the stage of preliminary design studies.
- DOS-EXpl

Documents leading up to the license application (III)

Four documents will be produced now leading up to the 2018 license application:

- The Master plan (PDE) :
  The objective of the proposed PDE is to describe the "reference" schedule for the Cigéo project as envisaged by Andra in 2015:
  - to explain the objectives of the pilot industrial phase
  - To present choices offered by the reversibility in the conduct of Cigéo project.
- The proposed PDE will be submitted to stakeholders for consultation. It foreshadows a governance tool of the project, the PDE itself, which will be updated periodically during the operation of Cigéo, in support of its governance.

Contents

Integration of Cigéo in its host environment

- Since 2010, economic support has been provided in the area through:
  - dans le champ
  - Support funds managed by two public interest groups
  - Waste producers (EDF, CEA and AREVA) moving activities into the area
  - Andra research activities at the Meuse/Haute-Marne Centre
- In 2013, the French government boosted this strategy with an **Interdepartmental Territorial Development Plan** (SIDT) that was presented at the Public Debate to highlight one of the Cigeo project objectives: ensure integration and economic development in the host areas.
- A new phase started in 2014 with a government **Territorial Development Contract** (CDT) whose aim is to organise the operational configuration and prepare the area for Cigeo by 2017.

Local development

Currently the impact of the URL is approx 300 direct jobs (in 2015

In the future, and in addition we are looking at

> 1000 jobs during the initial construction phase (2020 - 2025)

A little less during the operational phase (2030- 2100 and beyond)

In addition, local infrastructure is needed and some examples are given here. Some of these will be undertaken before the formal authorization, since they are needed.

Train link, needed before the end of the 20's

Modified road structure

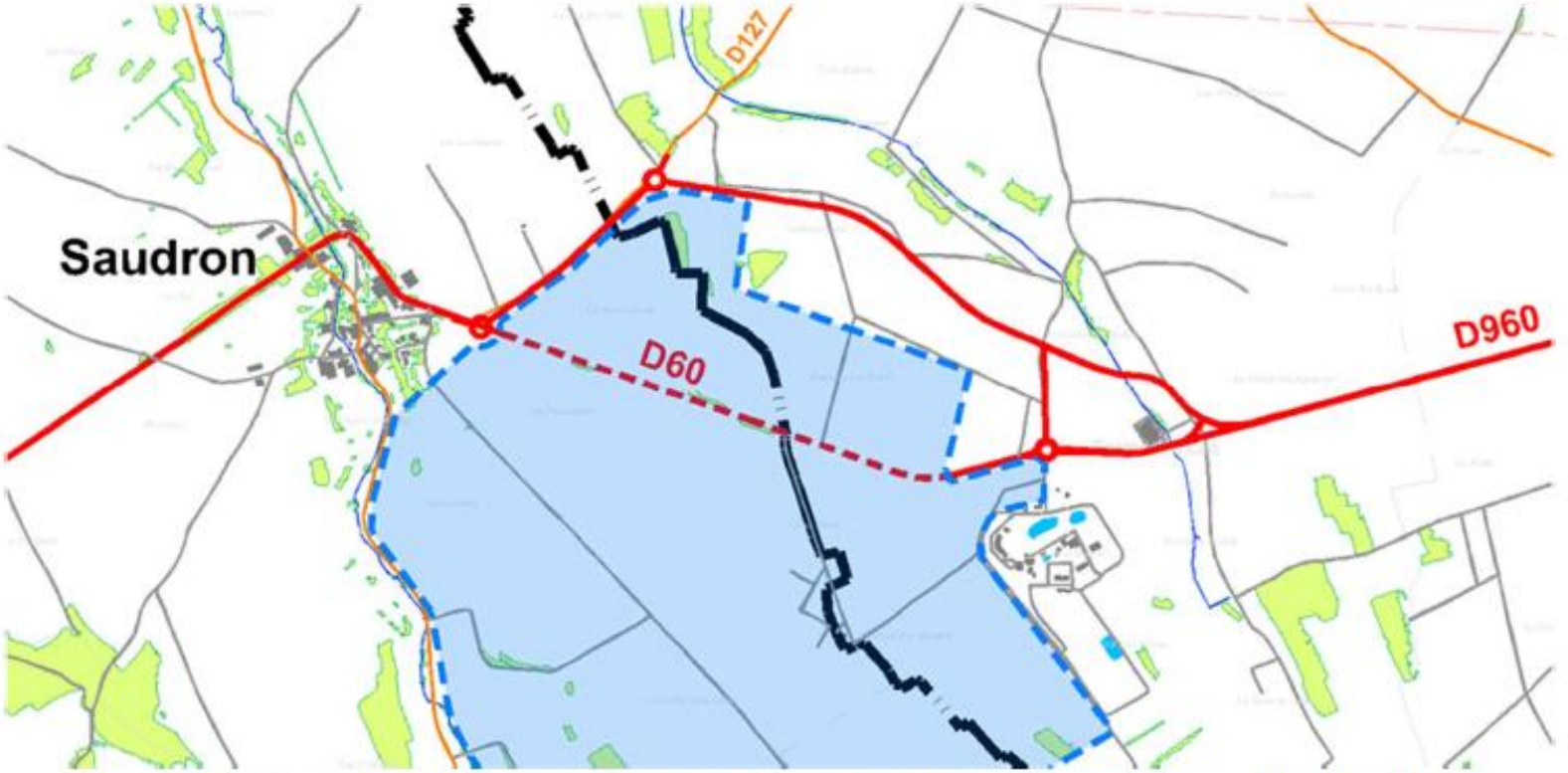


Schéma de principe, tracé à préciser après échanges avec les acteurs locaux.

Contents

Project follow-up actions

In order to take account of the opinions and expectations expressed during the public debate, and to continue the stepwise approach initiated by the Law of 1991, Andra pursued the Cigeo project with:

Four changes to the project following the public debate

- The integration of a pilot industrial phase at facility start-up
- The establishment of a regularly revised master plan for disposal operations
- Changes to the timetable
- The involvement of civil society in the project

A proposal regarding reversibility

- Definitions regarding reversibility and retrievability, phased approach

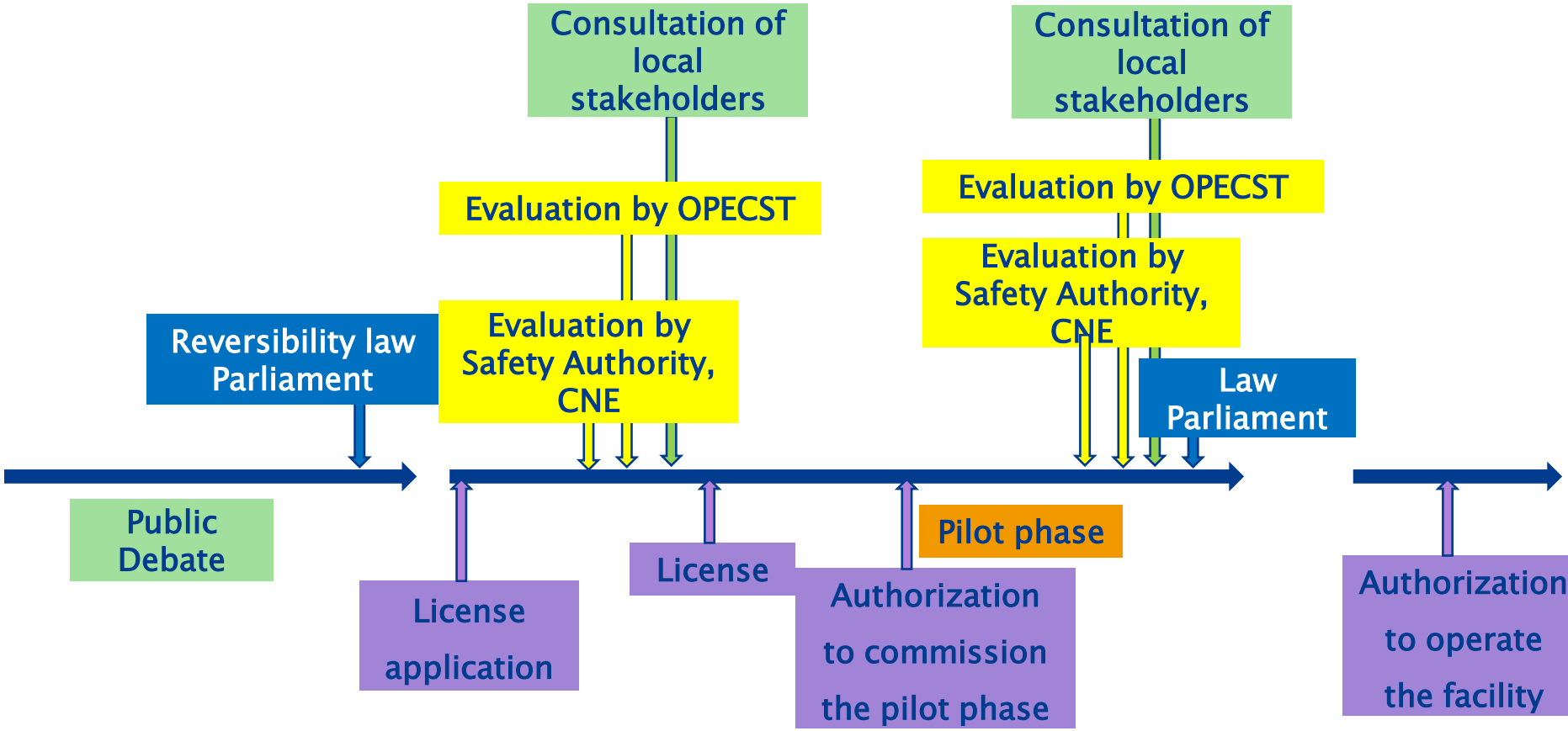
Three commitments

- To ensure safety as the top priority
- To preserve and develop the local area
- To control costs

Focus : how to increase Public involvement in the project ?

- Greater involvement of civil society in decisions taken in connection with the Cigeo project
  - consultation with local and national stakeholders to develop the Cigeo operation master plan and its revisions,
  - new procedures for exchanging information with the Local Information and Oversight Committee (CLIS) adapted to the current stage of the industrial project,
  - the development of pluralistic expertise on the management of radioactive waste (through discussion between Anccli (French national association of local information commissions and committees)/Clis/IRSN, HCTISN and GT PNGMDR (National Radioactive Materials and Waste Management Plan Working Group)),
  - Explore ways of opening up the Permanent Observatory of the Environment to local stakeholders;
- Andra has decided to launch a pluralistic committee to provide guidance on the consideration of societal issues in its activities

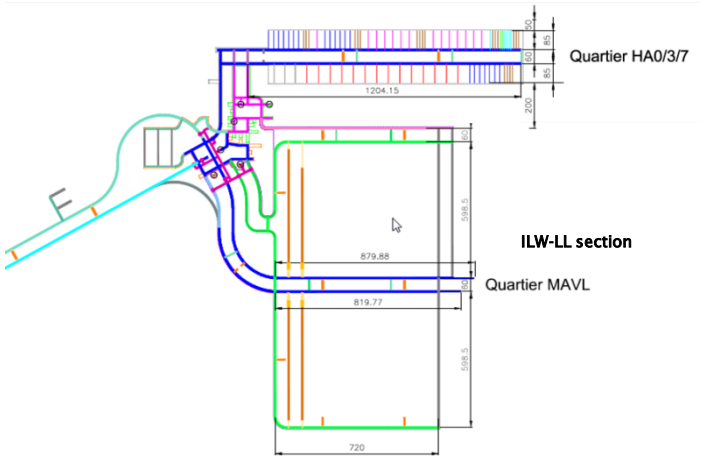
Rationale of governance and decision making



Cigeo startup phase

Industrial pilot phase, a « PERIOD of time » but not an « object »

- Opened after initial construction phase
- Includes
  - Inactive and then tests in operated disposal cells
  - Additional collection of information from monitoring and oversight
  - Retrievability tests
- Disposal of initial HLW and ILW-LL planned for 2029 provided operating licence is granted
- Gradual increase in activity from 2029 to 2034



which will include

- 5 shafts
- 2 ramps
- 1 logistical support zone
- Initial ILW-LL disposal caverns and HLW disposal cells, representing 4% of total planned at completion
- 1 testing zone for preparing later developments (large diameter disposal cell, sealing, etc.)

Contents

Progressive development of the underground facilities

Master plan for disposal facility operation – Revised regularly

- Defining the various stages of gradual operation of the disposal facility
- Defining major decision steps to be taken, based on available results from experience feedback, monitoring and pilot cells
- Offering flexibility and adaptability for future developments

PILOT PHASE

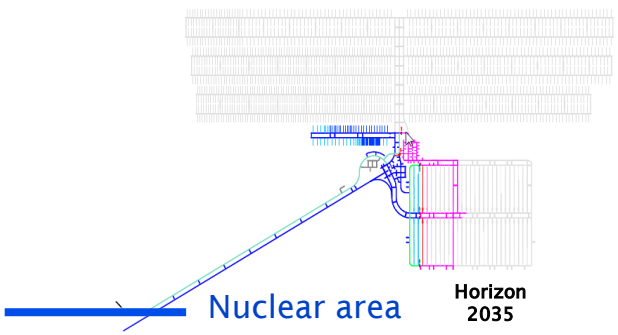
OPERATIONS

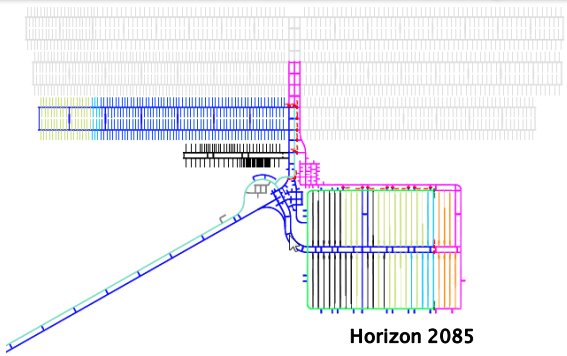
DISPOSAL OF ILW AND PILOT HLW

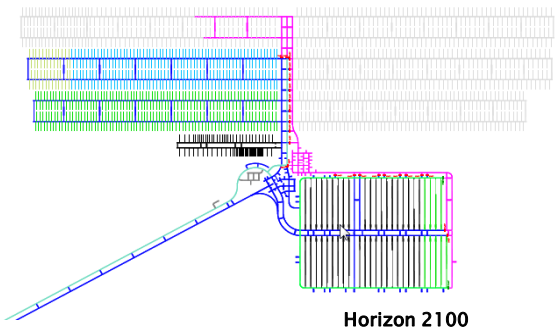
DISPOSAL OF HLW

PROGRESSIVE CLOSURE FOR ILW AND THEN FOR HLW

2035 | 2085 | 2100







Nuclear area

Nuclear ventilation

Construction area

Closed area

Thank you for your attention

November 13th, 2015