



The Origin of the Concept of Reversibility for Disposals

Discussions about the reversibility of disposal are as old as the concept of deep geological disposals (they first started in the 70's).

The question of the reversibility of disposal was naturally raised to challenge two fundamental points :

- the very long-term disposal period needed to guarantee the safety of HLW and SNF
- the unusually long operational period of disposal facilities (commonly over 100 years)

Our generation benefits from the nuclear energy, develops and may provide the HLW and SNF long-term management facility to future generations to protect their environment and their health from the hazard we generated.

The next generations will also play an important role to operate/develop/close/monitor the facility.

“How do you guaranty that they will be able to make their own choices and adapt the facility to their own needs and constraints ?””

At the origin of the reversibility concept is an ethical question.



The Complexity and Limits of Reversibility

The reversible disposal apparently bears a contradiction. At the time the disposal facility is imagined and designed and during the period of time when the disposal facility is operated or closed, the justification for disposal is that it is the best / only achievable solution to guarantee long term safety. Waste is emplaced in the facility without the intent to retrieve it later on.

- Reversibility opens the possibility that this initial decision may change
- Reversibility may apparently blur the clear difference between “disposal” (no intent to retrieve) and “interim storages” (intent to retrieve)

A reversible DGR may bear many features in common with interim storages, but it is the only concept that offers the possibility to be closed and to offer potential long-term passive safety.

A reversible DGR may be modified by future generations, however there are some limitations. It is not possible to design a facility that offers infinite modification possibility in time and in technical nature.

It is important that the role/limits/definition of reversibility are well defined and understood by all actors to reduce perturbations on the course of the projects.



Existing Definitions of Reversibility and Retrievability

It is useful that definitions of these complex notions are reached and fixed in the regulations :

- **NEA** : *" Reversibility denotes the possibility of reversing one or a series of steps in repository planning or development at any stage of the program. This implies the review and, if necessary, re-evaluation of earlier decisions, as well as the means (technical, financial, etc.) to reverse a step."*
- **NEA** : *" Retrievability denotes the possibility of reversing the action of waste emplacement. Retrieval is the action of recovery of the waste or waste packages. It is thus a special case of reversibility."*
- **IAEA** : *" Retrievability is the ability to remove waste from where it has been emplaced"*
- **French environmental code** : *" Reversibility is the capacity, for successive generations, either to pursue with the construction and the operation of a DGR, or to reassess previous choices and modify the waste management solutions." (Reversibility for no less than 100 years)*
- **French environmental code** : *" Reversibility is achieved through progressive construction, adaptability of design and flexibility of operations that permit the integration of potential technological progress and inventory modification. Reversibility includes the capacity to retrieve waste according terms and conditions coherent with the operational and closure strategies."*

Decisions may be reversible / Waste packages may be retrievable



Retrievability

Retrievability requirements may be introduced in the design :

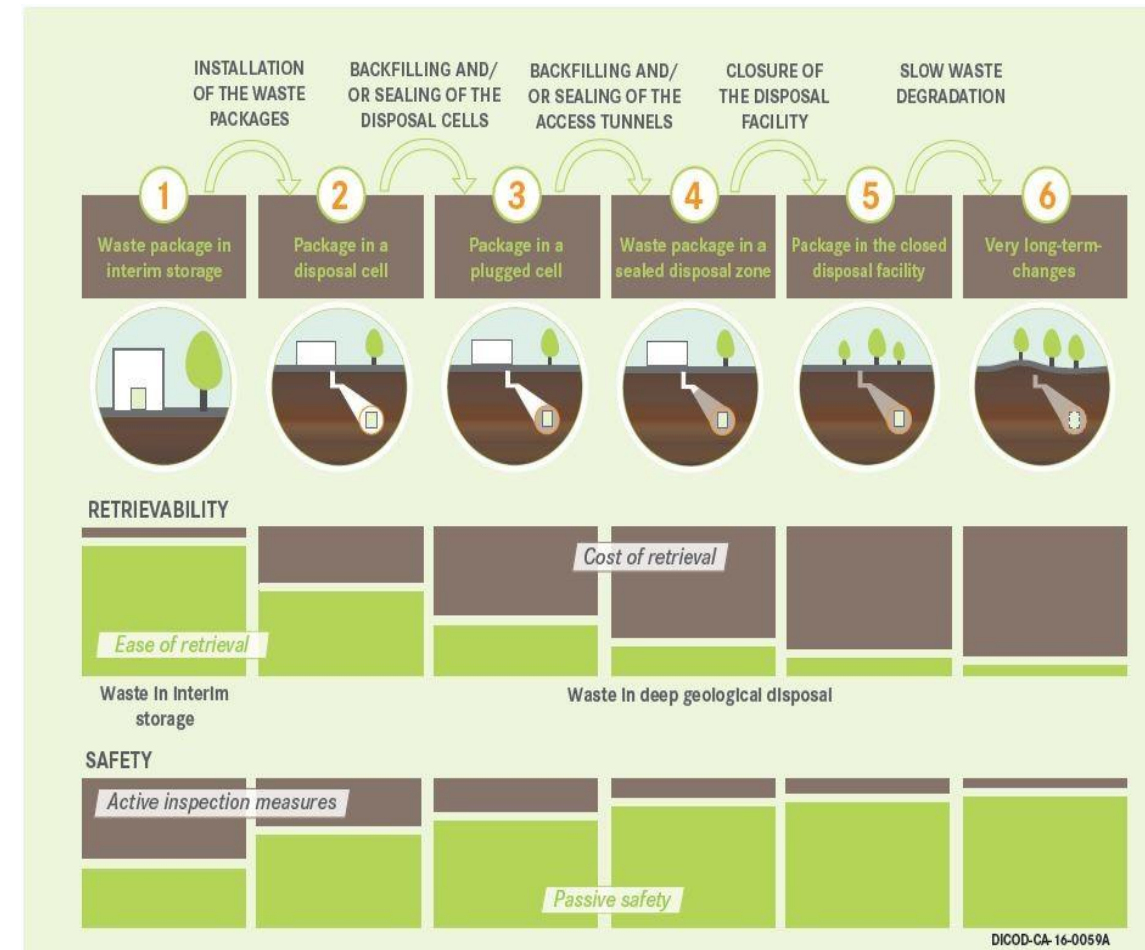
- Margins in terms of handling space/gaps
- Mechanically robust packages
- Reliable and flexible handling tools and systems
- Controlling and monitoring the atmosphere (corrosion/gas...)
- Safety provisions facilitating the re-opening of closed vaults

Technical temporary retrieval of waste could be beneficial in some cases (rearrangement of drums/control/maintenance...).

Strategic permanent retrieval of waste packages should only be the consequence of a high level decision:

- Why are they retrieved for ? (advantages including over the long term)
- What is the alternative management solution ?
- Is the alternative management solution ready or prepared at the National level ?

Retrievability is generally not a safety function. It may ease intervention, but it is primarily a tool for waste management.





The Main other Tools of Reversibility

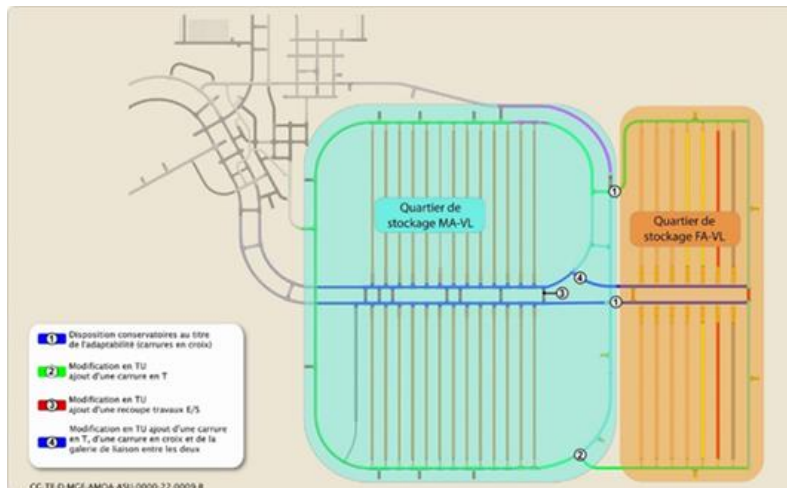
Reversibility also covers technical dispositions to enable :

- **Adaptability** : modification of the disposal inventory (including SF disposal)
- **Flexibility** of operations : change of waste conditioning, order of shipments, operational rhythms, closure...
- **Gradual development** : gradual construction and optimization

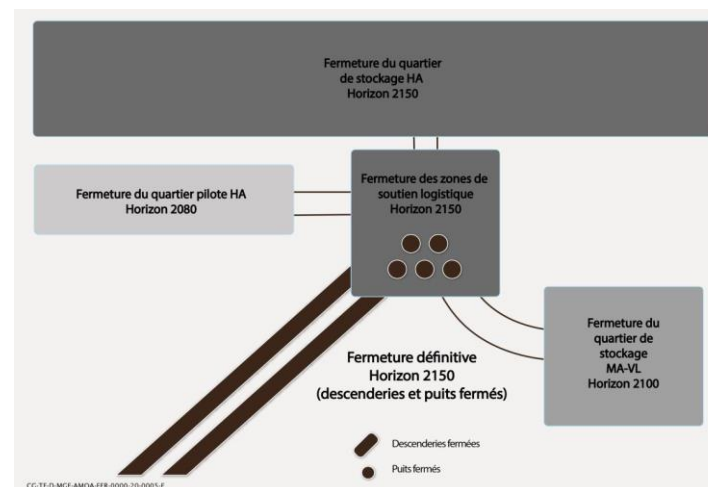
Proposition of closure scheme :

- As soon as possible ?
- As late as possible ?
- Progressive and flexible ?

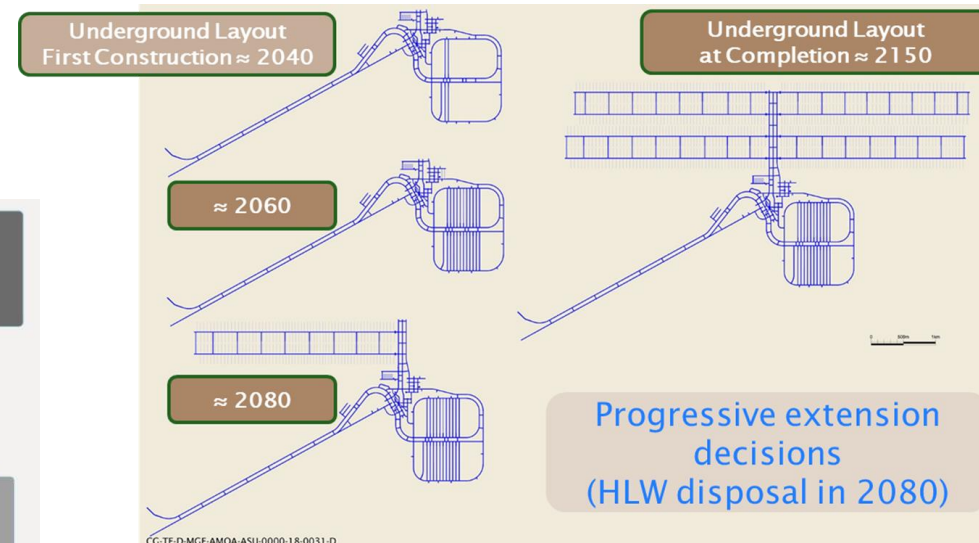
Flexibility offers choices for closure strategy and timing



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Conclusions

Reversibility answers ethical questions naturally linked with the long duration of RWM projects.

Reversibility has become increasingly important as it meets the questions and concerns of the public and of the stakeholders. It usually is an important subject during public hearings and decision making processes. It is a key concept for alleviating and managing mistrust.

Reversibility has a potential technical impact on DGR's technical feature and design. The requirements associated to reversibility may be introduced in the design studies as early as possible so they may not impair safety or increase costs.

To go further :

- NEA - Reversibility and Retrievability in Geologic Disposal of Radioactive Waste - Reflections at the International Level (2019)
- NEA - Reversibility of Decisions and Retrievability of Radioactive Waste - Considerations for National Geological Disposal Programs (2019)
- Andra - Position Paper on Reversibility (January 2016) and [Les documents de référence \(andra.fr\)](http://andra.fr)