



Definition of Interim Storages

Storage facilities are specially designed to keep radioactive substances safely for a certain amount of time after which these substances are recovered and transferred to another facility for further use or, in the case of waste, for their next management step.

Radioactive substances are introduced in interim storage facility with the intent of recovering them after storage.

Waste kept in interim storage facilities may be recovered for another interim storage period in another facility, for treatment, for reconditioning, for disposal.

In order to achieve safety, the design of storage facilities is adapted to :

- The physical nature of the radioactive substance (liquid, solid, powders...)
- The physicochemical properties of the radioactive substance (radiological emission, heat generation, criticality risks...)
- The foreseen use of the substance
- The need for monitoring, controls and safeguards...

Interim storage facilities and process “buffer” capacities present common features, although buffers are usually smaller and usually do not require the creation of dedicated separate buildings.



Interim Storages for Radioactive Waste

Interim storage is an essential step in the management of radioactive waste. It is necessary while waiting for the industrial availability of the next management stage. It permits useful radioactive and heat decay.

Interim storage is used to keep the radioactive waste safe until it is transferred to :

- **A treatment facility or a conditioning facility**
 - Waste conditioning are the operations that prepare the waste for its future successive management stages ie. handling, transport, storage, disposal... It may comprise operations for volume reduction, waste stabilization, solidification, inclusion in a containment matrix and over-packing. It results in a waste package designed to facilitate the future management operations
 - Waste treatment processes may recover and valorize part or the waste
- **Another interim storage facility**
 - the waste may be transferred to a another interim storage facility (usually a more modern one). This operation provide the opportunity of controls and of potential repackaging or addition of an overpack
- **A disposal facility where waste is managed over the long-term**

Different kind of facilities exist for the different categories of waste (VLLW, LLW, IL-LLW, HLW, SNF...).

Interestingly, interim storage is the final management step for very short-lived waste (half-life of less than a month). VSLW can be released in the environment or treated after a few month or year of interim storage.



The Various Concepts of Interim Storages

The safety functions of interim storage facilities are not different from other nuclear facilities (protection from external and internal hazards, protection from nuclear hazards - containment, heat production, radiological protection, criticality, surveillance...):

- Due to the concentration of radioactive substance and to the nature of the operation of emplacement and retrieval, special attention is paid to the prevention of handling risks

Most commonly encountered interim storages are vaults, pits or halls where waste packages are laid or stacked on one or several rows or layers.

Well designed and well operated interim storage facility for waste packages are usually safe and with low dosimetry.



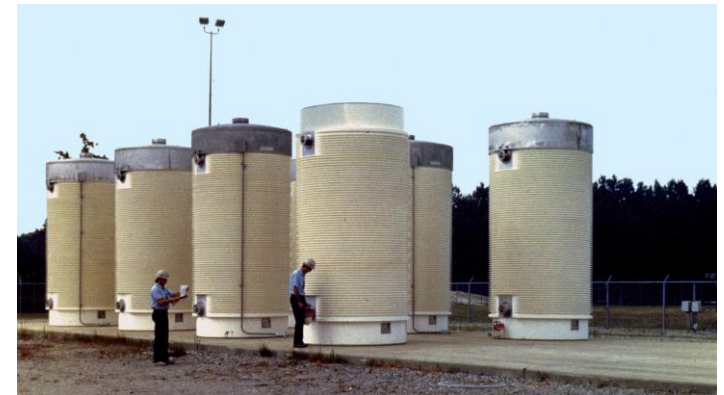


The Interim Storage Facilities for Spent Fuel

Interim storage is an essential management step for spent fuel.

It is used for :

- **Necessary reduction of dose rate and heat emission after SNF is unloaded from the reactor (several kW/assembly)**
 - Two years or more in fuel ponds in the reactor building or at the reactor site
 - The SNF is too hot/active to transport or to process for conditioning
- **Keeping the SNF until it can be reprocessed**
 - Usually in fuel ponds where the SNF can be stored in large quantities close to the treatment process and easily accessible and controlled
- **Keeping the SNF until the next management solution is available ie. deep geological disposal**
 - Commonly in fuel ponds for countries that have active deep geological disposal programs for SNF (Sweden, Finland) enabling easier recovery and transfer to the conditioning/encapsulation process
 - Commonly in dry storage facilities for countries that are at the preparatory stages of their long-term management solution (USA, Switzerland, Netherlands...)

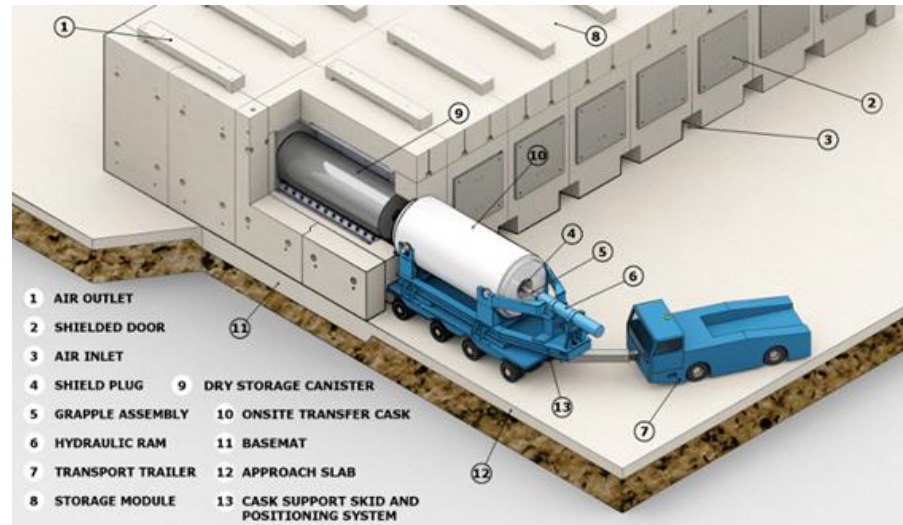




The Dry Storage Facilities for Spent Fuel

In a dry storage facility :

- **The SNF assemblies are commonly introduced in successive layers of canisters or containers of different nature and functions :**
 - Very robust stainless steel or special alloys canisters and containers welded or screwed lid
 - Guaranteed geometry and very high mechanical resistance (handling risks and external aggressions - earthquake)
 - Heat dispersion / shielding / corrosion / inspection possibilities
 - The conditioning process of SNF interfaces with the reactor fuel pound unloading process
- **The containers may (or not) be kept in a specially designed building (eg. commercially available NUHOMS dry storage system)**
 - The building provides additional protection (earthquake, tornados, flooding...)
 - The building is design to guarantee cooling of SNF (passive cooling is sought for)
 - The building interfaces with handling materials and monitoring needs (contamination, heat, safeguards) and should ensure retrievability

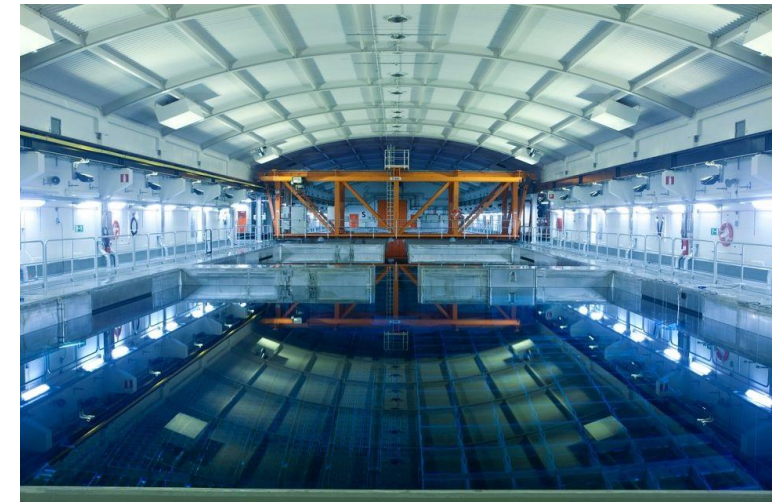
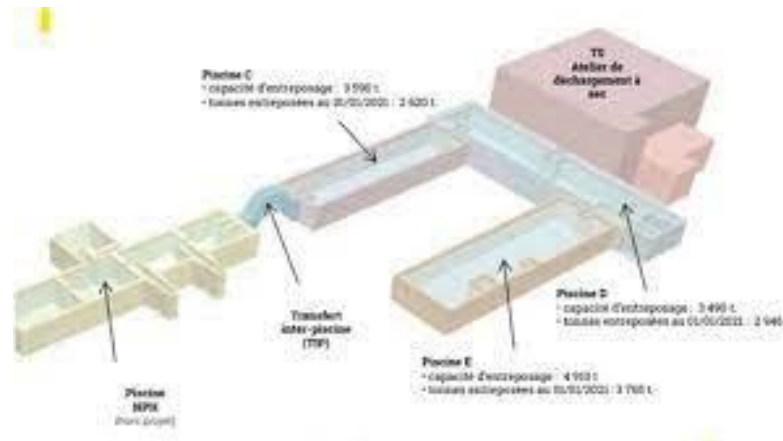
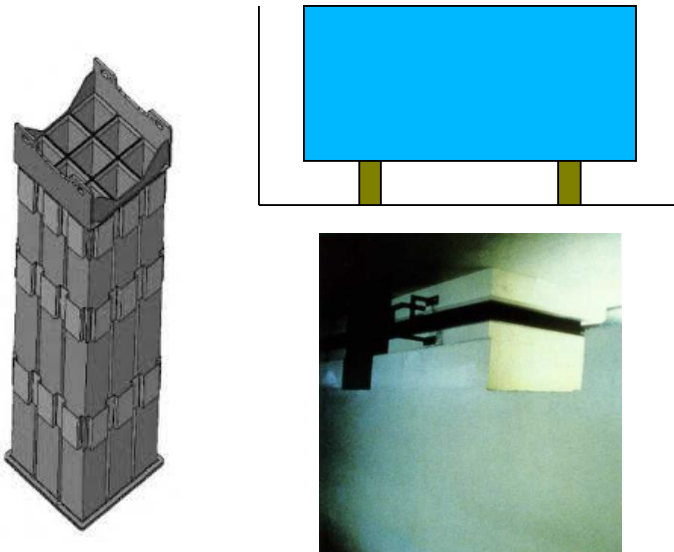




The Wet Storage Facilities for Spent Fuel

In a wet storage facility :

- **The SNF assemblies are commonly introduced in a handling cask. An additional canister is used in the risk of contamination (rod failure) :**
 - Protection against handling risks / Guaranteed geometry / Neutron absorption
 - The cask can be transported underwater and rearranged as needed. Casks may be loaded underwater or out of the water
- **The water provides radiological shielding and heat exchange. It is constantly purified by resins**
- **The pound building provides containment and protection against external hazards including earthquake, tornados...**
 - Fuel pounds may be interlinked and expended in a modular way
 - Fuel pounds may be build above ground (La Hague-Orano) or underground (Clab-SKB)
 - Fuel pounds may be loaded with a variety of SNF kinds and sizes and with other waste (reactor control bars...)





“Un-Comprehensive” Comparison of Wet and Dry Storage

Generally speaking and provided authorization is granted:

- **dry storage is well suited if you don't need to recover the SNF soon (for treatment or for conditioning)**
 - Simple design with passive safety provisions
 - Ease of operations
 - Relatively reduced investment costs
 - SNF containers may articulate with and facilitate transport operations
 - Only indirect surveillance of SNF – Safeguarded by seals
 - Retrievability is possible, but it is a heavy operation
 - Relatively large surface may be needed (depending on SNF inventory and characteristics)
 - Usually not versatile – only adapted to one kind of SNF
- **wet storage is well suited if you need to recover the SNF easily (for treatment or conditioning) or if you want to keep this possibility open**
 - SNF is readily accessible for any operations like controls, measurements, sampling (fuel rod extraction), transfer, retrieval
 - Fuel pounds are dense, their storage capacity can be very high
 - Fuel pounds are relatively small in surface size
 - Fuel pounds can be further densified and rearranged
 - Fuel pounds are versatile. They can hold various kind of SNF or even other waste and radioactive objects
 - Produce operational waste (exchange resins...) and effluents
 - Require active safety provisions and maintenance

The above are not “iron” rules but general trends for analysis and discussion.