



CHICADE nuclear facility

A technological platform, dedicated to the expertise and characterisation of nuclear wastes and tritiated waste

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1 ■ **CEA**
Directorate of Energies
Cadarache center

The CEA - Directorate of Energies

CHICADE is part of the Directorate of Energies, responsible for **structuring and piloting the research programmes on energy at CEA.**

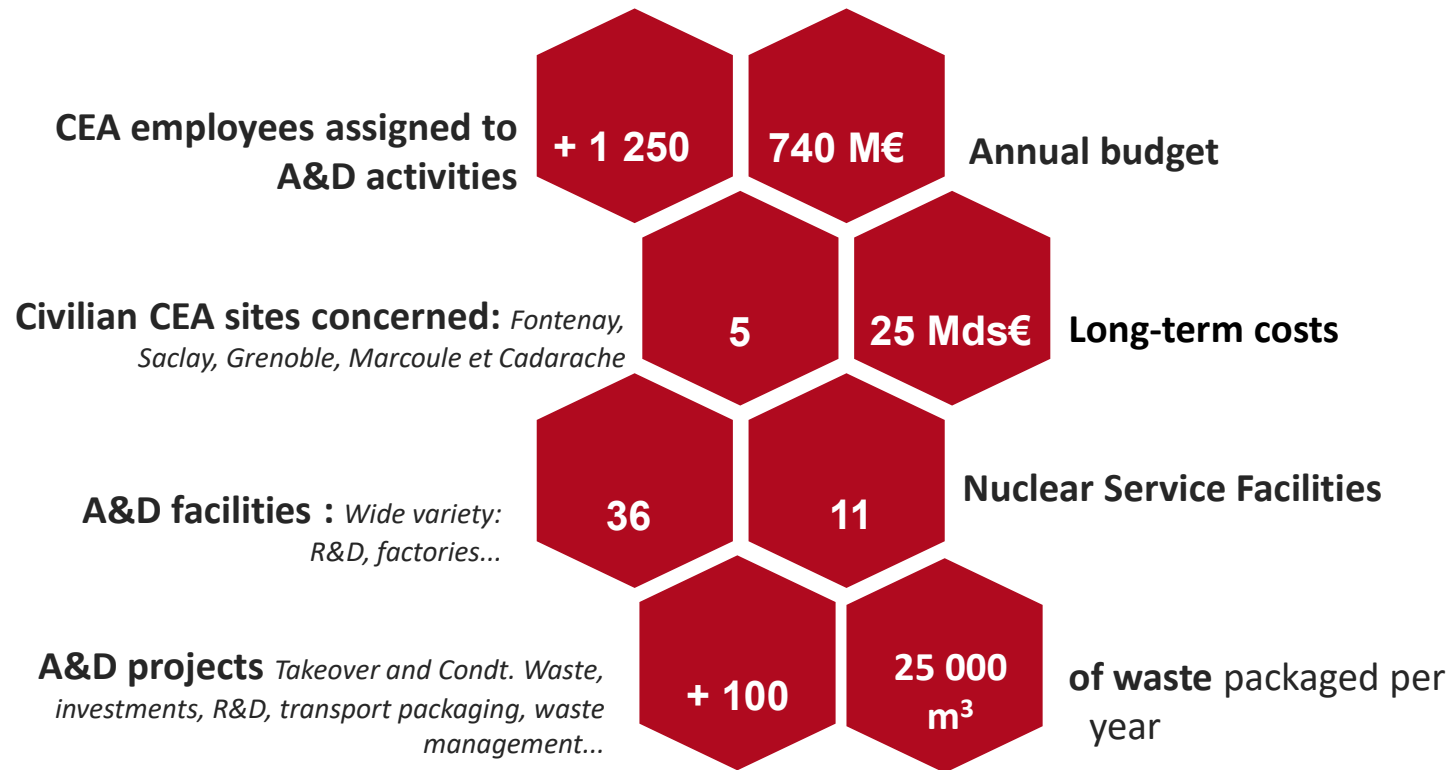
DES is dealing with low carbon energy production, resource management and global system performance.

In this area, we have to take into account injunctions that may appear contradictory : produce more electricity and produce less greenhouse gases.





CEA-DES – DDSD - Directorate for Dismantling, Nuclear Service and Waste Management Projects





The CEA center of Cadarache

CHICADE is located on the CEA center of Cadarache

- one of the CEA's historic centres,
- home to the first experimental fission reactors,
- a platform for fusion, solar energy and life sciences.





2 ■ CHICADE nuclear facility

CHICADE : a platform dedicated to physico-chemical analysis

- houses 4,000 m² of hot surfaces,
- with a wide range of equipment
- fifty employees in six laboratories each with specific expertise (characterisation, radiochemistry, imaging, gamma spectrometry, operation, manufacture of fission chambers)

It allows the assessment of waste, ranging from mg to several tons, from mBq to TBq!



Presentation of the CHICADE facility



CHICADE can :

- carry out research and technological development activities
- supervise PhD students,
- conduct teaching activities,
- meet the needs of other waste producers.



Objectives of the assessments on nuclear wastes



- Sample controls of waste assigned to existing outlets
- Development of waste conditioning methods
- Expertise in order to transport wastes to the appropriate outlet

CHICADE can answer certain questions, some of which are important for the safe storage of nuclear waste, such as :

1- Sample controls of waste assigned to existing outlets



Does the stored waste complies with specifications of the outlet ?

The inventory !

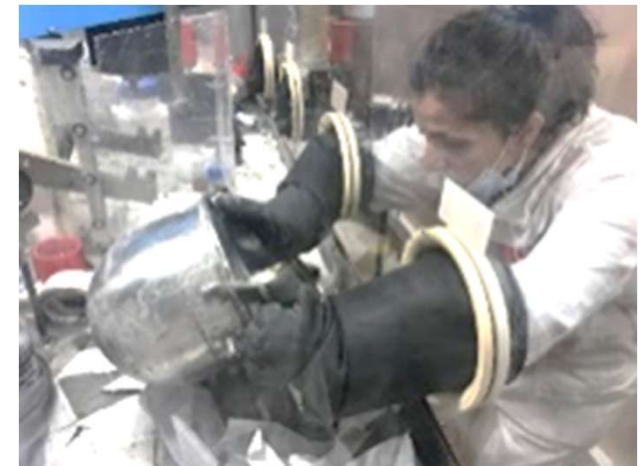
- ✓ To ensure the conformity
- ✓ carried out using various types of equipment



2- Development of waste conditioning methods : the example of cementation of incinerator ash

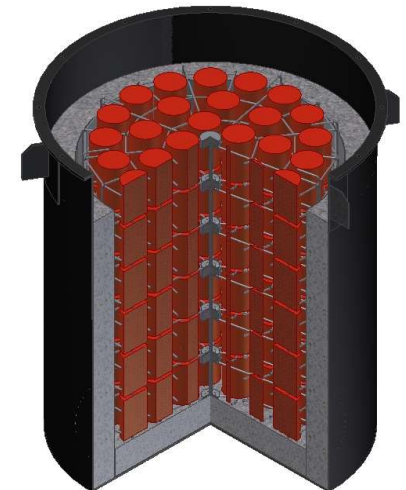
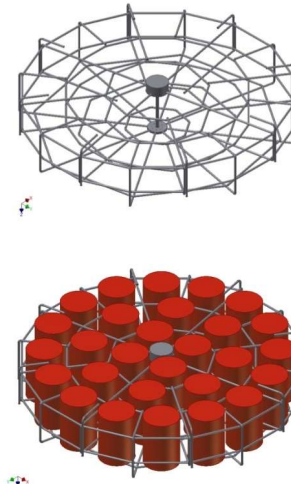
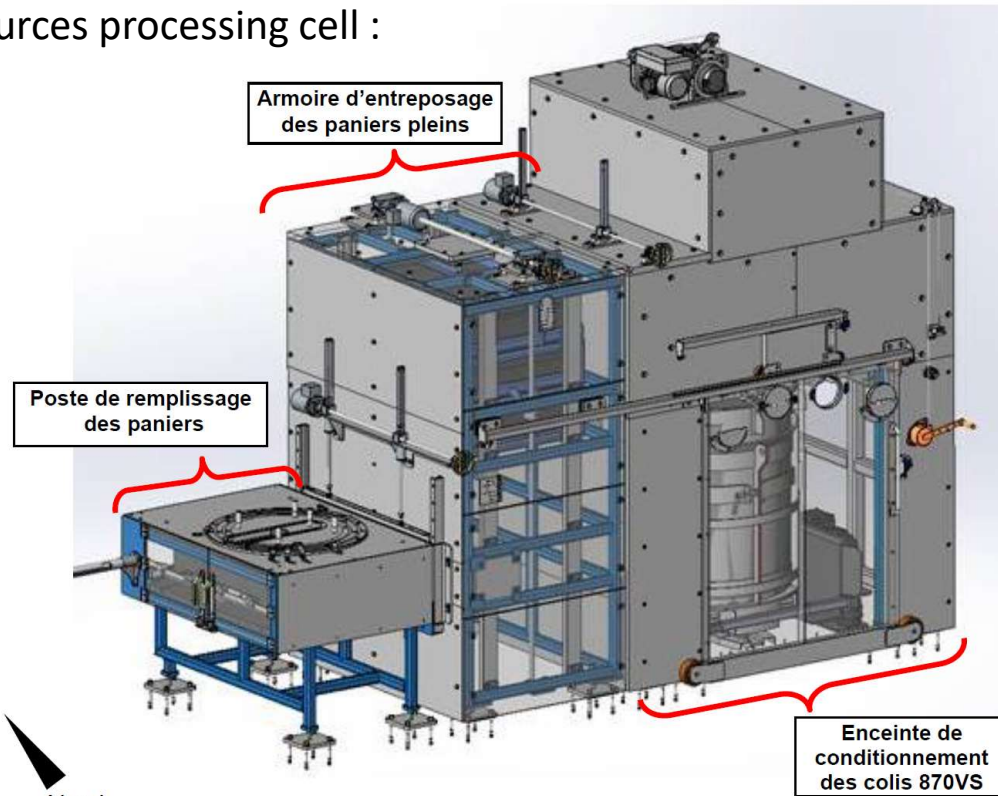
For new waste, what are the methods for blocking the package to meet the storage requirements ?

→ capacity to define and qualify new formulations in line with downstream requirements and or new conditioning technologies



2- Development of waste conditioning methods : the example of used sealed sources

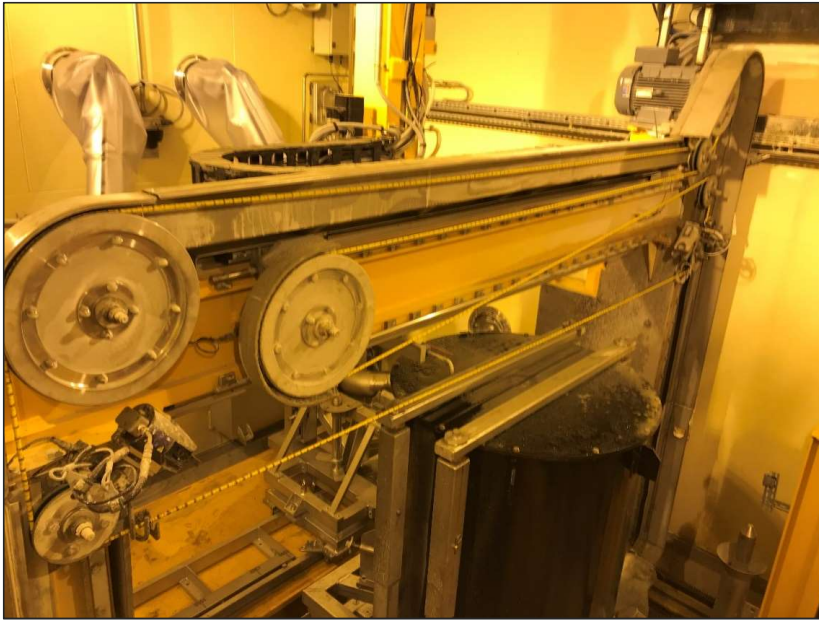
Sources processing cell :





3- Expertise in order to transport wastes to the appropriate outlet : Destructive Sampling

Shielded cell, equipped to cut through drums under water spray



Positioning of the cutting system

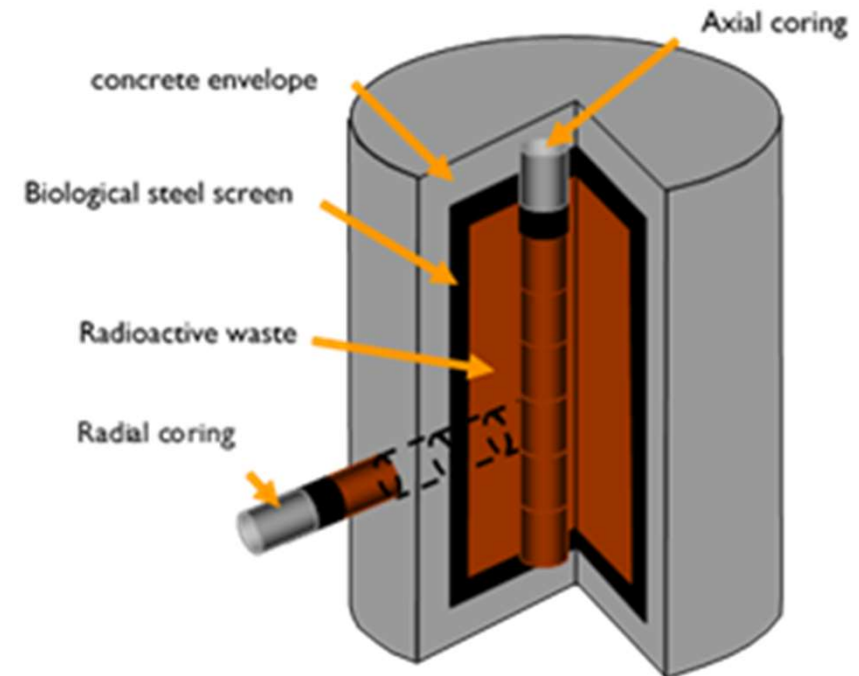


Cutting

3- Expertise in order to transport wastes to the appropriate outlet : Destructive Sampling

Shielded cells equipped :

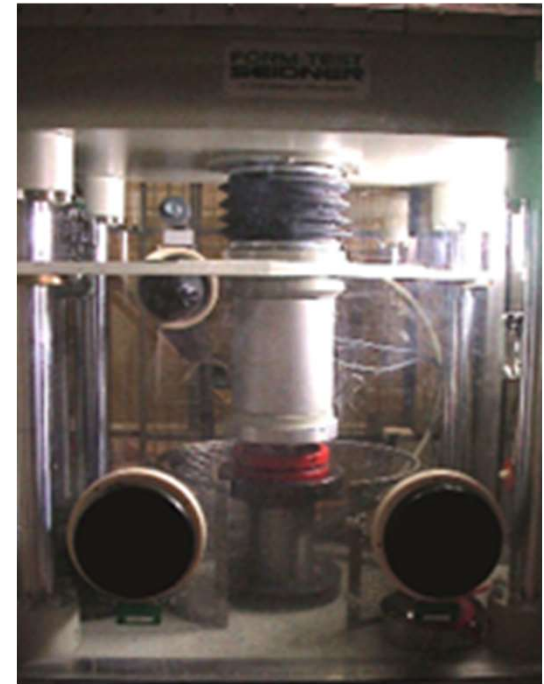
- to drill dry axially or radially through shells :
- To core and/or cut waste materials up to several tons and to take samples suitable for the expertise to be performed
- Those cores are then sliced in standardized samples suitable to answer few more questions !



The physico-chemical characterisation carried out on CHICADE : Mechanical resistance measurements to compression

Does the mechanical strength of the waste packaging comply with the storage requirements, in particular with regard to the stacking of waste packaging ?

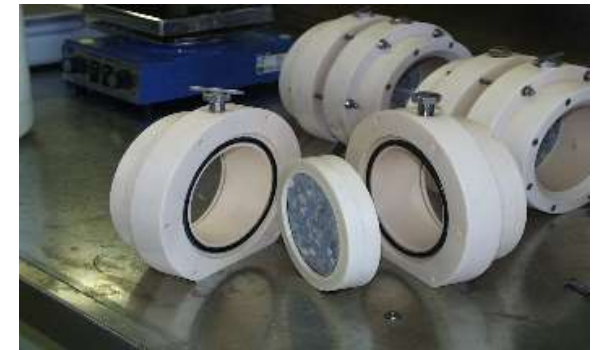
- Test samples are subjected to compression tests using a 50 or 100-Ton press
- The pressure of the load is increased gradually until rupture. The measured value must be in conformity with the limit of acceptability.



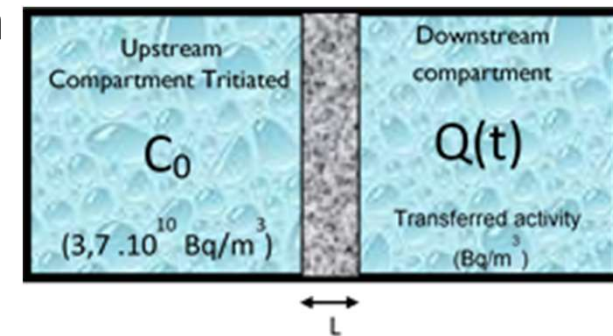


The physico-chemical characterisation carried out on CHICADE : Measurement of the diffusion coefficient

Will the radionuclides contained in concrete waste packages remain in these packages after several hundred years and under severe conditions?



To measure the capacity of the waste packages to contain the radionuclides in saturated medium



The physico-chemical characterisation carried out on CHICADE : Permeability measurement

Will the radionuclides contained in concrete waste packages remain in these packages after several hundred years and under severe conditions?

Special equipment is used to apply a gas pressure on the side of a sample in order to measure the flow through it. A permeability coefficient is thus deduced



The physico-chemical characterisation carried out on CHICADE : Leaching Test



The capacity of containment in a saturated medium of a block of waste is one of the important characteristics taken into consideration for storage

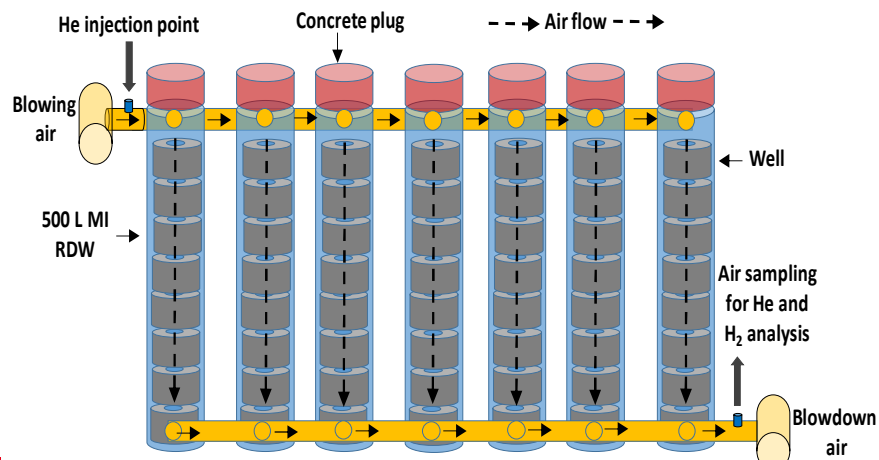
The sampling of the leaching water during immersion is done according to a precise timetable.



The physico-chemical characterisation carried out on CHICADE : Gas measurements of waste package gas release



- In which extend, a radioactive waste package is able to remove the gases produced by radiolysis (such as H₂, CO, ...)
- Storage and environment require knowledge of the nature and quantities of the gases released.



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The physico-chemical characterisation carried out on CHICADE : Radiochemical Analysis

The challenges are :

- dissolution (because the samples are mostly solid)
- Separation of the chemical elements of interest
- quantification of the chemical elements of interest

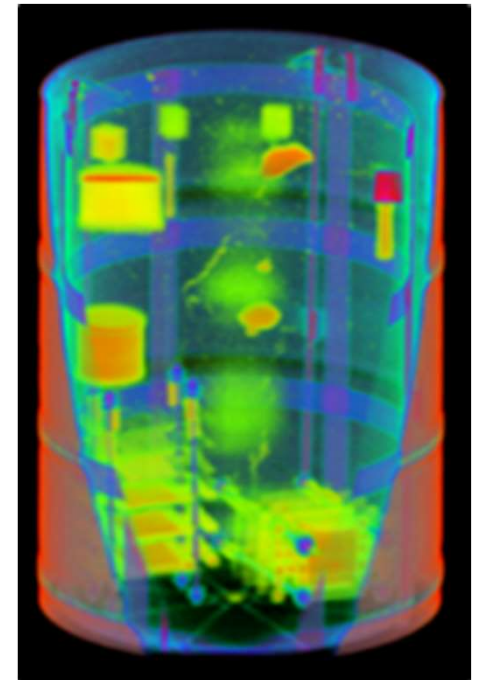



The physico-chemical characterisation carried out on CHICADE : Imagery



The objective of imaging is to obtain a non-destructive assessment of the waste

- Physical Characterization: X-rays and CT scans - HE
- Radiological Characterization: γ Spectrometries - Passive and Active Neutron Measurements
- Chemical Characterisation: γ spectrometry after neutron/photon activation



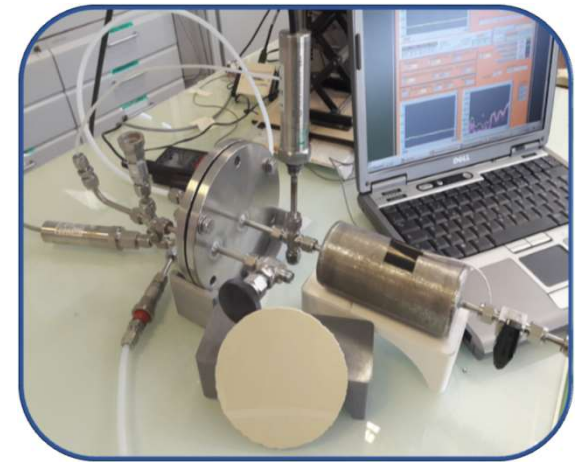


3 ■ Example of characterisation in the domain of nuclear fusion

Study of the containment capacity of a paint coating



- Permeability of hydrogen
- Solubility of hydrogen
- Diffusion of tritiated vapour
- Solubility of water





Tritium Degassing measurement for tritium containment evaluation

Measuring the outgassing rate of tritium in radioactive wastes



Tritium degassing measurement of a 5m³ waste package



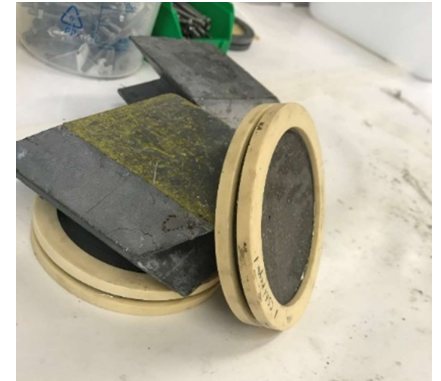
Tritium degassing measurement of 200 L drum

This tritium outgassing measurement can also be carried out on large surfaces such as storage trenches.

Tritium trapping research



- The aim is to find a material, to be mixed with the hydraulic binder, that will trap the tritium.
- CHICADE is involved in research carried out by the CEA into tritium trapping, an objective that can be achieved by developing adjuvants (known as ghetter).

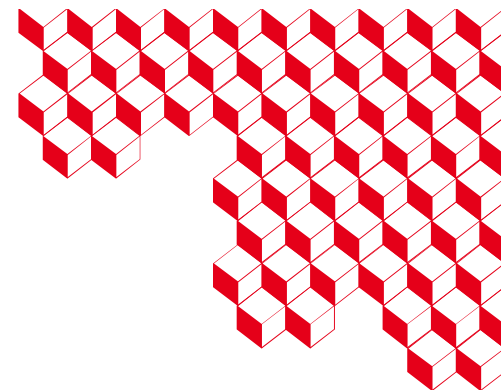




Conclusion

- CHICADE is a unique technological platform dedicated to the physico-chemical analysis of nuclear or conventional materials.
- CHICADE is a strategic facility for nuclear waste management
- CHICADE is a nuclear facility with unique equipment, allowing complete expertise to be carried out in a single location, benefiting from cross and complementary methods.





Merci

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