

**19<sup>th</sup> REFORM Group Meeting, Salzburg – September  
1–5, 2014**

**Low Carbon Markets and the Legacy of Nuclear Power**

# **HLW storage and SL-LLW disposal in Spain**

**Pablo Zuloaga, Dr. Ing.  
pzul@enresa.es**



## NPP LOCATION AND SF SITUATION



STA. Mª DE GAROÑA



ALMARAZ I Y II



TRILLO



JOSÉ CABRERA



ASCÓ I Y II



VANDELLÓS I

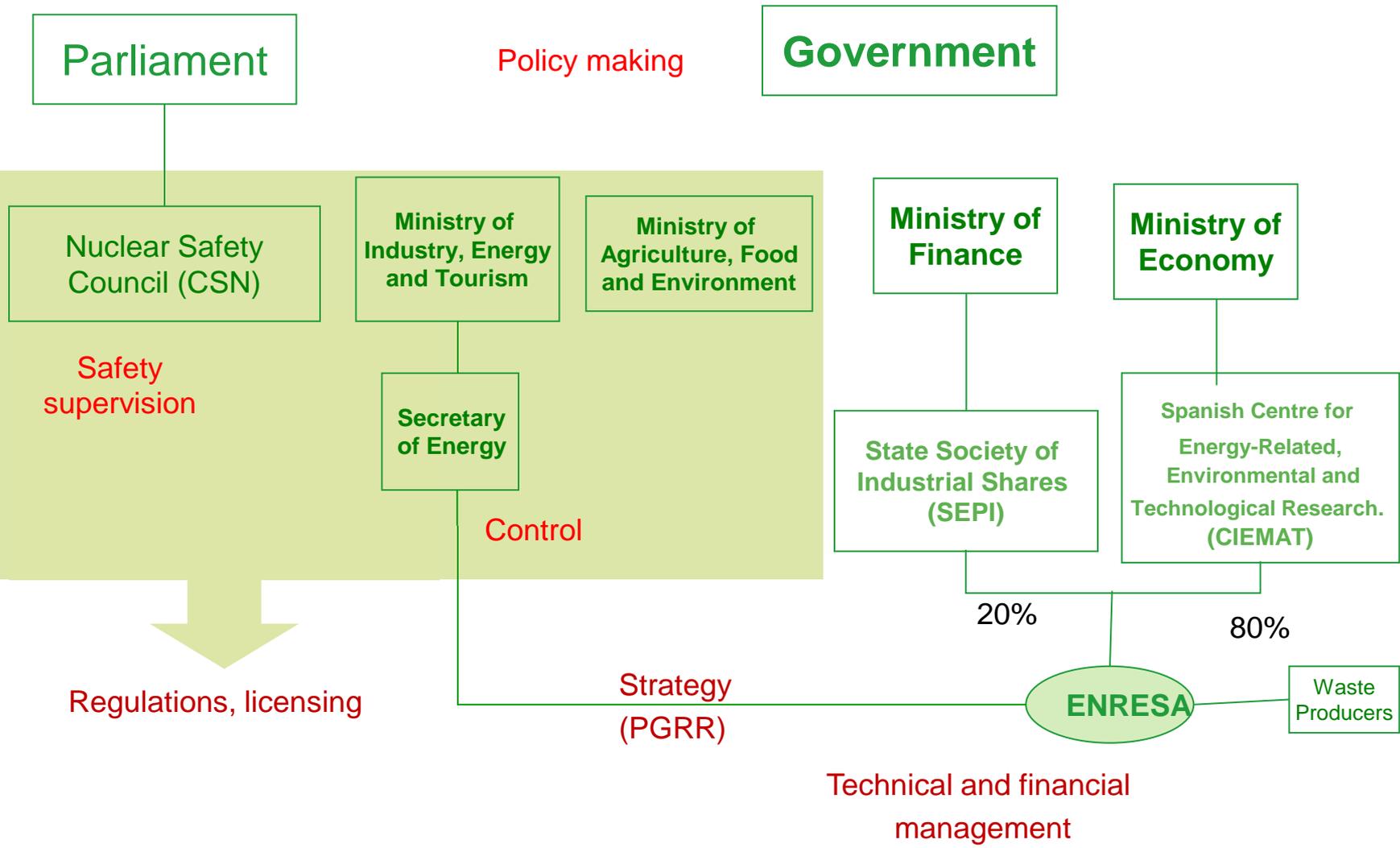


VANDELLÓS II

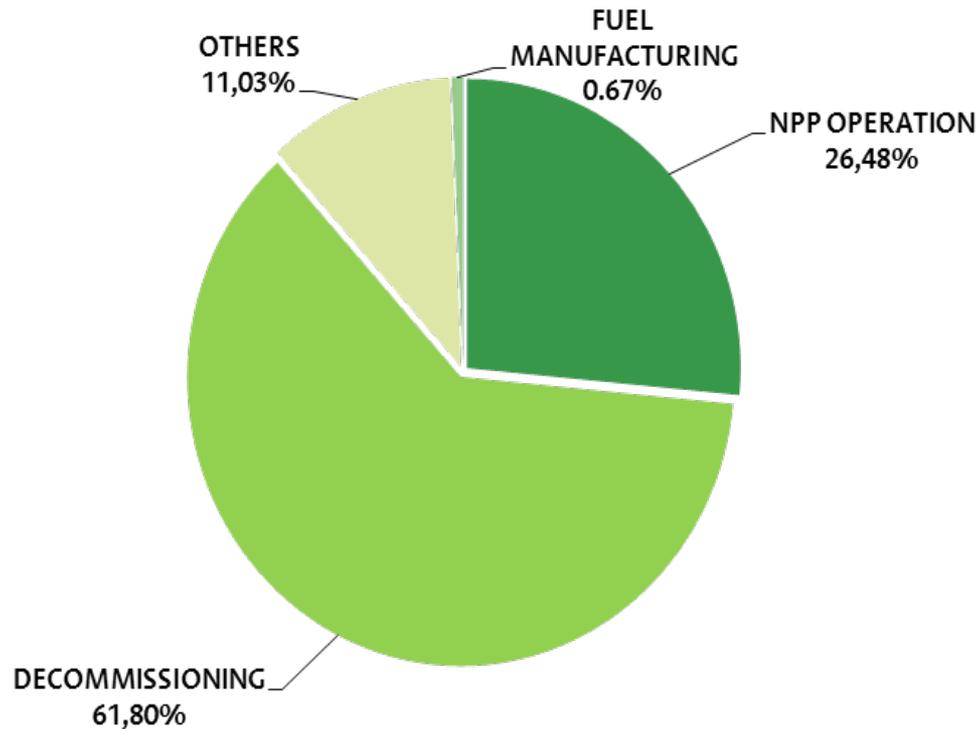


COFRENTES

- 10 Nuclear Reactors
- 7 reactors in operation at 5 sites
  - 7.400 MW
  - 20.86 % of country's electricity generation (2013)
- 2 NPP shut down, under decommissioning
- 1 NPP stopped, re-opening in licensing process

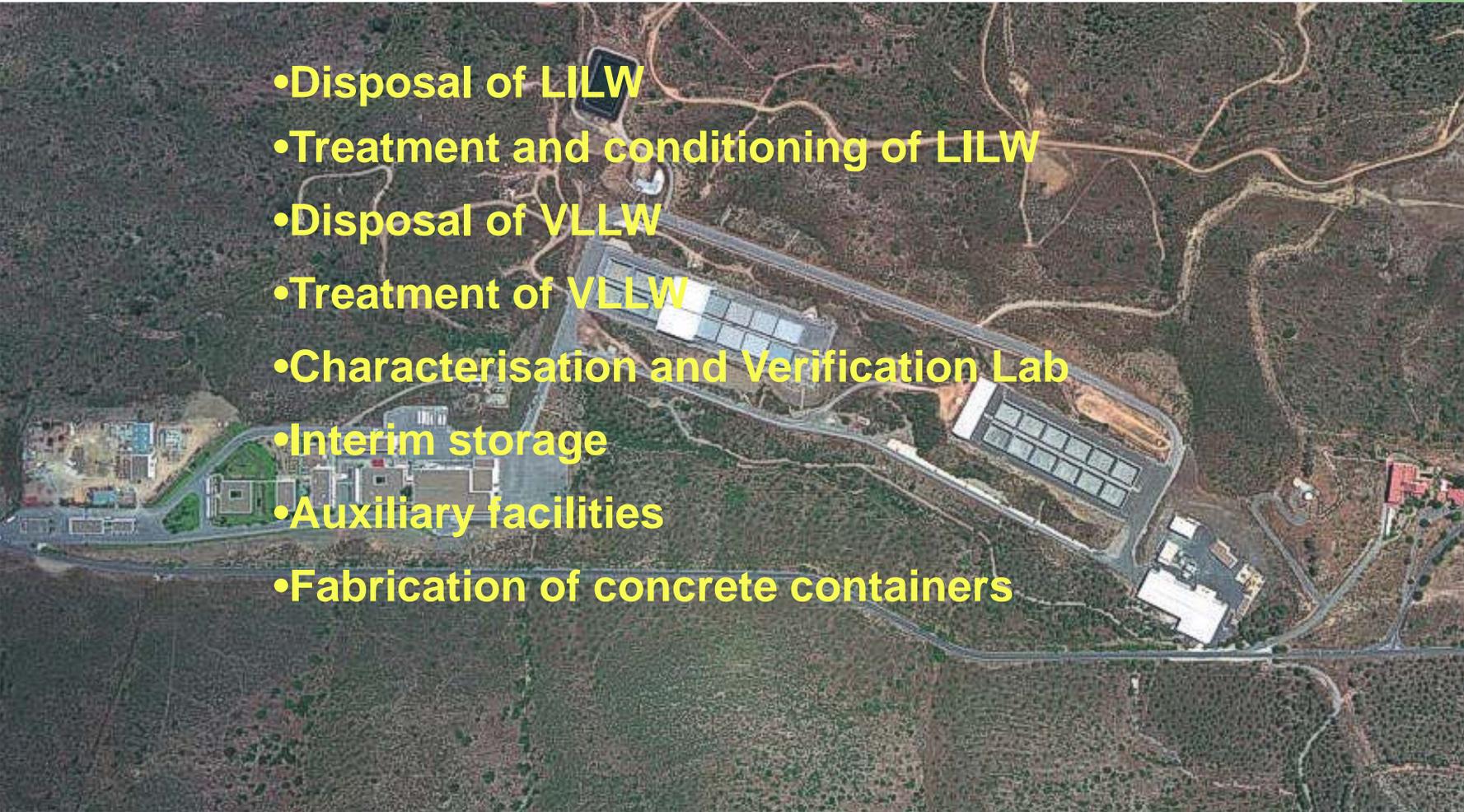


# 182,000 m<sup>3</sup>

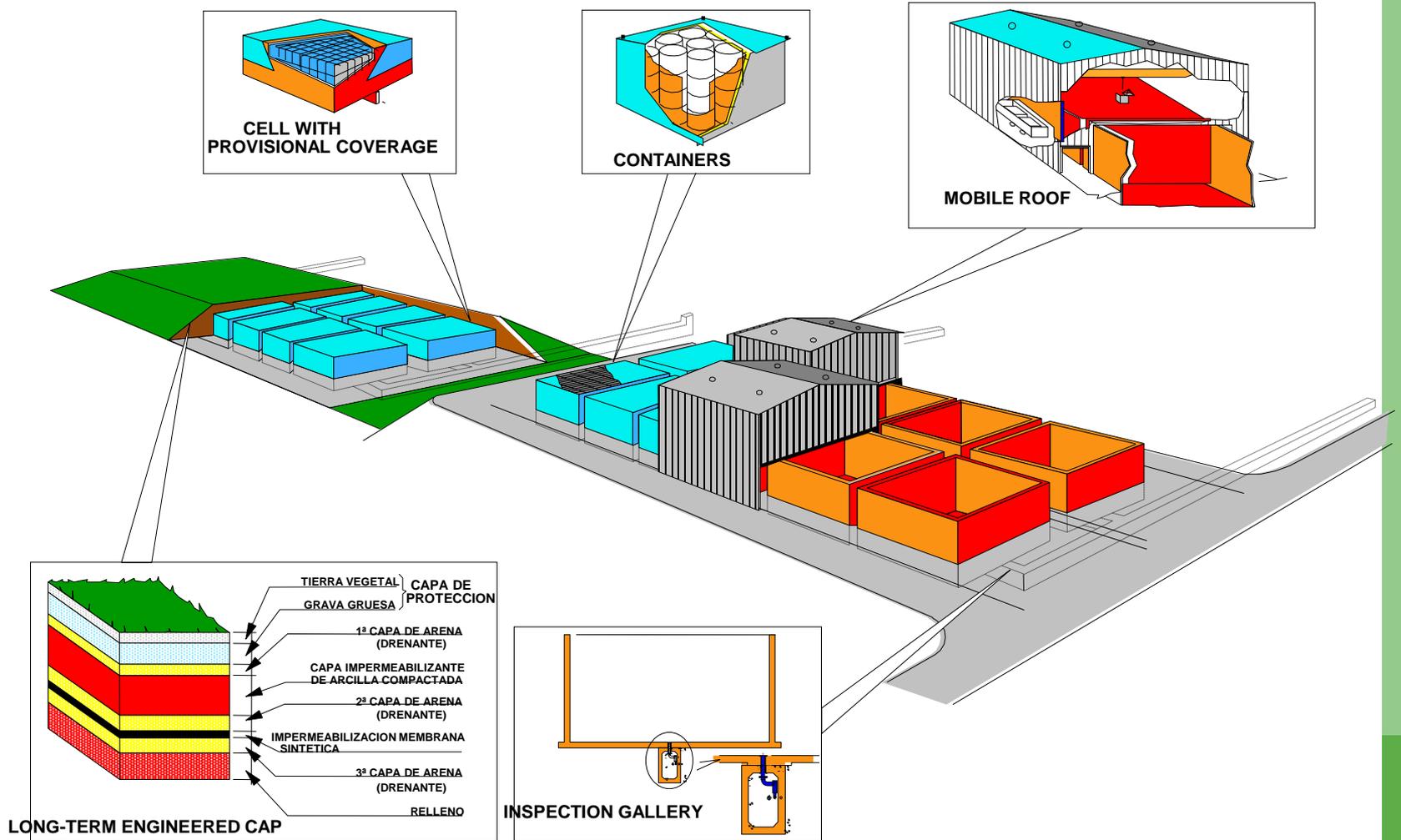


**(37,214 m<sup>3</sup> disposed of by 31/12/2013)  
(29,602 m<sup>3</sup> LILW and 7,612m<sup>3</sup> VLLW)**

## Aims of El Cabril facility

- 
- Disposal of LILW
  - Treatment and conditioning of LILW
  - Disposal of VLLW
  - Treatment of VLLW
  - Characterisation and Verification Lab
  - Interim storage
  - Auxiliary facilities
  - Fabrication of concrete containers

# Disposal concept



## Disposal vaults operation, construction of closing slab



- **Mostly 11 m<sup>3</sup> concrete containers**
- **Also 400 and 480 l drums with concrete sleeve**
- **Containers touching each other**
- **Central gap backfilled with gravel**
- **0.2 m mass concrete**
- **0.5-0.7 m thick reinforced concrete walls and closing slab**
- **Impervious provisional capping**

## Disposal vaults operation, construction of closing slab, and shelter transfer



## Inspection gallery and infiltration collection network



## Treatment and Conditioning of waste



Conditioning building



Super-compaction



Incineration of solids and liquids



Leaching and electrolysis of ashes



Drums, pellets and boxes reconditioning



Grout injection

## Control room



- Supervision of all systems and processes of the facility
- Remote handling of equipment both in conditioning building and disposal area
- Tracking system

## Waste acceptance characterisation: distribution of responsibilities

- The producer (large producers) is responsible for:
  - Establishing the conditioning method;
  - Conditioning their waste (in most cases)
  - Industrial control of packages production;
  - Measurement of key gamma nuclides.
- ENRESA:
  - Performs and evaluates the characterization tests,
  - Carries out production controls at producers' sites and verification tests at El Cabril Laboratory.
  - Also determines alpha content and scaling factors (correlation) for nuclides difficult to measure



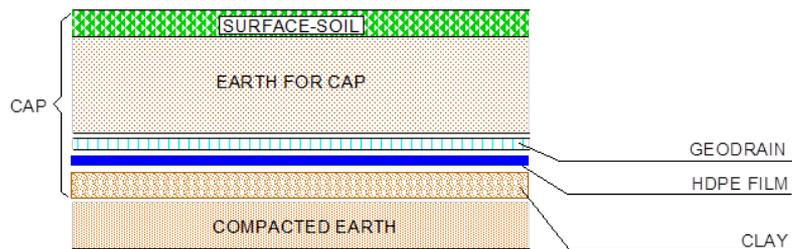
## VLLW facility

- Part of the same Nuclear Installation
- 130,000 m<sup>3</sup> capacity in 4 cells, each two stories
- Lower section of the first cell almost full. Second cell under construction
- One Treatment building (stabilisation of hazardous VLLW; void backfilling)

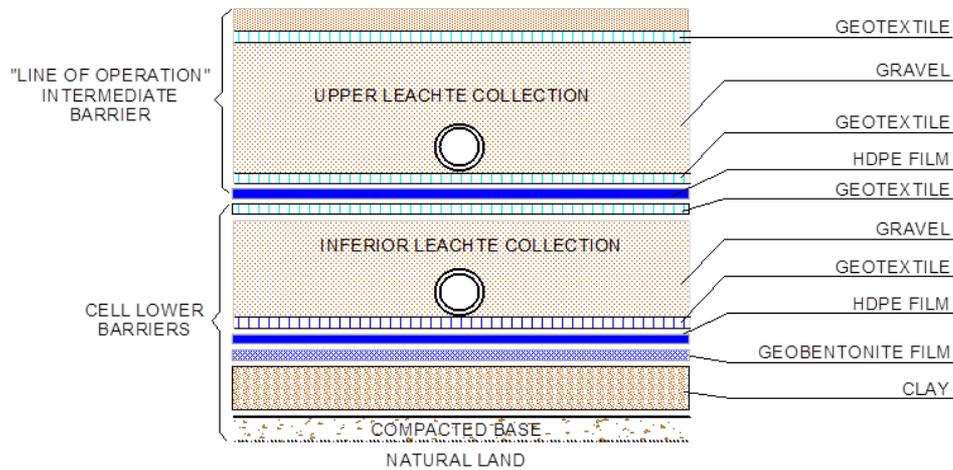


# VLLW disposal cell construction

## BARRIERS



WASTE



## Construction and operation of cell n° 29



## Construction of cell n° 30



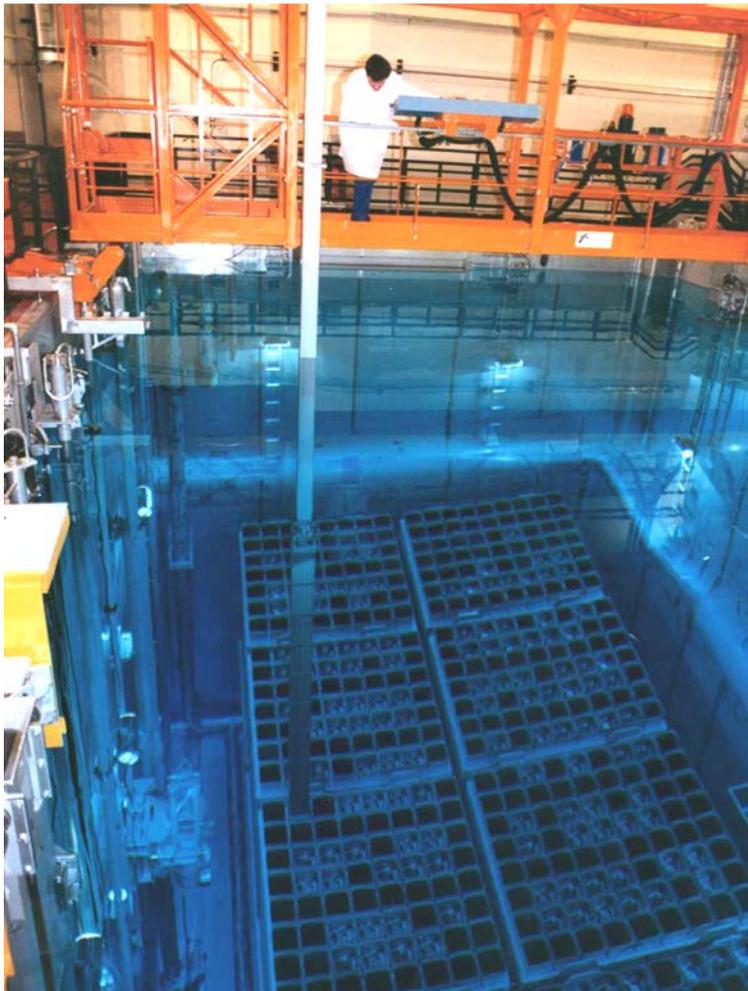
## SNF AND HLW-ILW INVENTORY and ESTIMATES

- Present Inventory
  - 4,600 tU SF in storage (December 2013)
    - Most of it in pools
    - 3 ISFSI in operation (dry-storage)
      - Trillo NPP → dual purpose metal casks indoor
      - Jose Cabrera NPP → HI STORM concrete casks on a pad outdoors
      - Ascó NPP 1&2 → HI STORM similar to Jose Cabrera ISFSI, commissioned 2013
- Total amount of spent fuel considered (40 years service lifetime for the operation NPP's)
  - 20.000 Fuel assemblies
  - 6.700 tU
- HLW and MLW
  - HLW (vitrified waste canisters)
  - Medium Level (long-lived) waste packages
    - Around 2 m<sup>3</sup> from reprocessing after swap

Around 1000 m<sup>3</sup> to be generated in decommissioning reactor internals

## All reactor SF pools where re-racked to compact racks in the 1990's

### Agreements between ENRESA and owners



# DRY STORAGE FACILITIES AT TRILLO , ZORITA AND ASCÓ NGS

## TRILLO



### Dry storage at Trillo NPP

- ENSA DPT Dual purpose casks
- Licensed for 80 casks
- Commissioned in 2002
- 483 FA (Dec 2013), 23 casks

## ZORITA



### Dry storage at José Cabrera NPP

- HI STORM system/ MPC for 32 FA (some damaged with NFH inserted)
- Total fuel inventory.(100 tU). No selection
- 12 casks with 377 FA

## ASCÓ I



### Dry storage at Ascó 1&2 NPP

- HI STORM MPC32 system
- Number of casks will depend on ATC Commissioning date (design for
- Commissioned in 2013

## Common problems to most NPP's

- Typical issues

- Pool saturation
- Crane upgrading requirements and limitations
- Dimensional limitations
- Pool positions occupied with other waste material
- Pool positions not accessible
- State/classification of SF assemblies

- Need of joint effort with NPP's

- Holistic approach (all plants)
- Acceptance/conditioning criteria
- Planning, specially for treatment of damaged fuel
- Equipment and its licensing

# ATC. THE CENTRALIZED SNF AND HLW STORAGE FACILITY PROJECT

- Defined as a priority in the 6<sup>th</sup> General radioactive Waste Plan
- Parliament supported:
  - In **2004**, the Industry Commission of the Parliament unanimously asked the Government to develop an ATC facility
  - In 2006, the Parliament urged the Government to set up an Inter-Ministerial Commission to lead the site selection process
- Site selection Process
  - Launched in December **2009** with a decree establishing the criteria and procedure on a volunteer, public and participative process.
  - Technical report released in September **2010** pre-characterizing the eight (8) final candidates' sites and providing proposal a candidate sites to the Cabinet
  - In December **2011** site selection is approved by Cabinet Minister (Villar de Cañas, Cuenca)
  - In October **2012** selection and purchase of the plot of land



# ATC. THE CENTRALIZED SNF AND HLW STORAGE FACILITY PROJECT

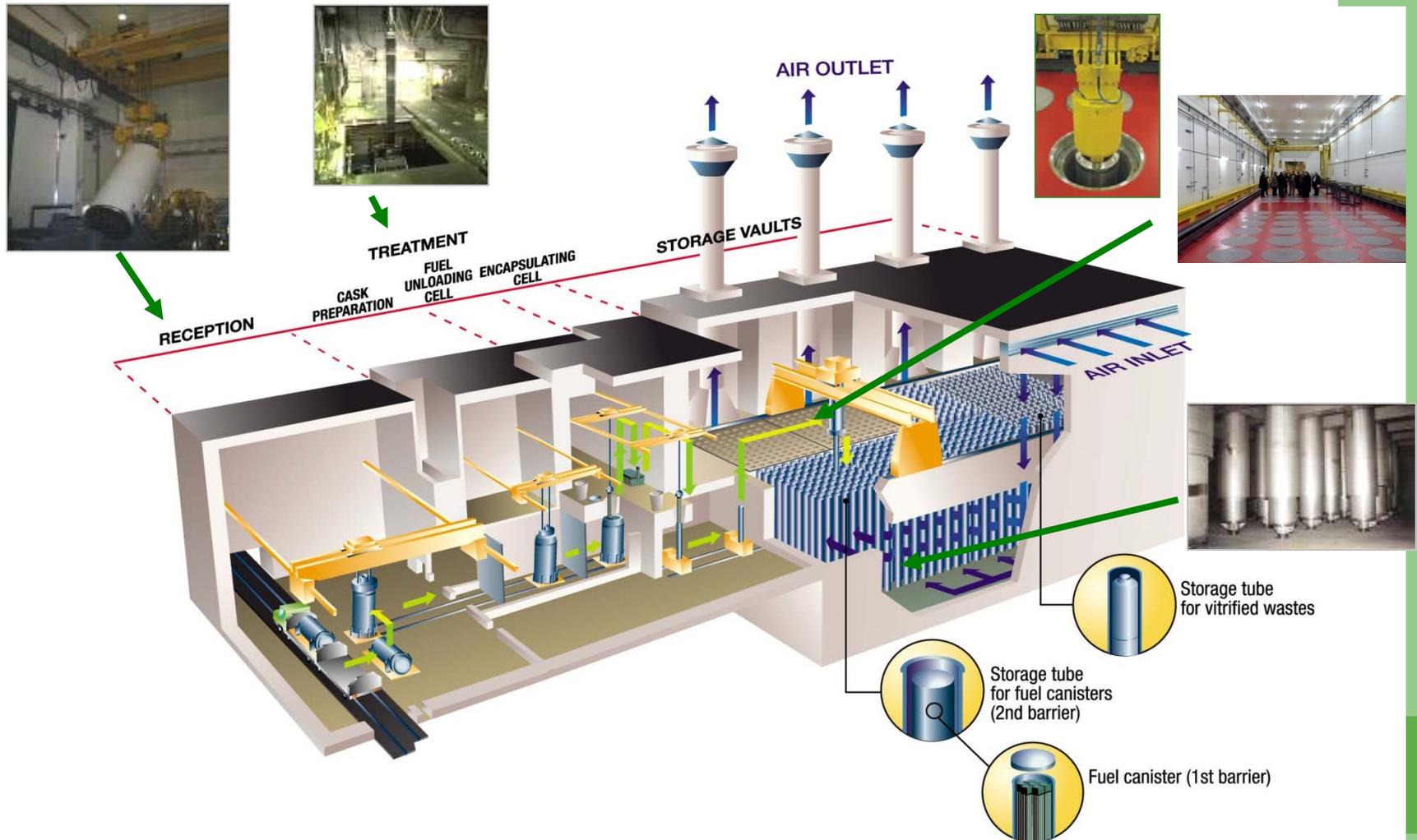
- 2012
  - Preliminary surveys and site selection
  - Purchase of land
  - Agreements with regional and local authorities for local development and infrastructures improvement
  - Launching the site characterization works
  - Calling for bids of Engineering companies
- 2013
  - Characterization works: Phase 1 and launching phase 2
  - Main Engineer and other engineering companies selected
  - Design and Official Licensing Documentation prepared
  - Initiation of the Environmental Impact Assessment Procedure
  - Initiation of the Urban and Land Planning procedures in agreement with the local authority
- 2014
  - Application of the site and construction licenses
  - Detailed design
  - Public enquiry process







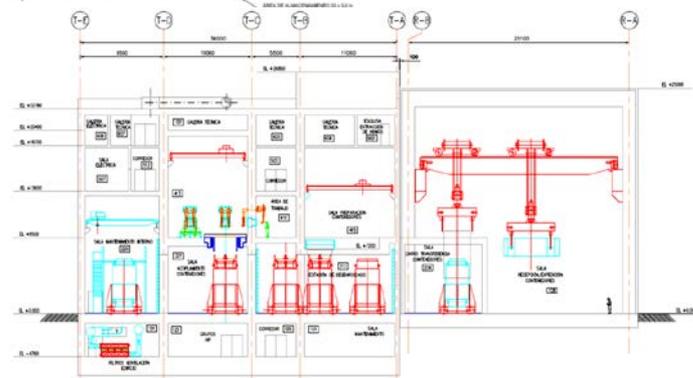
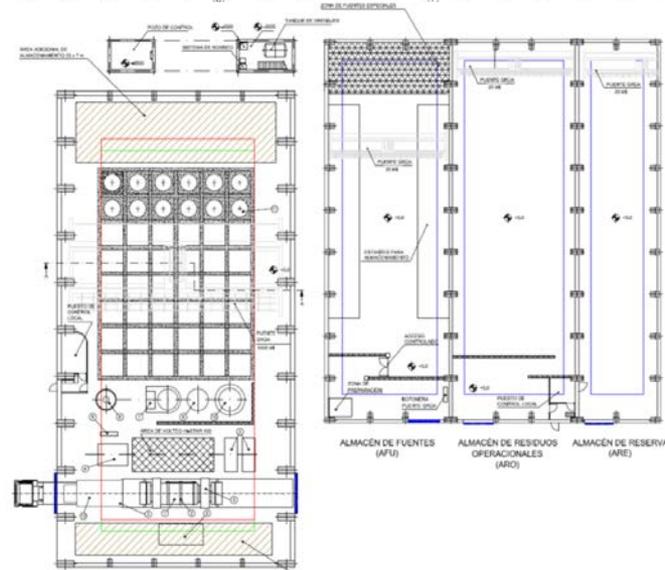
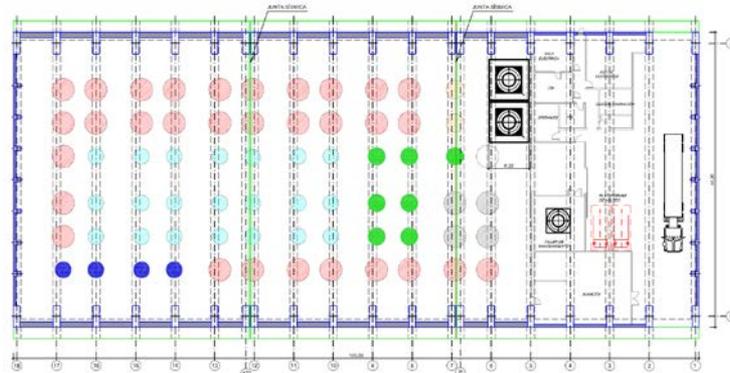




□ Buffer storage building for up to 70 casks

□ LL-ILW storage building

□ Transport casks maintenance workshop



- **Technology center**

- NF and RW Lab
- Conventional Labs
  - Prototypes
  - Materials
  - Chemistry
  - Local support
- Information center



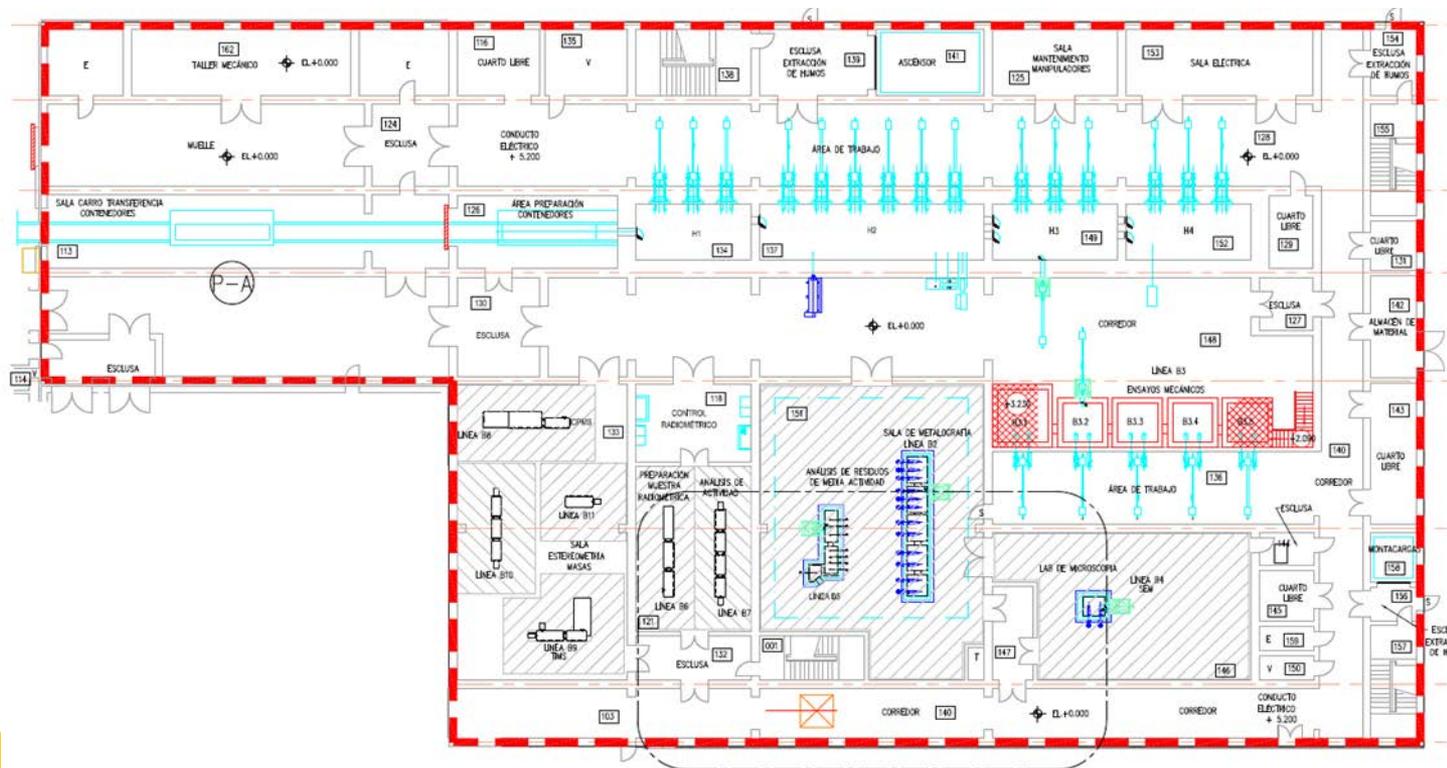
- **Business park**

- Infrastructure to companies settlement
- Business cradle
- Industrial buildings



# Main laboratory: NF & RW Lab

- Support ENRESA's R&D work, providing a facility for research on real material.
- Hot cell lab for Fuel characterization
- It is a part of the Nuclear Installation



# Licensing

- Authorizations (site and construction) granted by the Ministry of Industry and Energy
  - After binding report from CSN
  - After Environmental Impact Statement by Ministry of the Environment
  - After non-binding report from the regional government
- Operations Authorization granted by the Ministry of Industry and Energy
  - After binding report from CSN
  - Storage of Nuclear Material in a Nuclear Installation under construction by Ministry of Industry and Energy
    - After report from CSN
- Building requires Urban Planning License
  - Local authority

**Site characterization very complete**

US Regulations for ISFSI and for new NPPs

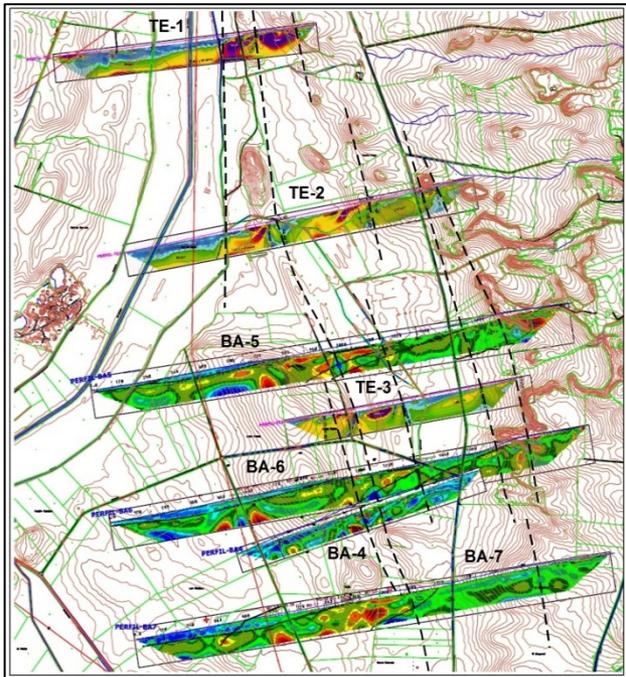
Including after Fukushima issues

Complex site (Gypsum and Clay)

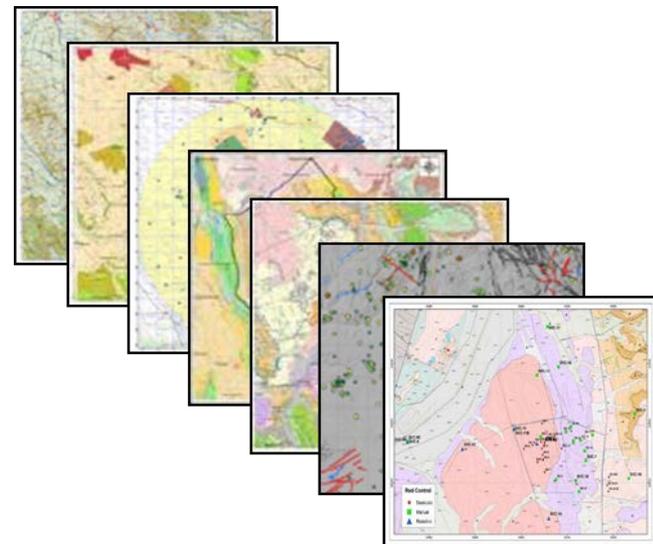
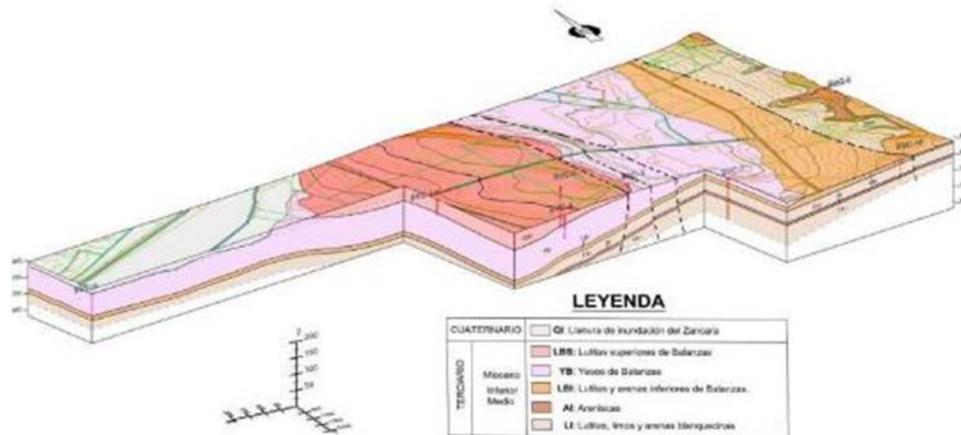
Sophisticated characterization techniques and borehole drillings ensuring absence of karstic formations

**Iterative process:**

A number of phases based on the results of the previous phase



PERFIL CENTRALESE-ONO



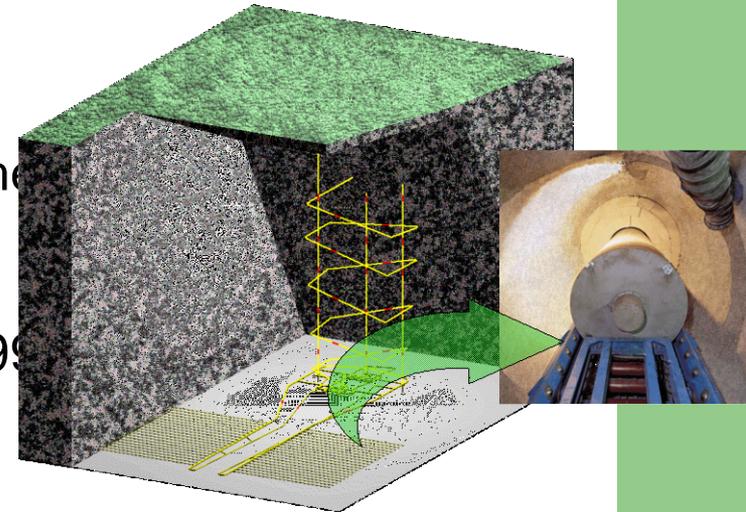
# Main milestones

- **July 2013:** Initial document for Environmental Impact assessment
- **January 2014:** Application for the
  - Site (previous) authorization
  - Construction Authorization
- **May 2014:** Environmental Impact study (with allegations from initial document review by stakeholders)
- **June 2014:** Public information
  - **Report to the Site authorization expected in January 2015**
  - **Report to the Construction authorization expected in September 2015**



## Deep Geological Disposal. Previous works

- **Site identification Program: 1986-1996**
  - Stepwise Screening
  - To a phase where drilling boreholes became necessary
- **Deep Geological Repository design and associated Performance assessment (1999-2004) in three steps:**
  - Disposal concept and basic design
    - Carbon steel canisters placed horizontally in parallel galleries, with Calcium-Bentonite seal
  - Strengthening the bases of the concept
  - Optimization through requirements review
- **Three rocks:** 2 basic design + Performance Assessment (**granite and clay**)
- **R&D projects**, including participation in international projects





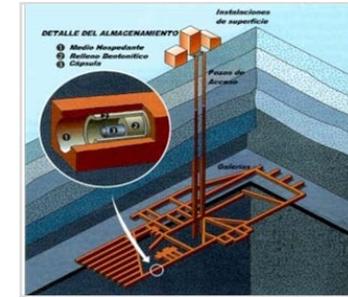
1.- Reracking  
90's



2.- ISFSI  
2000-2016



3.- ATC  
2017-2077



4.- DGP  
2068-

## DGD stages as proposed in the 7th General radioactive Waste Plan:

- 1 2014-2020 Report to the Government on knowledge actualization
- 2 2020-2023 Report assessment
- 3 2023-2027 Site designation
- 4. 2028-2035 Analysis of candidate sites
- 5 2036-2050 Site characterization and validation
- 6 2051-2063 Licensing and Construction
- 7 2063-2068 Initial Operation
- 8 2069- Normal Operation

## Summary and conclusions

- A complete system working in LILW management based on El Cabril facility for LILW disposal, VLLW disposal, Characterization and treatment
- The priority is the Centralized Interim Storage Facility (ATC)
  - Site selected December 2011
  - Casks Storage Building to be commissioned in December 2016
  - Main Installation scheduled in March 2018
- Completed by In situ Increased Storage capacity when required
  - ISFSI
  - Preparation for pool unloading and transport to ATC
  - SF classification and preparation: important joint work with utilities
- Deep Geological Disposal studies continuation to complete step-wise approach
  - Direct disposal considered as the basic assumption
- R&D plan