HLW storage and SL-LLW disposal in Spain

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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
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INSTITUTIONAL FRAMEWORK

Parliament

Nuclear Safety Council (CSN)
Safety supervision

Ministry of Industry, Energy and Tourism

Ministry of Agriculture, Food and Environment

Ministry of Finance

State Society of Industrial Shares (SEPI)

Ministry of Economy

Spanish Centre for Energy-Related, Environmental and Technological Research (CIEMAT)

Waste Producers

Policy making

Secretary of Energy

Control

Strategy (PGRR)

Regulations, licensing

20%

80%

ENRESA

Technical and financial management
HLW storage and SL-LLW disposal in Spain

LLW/VLLW inventory

182,000 m³

- DECOMMISSIONING 61.80%
- NPP OPERATION 26.48%
- MANUFACTURING 0.67%
- OTHERS 11.03%

(37,214 m³ disposed of by 31/12/2013)
(29,602 m³ LILW and 7,612 m³ 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

- CELL WITH PROVISIONAL COVERAGE
- CONTAINERS
- MOBILE ROOF
- LONG-TERM ENGINEERED CAP
- INSECTON GALLERY
Disposal vaults operation, construction of closing slab

- Mostly 11 m³ 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 m³ 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**

- **Surface soil**
- **Earth for cap**
- **Geodrain**
- **HDPE film**
- **Compacted earth**
- **Clay**

**Waste**

- **Line of operation**
- **Intermediate barrier**
- **Upper leachate collection**
- **Gravel**
- **Geotextile**
- **HDPE film**
- **Geotextile**
- **Cell lower barriers**
- **Inferior leachate collection**
- **Gravel**
- **Geotextile**
- **HDPE film**
- **Geotextile**
- **Geomembrane film**
- **Clay**

**Compressed base**

**Natural land**
Construction and operation of cell nº 29

Construction of cell nº 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 m³ from reprocessing after swap
    • Around 1000 m³ to be generated in decommissioning reactor internals
All reactor SF pools were re-racked to compact racks in the 1990’s

Agreements between ENRESA and owners
Dry storage at Trillo NPP

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

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

Dry storage at Ascó 1&2 NPP

- HI STORM MPC32 system
- Number of casks will depend on ATC
- 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 6th 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
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General View
Main process conceptual design

- Unloading transport casks
- Cask opening and coupling to the transfer cell
- Dry transfer of Fuel Assemblies from transport casks to storage capsules
- Inertization of capsules cavity and sealing
- Transfer of capsules to storage wells
- Storage of capsules in sealed storage wells
- Cooling by air circulating outside the wells and flow induced by natural draft
- Concern about failed fuel, specially in those assemblies with loss of tightness
HLW storage and SL-LLW disposal in Spain

http://www.enresa.es/publicaciones_y_audiovisuales/videos_e_interactivos/interactivo_atc
- 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
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** (1990-2004) 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
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 complet step-wise approach
  • Direct disposal considered as the basic assumption

• R&D plan