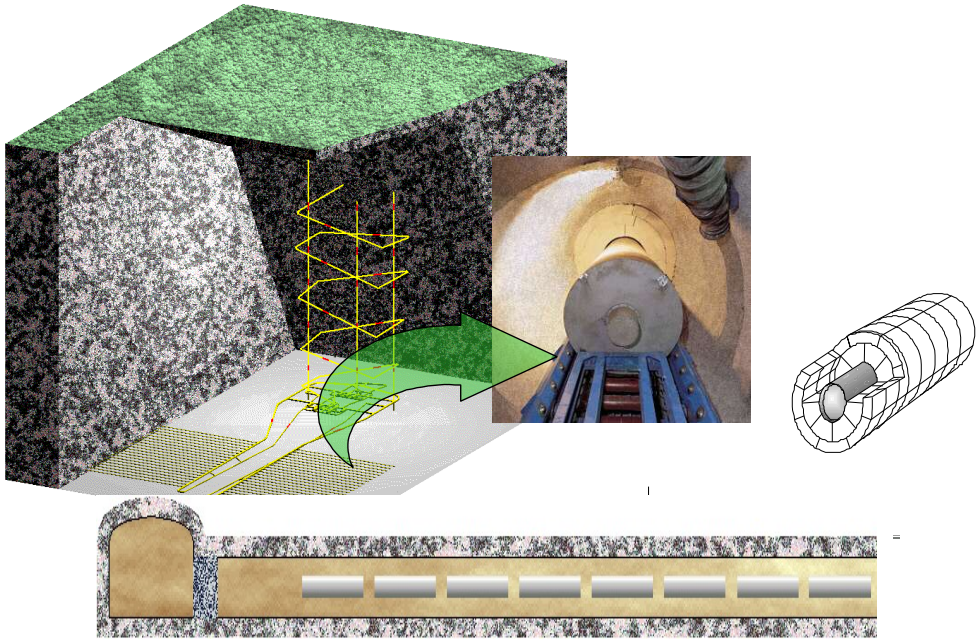
Status of the DGR programme in Spain



Joaquín Farias, Silvia Rueda.
Head of International cooperation and R&D

IGD-TP 10th International Exchange Forum

Prague, Spain, 25-27 November 2025

Enresa, the Spanish Radioactive Waste Management Organization

- Enresa was created in 1984 and has the character of a state-owned limited liability company. Its functions are regulated by Royal Decree 102/2014, of February 21, for the responsible and safe management of spent nuclear fuel and radioactive waste
- The management of radioactive waste, including spent nuclear fuel, and the dismantling and decommissioning of nuclear facilities, constitutes an essential public service that is reserved to the State
- The National Radioactive Waste Company, S.M.E., S.A. (Enresa) is entrusted with the management of this public service, in accordance with General Radioactive Waste Plan approved by the Government
- Enresa is a technical service of the Administration

Historical review of the priority consideration of the DGR programme in Spain

High priority

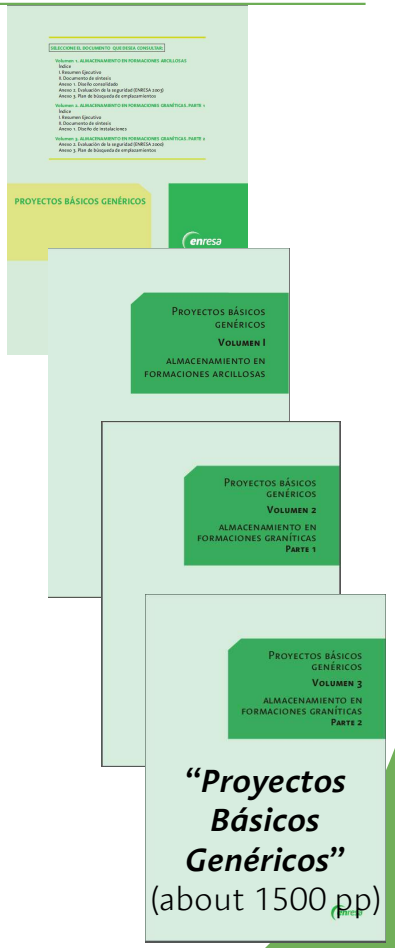
- ✓ Site selection plan
- ✓ Design of AGP reference concept: (Salt + clay + crystalline formations)
- ✓ ➔ convergence design (clay + crystalline)
- ✓ Performance assessment (clay + crystalline)
- ✓ R&D plans

Very Low priority

- COUNCIL DIRECTIVE 2011/70
- Royal Decree 102/2014
- ARTEMIS Mission
- 8th R&D Plan
- ✓ Summary of activities: "*Proyectos Básicos Genéricos*"
- ✓ R&D plans

Increasing priority

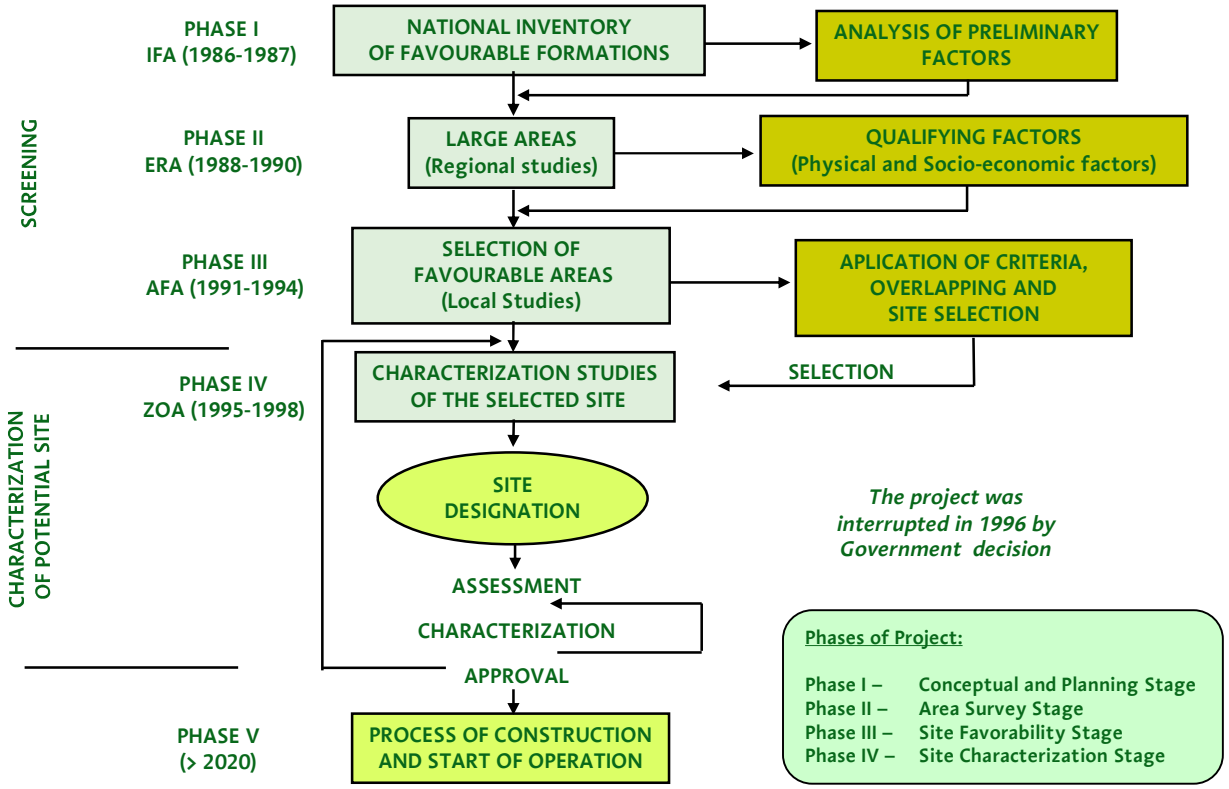
- ➢ 7th GRWP (2023)
- ➢ Tripartite Group (2020)
- ➢ Update of knowledge (2025)
- ➢ Gap analysis
- ➢ 9th R&D plan (2024-2028)



"Proyectos Básicos Genéricos" (about 1500 pp)

1986 - 2004	2004 - 2019	2019 – on -

Site selection work scheme and results so far (interrupted in 1996)



The project was interrupted in 1996 by Government decision

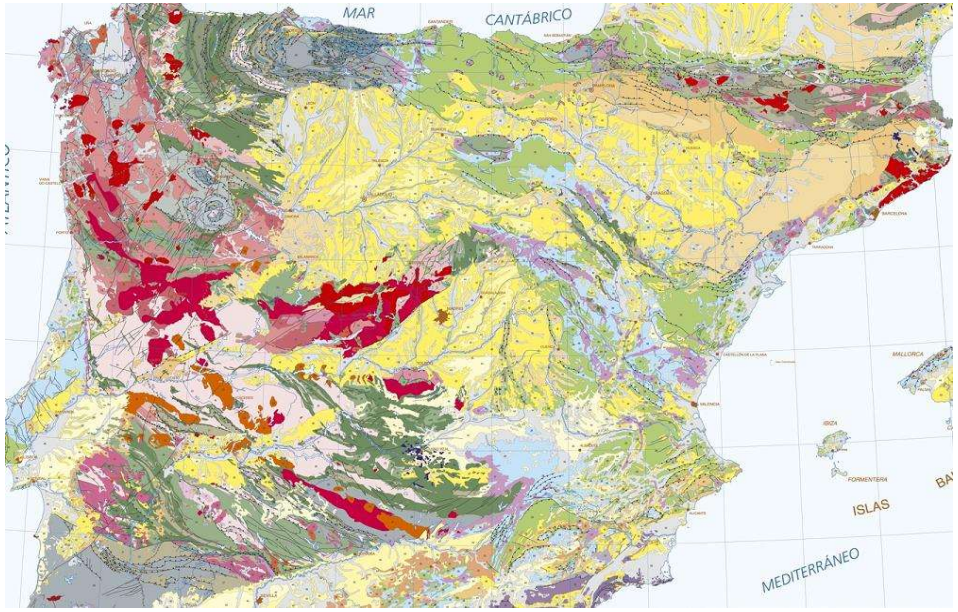
Phases of Project:

Phase I – Conceptual and Planning Stage
Phase II – Area Survey Stage
Phase III – Site Favorability Stage
Phase IV – Site Characterization Stage

Project	Lithology	Areas/Zones	Surface (km²)
IFA (1986-1987) 1:400.000	Outcropping granite	216	39.000
	Subsurface granite	N/D	8.000
	Clays and marls	29	70.000
	Salt formation	9	76.000
Total IFA			193.000
ERA (1988-1990) 1:200.000	Granites	22 areas	26.000
	Clays and marls	19 areas	22.150
	Salt formation	18 areas	10.200
Total ERA		59 areas	58.350
AFA (1990-1994) 1:50.000	Granites	16 areas	25.717
	Clays and marls	11 areas	8.732
	Salt formation	10 areas	8.053
Total AFA		37 areas	42.502
ZOA (1995-1996) 1:20.000 / 1:10.000	Granites	12 zones	3.405
	Clays and marls	6 zones	1.494
	Salt formation	2 zones	553
Total ZOA		20 zones	5.452

Site selection excerpt of the Spanish DGR programme

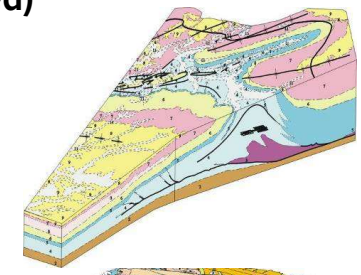
PHASE I (IFA): Favorable formations



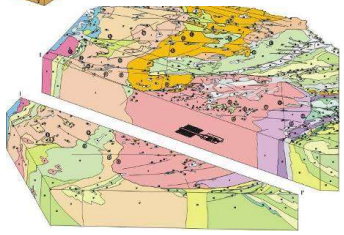
- Granites: 39,000 km² , 216 bodies (mostly connected to Hercynian Orogeny).
- Argillaceous or Marly Rocks Formations: 70,000 km², 29 Units.
- Evaporitic Formations: 67,000 km², 9 Units.

PHASE IV (ZOA): Studies of favorable zones (interrupted)

EVAPORITES: SALT DOMES AND BEDDED SALT

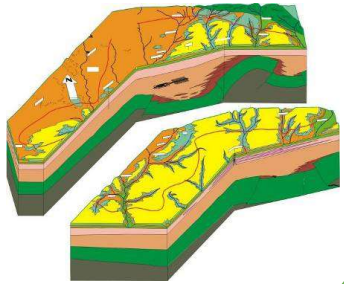


CRISTALINE ROCKS GRANITES



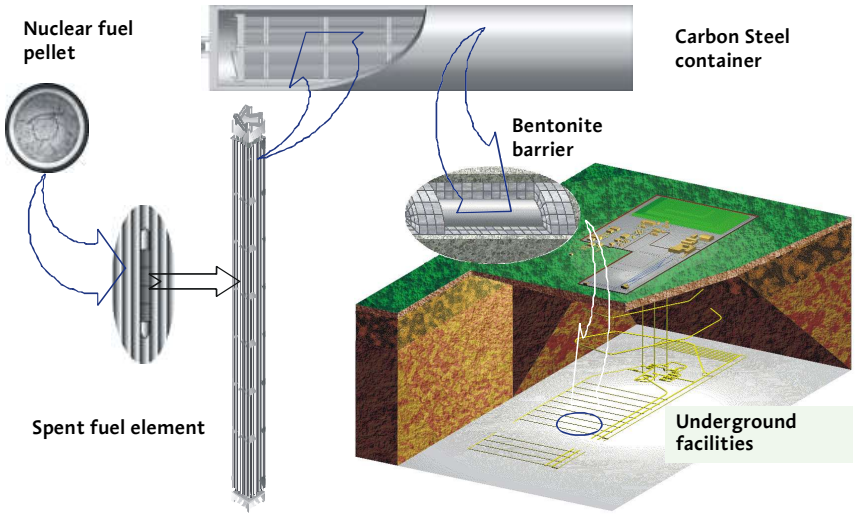
Objective:

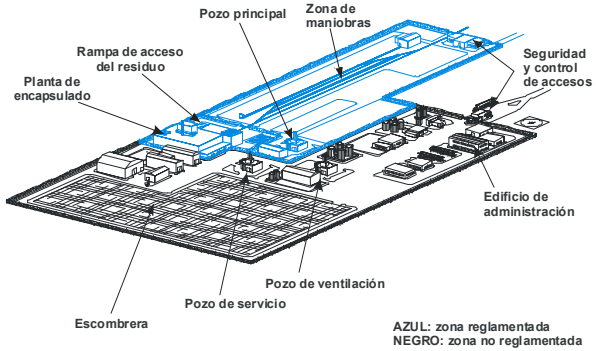
- 1st step: selection of 3 zones (one per lithology type) from those pre-selected zones (6 clays and marls formations, 2 saline formations and 12 granitic bodies) that are suitable for hosting a HLW repository (results from Phase III, AFA).
- 2nd step: Selection of the host rock, and then selection of one out of the 3 selected sites.

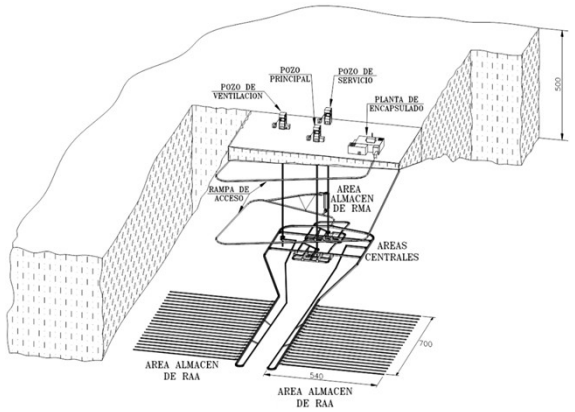


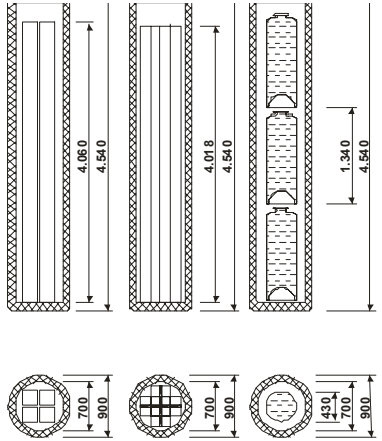
ARGILLACEOUS ROCKS

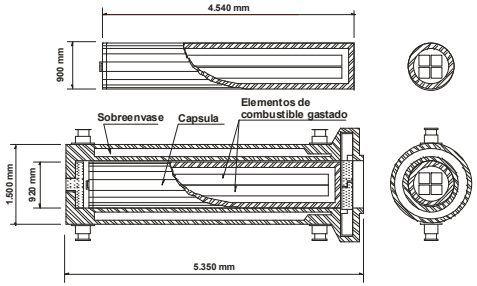
Spanish DGR reference concept: some schemes



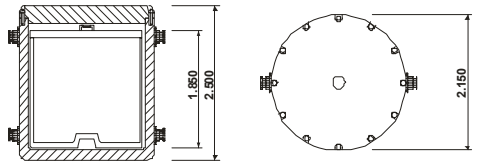








(Dimensiones en milímetros)



(Dimensiones en milímetros)

Artemis mission to Spain 2018

ARTEMIS

Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS)

DRAFT REPORT OF THE ARTEMIS COMPONENT OF THE COMBINED IRRS- ARTEMIS MISSION TO SPAIN

ARTEMIS Mission to Spain in October 2018

Observation: *There is currently a lack of progress in establishing the **Deep Geological Disposal facility**. This is further hampered by the fact that the existing generic authorization framework and regulations needs to be complemented by regulations and an implementation plan to specifically address the establishment of the Deep Geological Repository (DGD) programme. This creates uncertainty and decreases the likelihood that the project will be able to meet the key milestones and deadlines.*

RA3a Recommendation:

The Government should complement the existing legal regulatory framework by developing regulation and an implementation plan for establishing the Deep Geological Disposal facility. This plan should clarify the roles and responsibilities and engagement of the appropriate stakeholders, at each stage of implementation.

RA3b Recommendation:

Further, **CSN** and other competent authorities should develop a plan for regulatory engagement, licensing submissions and regulatory hold points in consultation with Enresa and other appropriate stakeholders.

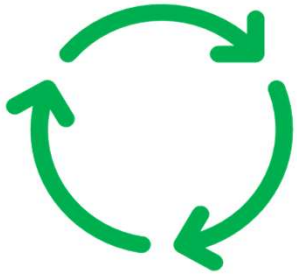
RA3c Recommendation:

In addition, **ENRESA** should proactively complete establishment of the technical basis of the geological disposal programme, particularly the site selection process, and define the major milestones with proposed deadlines.

After ARTEMIS mission in 2018

- ENRESA elaborated a first Roadmap for the DGR programme, 2019
- A working group Enresa-MITECO-CSN was created, Tripartite Working Group (TWG), in 2020
- Roadmap was discussed in several TWG meetings during 2020-2021
- Final Roadmap edition in 2021

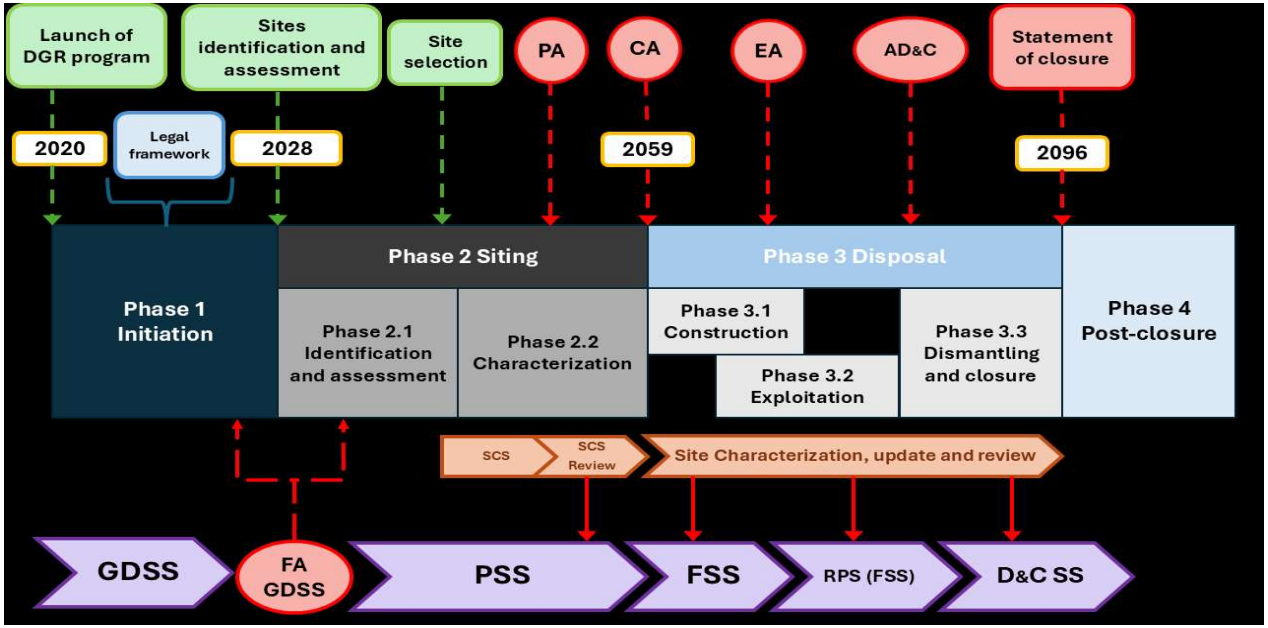
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO



CSN CONSEJO DE SEGURIDAD NUCLEAR

Roadmap for developing a DGR in Spain (September 2021)
Tripartite Working Group (MITECO-CSN-Enresa)

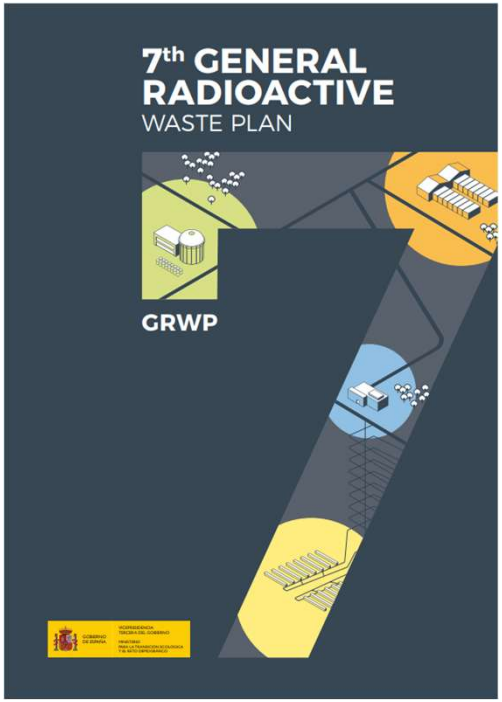
In 2020, the group was established with the goal of studying and developing a proposed legislative, regulatory and procedural framework to support a DGR program in Spain, in response to recommendations RA3a, RA3b, and RA3c from the IRRS-ARTEMIS mission report.

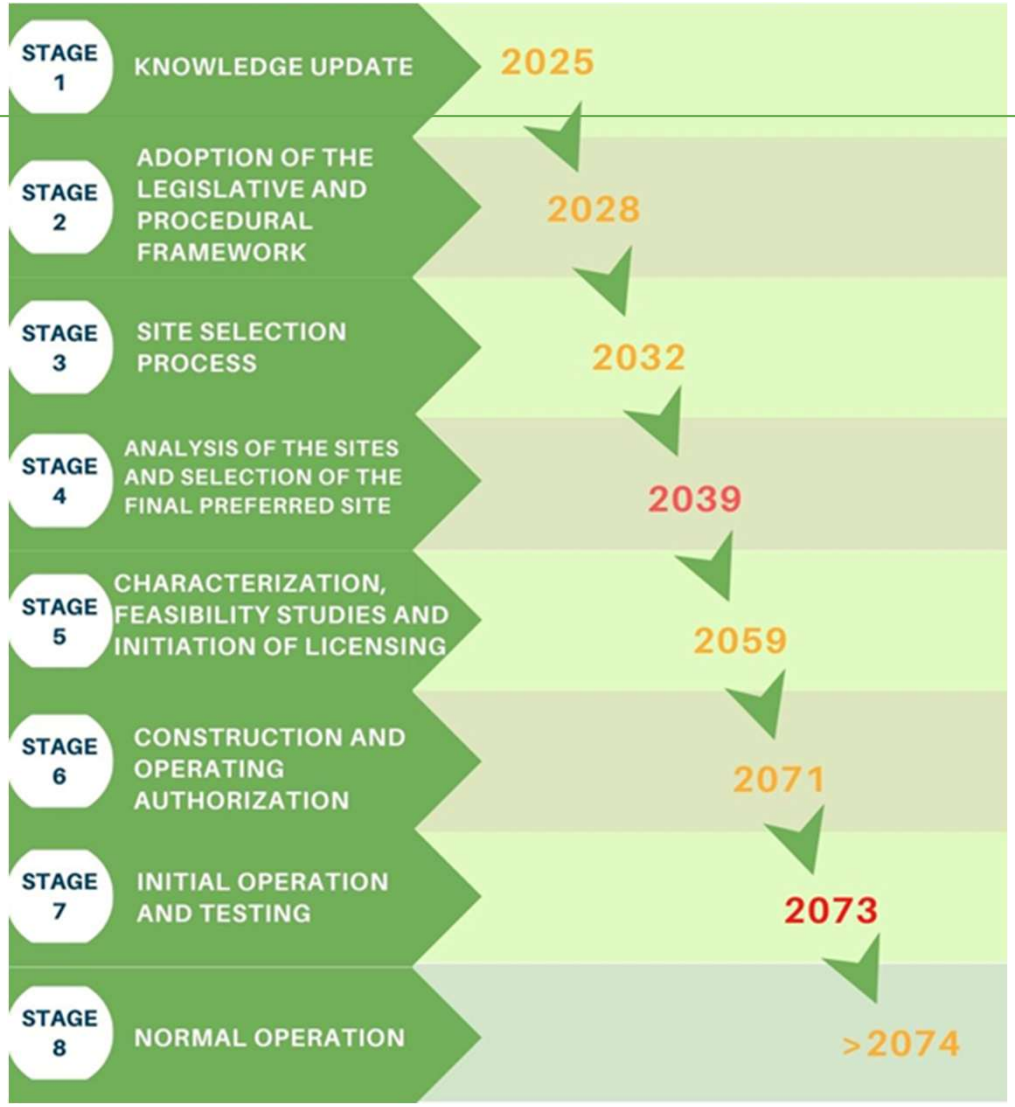


PA: Preliminary Authorization
CA: Construction Authorization
EA: Exploitation Authorization
AD&C: Authorization of Dismantling and Closure
FA: Favorable Assessment

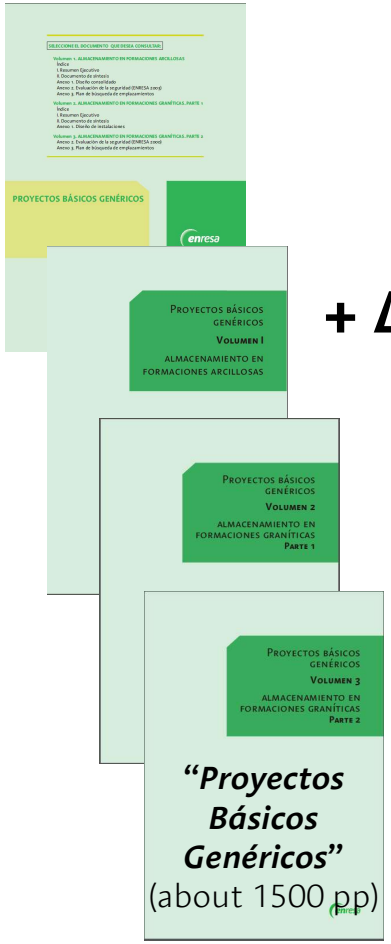
GDSS: Generic Design Safety Study
PSS: Preliminary Safety Study
FSS: Final Safety Study
PSR: Periodic Safety Review
D&C SS: Dismantling and Closure Safety Study
SCS: Site Characterization Study

Timeline for the DGR project in Spain
In the official National Policy Spanish Document





Stage 1
of the DGR programme “Knowledge update”



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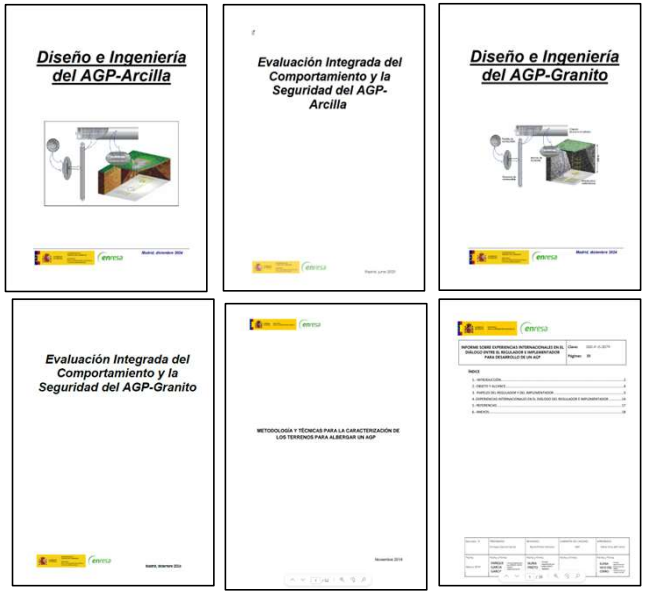
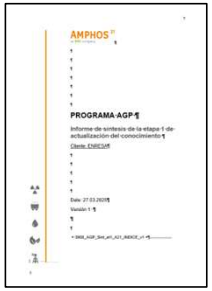
6 Annexes to the Final Report to the Ministry





Summary of Annexes (interim report) (Sep 2025)

Final Report to the Ministry (Dec 2025)

- **Stage 1 (out of 8) of the DGR programme: “Knowledge update”,** ends in Dec 2025: Final report + 6 annexes [(1 to 4) Design and Engineering and Performance assessment of the DGR in Clay and Granite (crystalline rock); (5) methodology and techniques for soil characterisation and (6) Situation of DGR in the Most Relevant Countries to Spain]

Stage 1

Draft Table of contents of the final document to the Ministry

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Final Report to the Ministry (Dec 2025)

EXECUTIVE SUMMARY
1 INTRODUCTION
2 OBJECTIVES AND SCOPE
3 THE DGR
- 3.1 General Description
- 3.2 The DGR in Granite
- 3.3 The DGR in Clay
- 3.4 Performance Assessment
- 3.5 Site Selection Plan
- 3.6 Site Characterization Methodologies and Techniques

4 AVAILABLE CAPABILITIES AND NEEDS ASSESSMENT
- 4.1 Conceptual Design of the DGR
- 4.2 Site Search Plan 70
- 4.3 Site Characterization Methodologies and Techniques

5 R&D PLANS FOR ALL STAGES OF THE AGP PROGRAM
- 5.1 DGR Program Stages and Enresa's Responsibilities
- 5.2 R&D Needs Identified in the Review of Information Developed to Date
- 5.3 Identification of R&D Needs in Future Stages

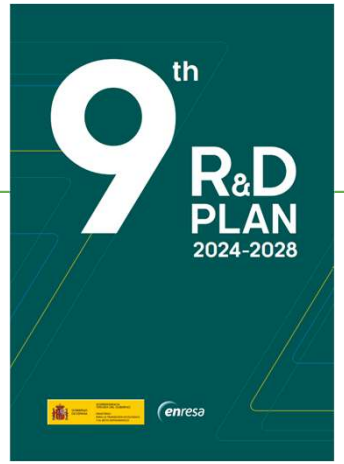
6 PREPARATION OF BASE DOCUMENTATION FOR THE SITE SELECTION PROCESS
- 6.1 Introduction. Problem Statement: How to Address Projects with Low Social Acceptance
- 6.2 Law as an Instrument to Establish a Site Selection Process
- 6.3 Need to Establish Institutional Cooperation
- 6.4 The Decision-Making Process from a Social and Political Perspective

7 DEVELOPMENT OF GENERIC TECHNICAL DOCUMENTATION FOR THE FACILITY AND ITS PERFORMANCE ASSESSMENT METHODOLOGY FOR THE MAIN FAVORABLE LITHOLOGIES
- 7.1 Modifications Considered by Enresa: 1998–2004 Period (Granite and Clay)
- 7.2 Modifications Derived from Future Waste Management Scenarios in Spain (Granite and Clay)
- 7.3 Modifications Derived from International Experience After 2004

8 CONCLUSIONS
9 NEXT ACTIONS: STAGE 2. ADOPTION OF THE LEGISLATIVE AND PROCEDURAL FRAMEWORK (2026–2028)
10 LIST OF ACRONYMS
11 REFERENCES

(Thanks Copilot for the translation)

R&D needs for a DGR programme



- The Final report to the Ministry suggests R&D activities (in chapter 5). Most of them are included in the current Enresa's 9th R&D Plan that covers the period 2024-2028.

- Detailed R&D activities for each step (>step 2) of the DGR programme will be defined mainly based on the following considerations:
  - Enresa and international experience so far, including the final report of Step 1 (chapter 5)
  - Country regulations (Ministry, CSN, other authorities)
  - SRA and related documents that WMOs (including Enresa), TSOs (including Ciemat), REs, of the EC member countries within EURATOM projects and IGD-TP, have already prepared or will update

Potential modifications of the Spanish DGR conceptual design of 1997

1. Modifications suggested internally in Enresa between 1998 - 2004
   - Engineered barrier based on bentonite: thickness, bentonite, blocks size, dry density target at the end, liner, initial degree of saturation; Max Temp.
   - Selection of Spent Nuclear Fuel Elements: selection and distribution of SFE
   - Retrievability: Alternative design of the repository components

2. Modifications based on inventory modification (NPP life-time, Burn-up degree)

3. Modifications based on International experience from 2004

   - Granite GD: issues of interest:
     - Retrievability of the SNF (Canadian concept)
     - Supercontainer (Canadian concept)
     - Vertical holes (Finnish and Swedish concepts)
     - Container durability requirements (Canada, Sweeden, Finland)
     - Installation of the bentonite barrier: liner disregarding, EB Project system for bentonite emplacement

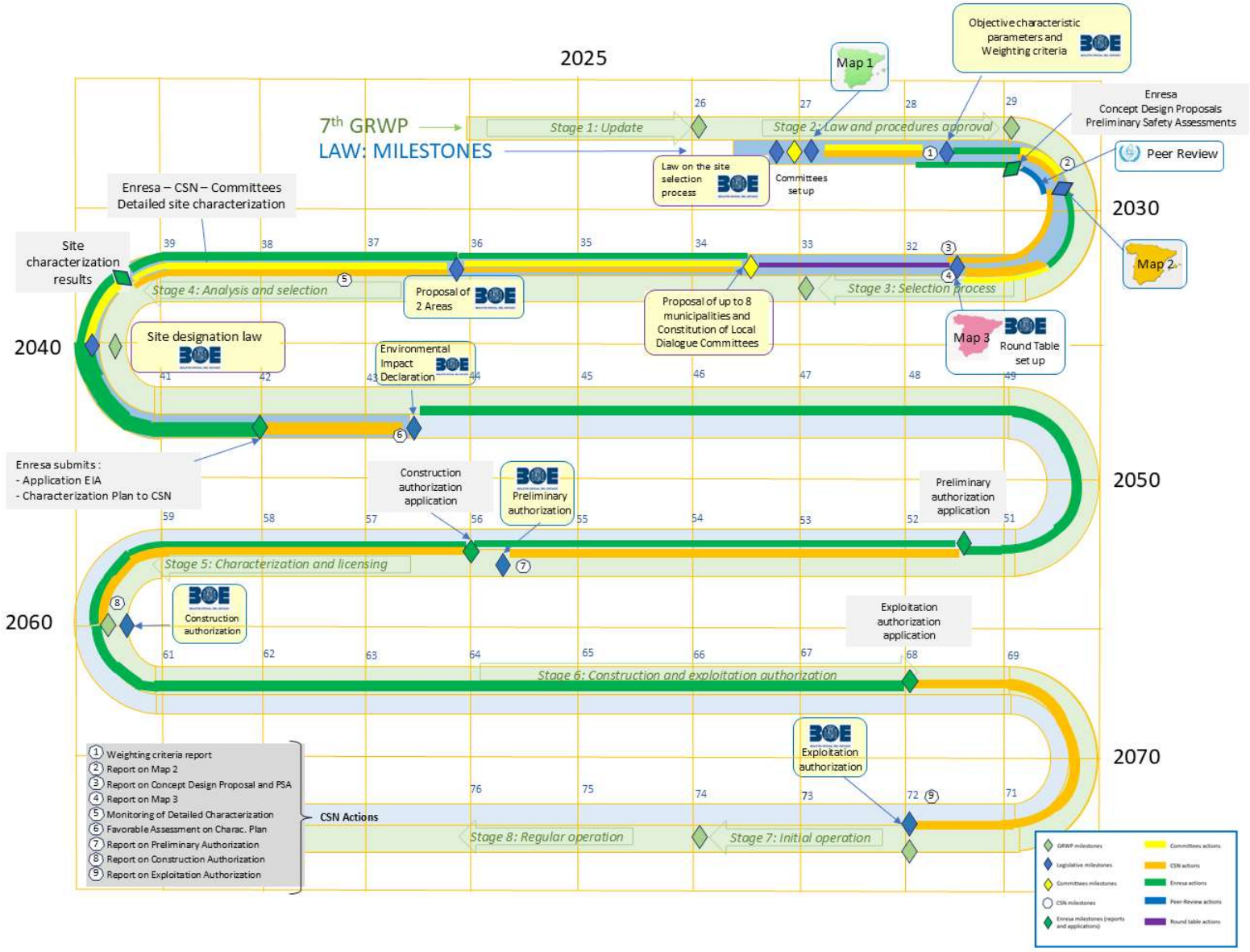
   - Clayey GD
     - Retrievability based on French concept
     - Supercontainer (Belgian concept)
     - Consolidated Clay (as in France and Switzerland)
     - Installation of the bentonite barrier (Swiss concept)

Summary

Tripartite Working Group (MITECO-CSN-Enresa, since 2020)

SF, HLW and SW POLICY
7th GRWP (2023)

RINR (2024)
Specific requirements for DGR



Thank you!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