Rapporteur feedback slides from EF8 technical break out sessions

Technical topic ‘Progress in site investigation and characterisation techniques’

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Irina Gaus

The research leading to these results has received funding from the European Union's European Atomic Energy Community's (Euratom) Seventh Framework programme FP7 (2007-2013) under grant agreements n°249396, SecIGD, and n°323260, SecIGD2.

Summary of working group attendees

- **WMO** = Puram, RWM, SKB, Andra, Nagra, Enresa, SURAO, Dekom, BGE
- **TSO** = VTT
- **RE** = BRGM, KIT, FZJ, IST-ID/C^{2}TN, SCK-CEN, V REZ, TUS, ENEA, GSL, TU Braunschweig, AMPHOS 21, HZDR, UJV REZ, LEI, IBRAE RAN,
- **Regulator** = BFE
- **Private company** = BRENK Systemplanung
- **Civil Society representatives** = ……

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Presentations

- Hungary / Peter Molnar (Puram) - Site characterisation in the Hungarian early-stage programme
- UK / Rob McLaverty (RWM) - Preparation for site characterisation in the UK: a needs-driven exercise
- Switzerland / Bernd Frieg (Nagra) - Site characterisation in the final stage of selecting the site in sedimentary clay rock in Switzerland
- Sweden / Peter Wikberg (SKB) - Site characterisation in the Swedish crystalline rock before and after submitting the construction licence.
- France / Jacques Delay (Andra) - Site characterisation in the French sedimentary/clay rock programme, close to construction licence submission

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Working group aims

- A geological disposal site characterisation programme will need to meet the information requirements of the design and disposal system safety assessments and also contribute towards the development of a site descriptive model.
- Typically, a site characterisation team will need to define the parameters to be measured to provide this information.
- This technical session will seek to address aspects of advanced site characterisation techniques and identify topics for potential knowledge transfer towards emerging programs.

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Summary of working group contributions

Methodological topics for site selection

- Shared disposal options for countries with small inventories – international siting investigations – how to realise collaboration?
- Public participation: how to make it successful? --> NEA – IGSC (International Group for Safety Case) efforts already in place.
- What were the motivating factors to move the next stage?
- Is the schedule a key element?

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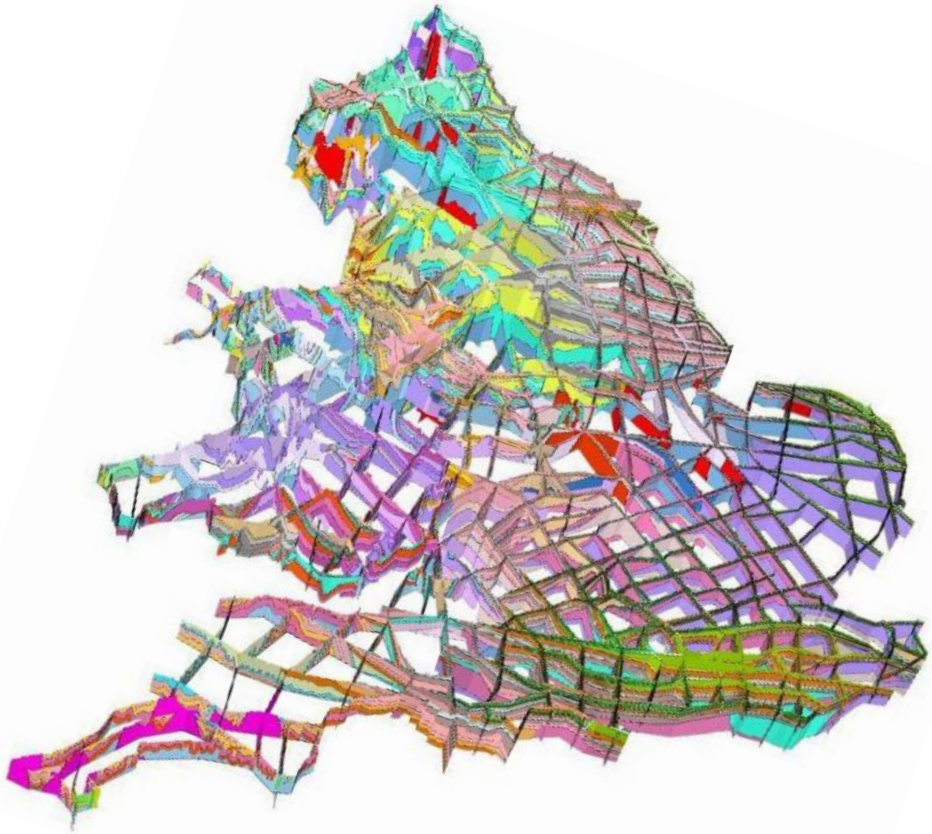
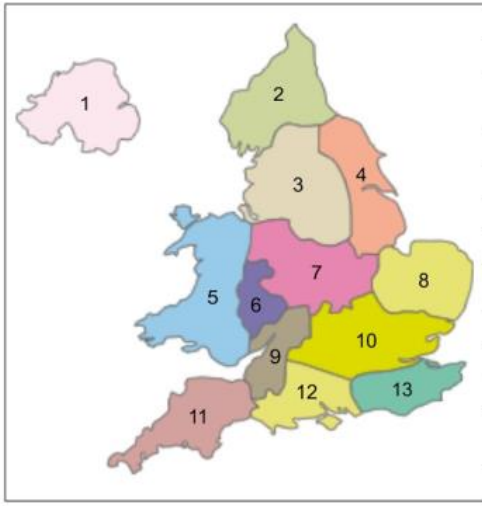
National Geological Screening





1	Northern Ireland
2	Northern England
3	The Pennines and adjacent areas
4	Eastern England
5	Wales
6	The Welsh Borderland
7	Central England
8	East Anglia and adjoining areas
9	Bristol and Gloucester region
10	London and the Thames Valley
11	South West England
12	The Hampshire Basin and adjoining areas
13	The Wealden district

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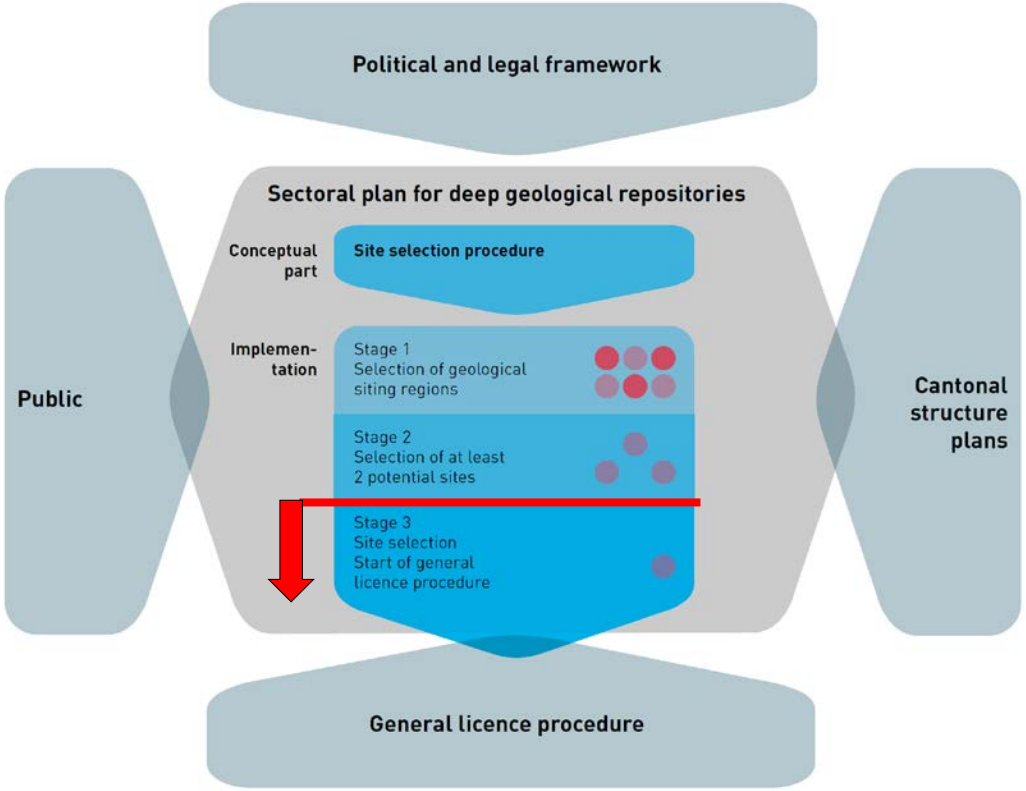
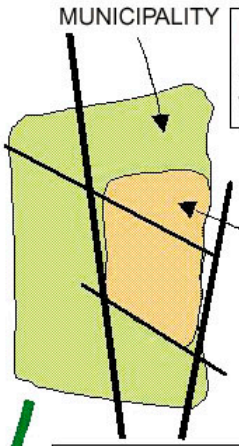
Radioactive Waste Management

Sectoral Plan – 3 stages towards site selection



Stage 1	2008 - 2011
Stage 2	2012 - 2018
Stage 3	~ 6 years

INITIAL SITE INVESTIGATION



PURPOSE

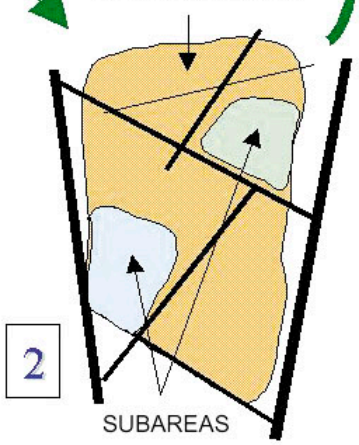
Select priority site within candidate area.

RESULTS

- Homogenous rock area of 5–10 km^2 selected as priority site.
- Description of surface ecosystems and fundamental geoscientific conditions.

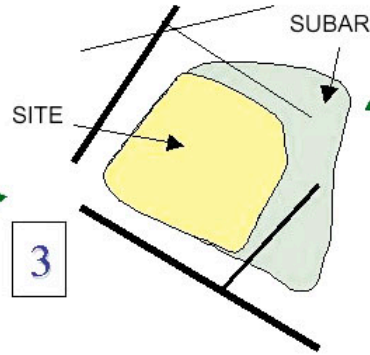
PREREQUISITE

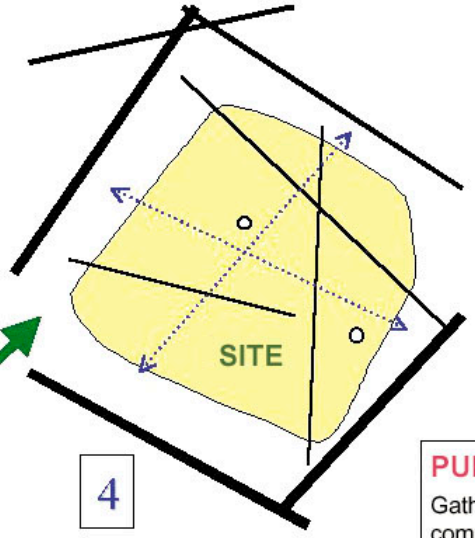
Candidate area of up to 200 km^2 has been selected on the basis of feasibility study.



SCOPE

- Regional area.
- One or more subareas.
- General field investigations, mainly:
  - airborne geophysics and ground geophysics
  - geology and surface groundwaters, and
  - inventory of flora, fauna and cultural environments.
- Limited percussion drilling.
- Initiate long-term monitoring of near-surface groundwaters and ecosystems.
- General studies regarding the execution of a deep repository.





LEGEND

Interpreted lineaments and fracture zones of varying size

Seismic reflection measurement profile

Deep cored borehole

PURPOSE

Gather data for decision on complete site investigation.

SCOPE

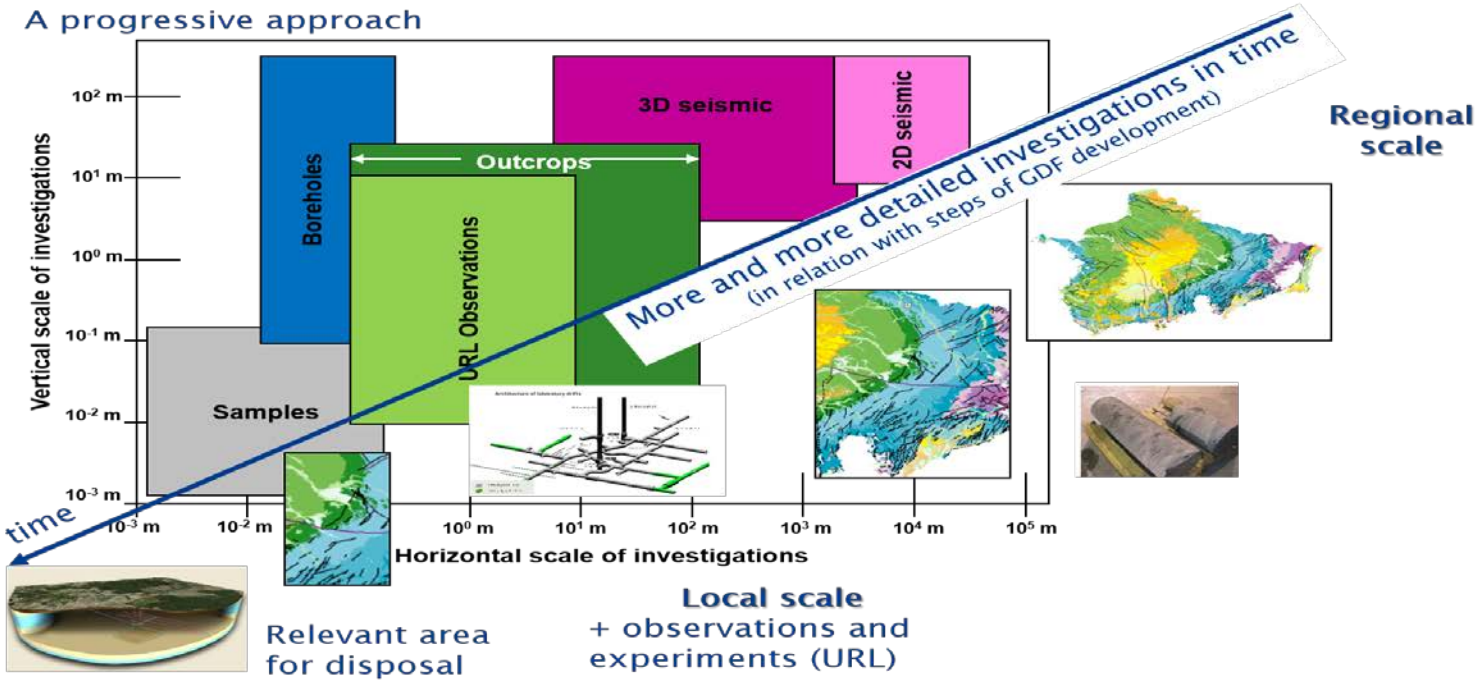
- Seismic reflection and VSP (downhole) for preliminary mapping of fracture zones and depth.
- 2–3 deep (~ 1000 m) cored borehole for checking essential conditions within groundwater chemistry (dissolved oxygen, salinity), rock mechanics (stresses, strength), geology and hydrogeology.
- Initiate long-term monitoring of seismic movements and deep groundwater.
- Establish initial site-adapted layout and analyze feasibility.
- Safety assessments based on requirements and criteria and compare with SR 97.

RESULTS

- Preliminary site description (based on in-depth information as well).
- Preliminary facility description.
- Preliminary safety judgement.

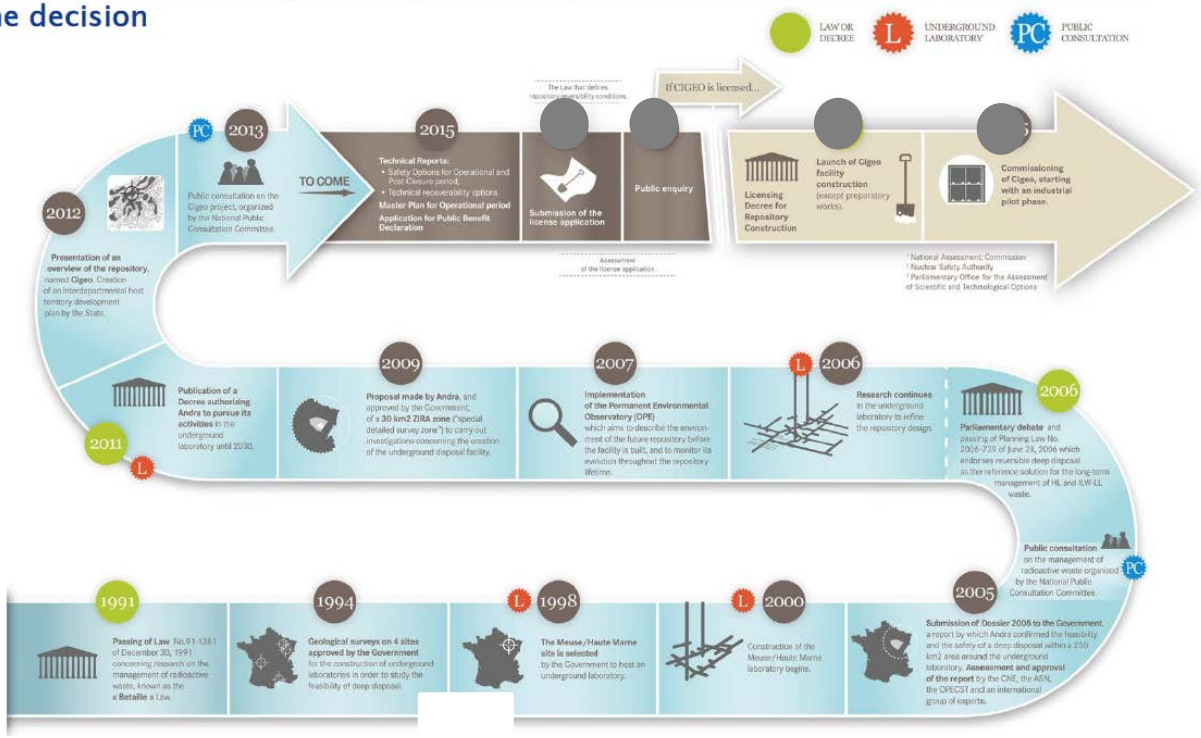
Geoscience in Siting Process

Geosciences in Siting process
From regional to local scale for investigations



From 1991 to now…
Global overview

At each step of siting process, **geosciences** had, have and will have a **large role in the decision**



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Summary of working group contributions

Site characterisation topics

- Bring together in a more comprehensive way the lessons learned from site investigations for construction (e.g. ramp and shaft construction) and accompanying monitoring (e.g. Andra, SKB).
- Requirement driven approach from safety case versus geology - based approach. The question is what a program needs to know and when: what justifies the decision?
- Strategy of limited extensive deep boreholes (e.g. Nagra) vs. multiple boreholes with limited objectives (e.g. Andra)

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Summary of working group contributions

Timing questions of programme elements for site selection

- At which stage the inventory has to be defined?
- How does the inventory affect the footprint of the facility? -> Andra?!
- At which stage waste package needs to be defined?
- At which stage the decision of the location of the site specific URL needs to be defined?

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Some questions in an early-stage site characterisation programme

At which stage the **inventory** has to be primarily defined?

- decision on the back-end strategy of the fuel cycle influences the heat production and volume of the waste, footprint of the facility

At which stage **type of waste packages** has to be basically specified?

- influences the size of the shafts and tunnels, excavation and support methods, facility layout, disposal equipment etc.

At which stage decision has to be taken about the **location of an URL**? What are the most relevant considerations?

- complexity of the geology, transposition of information from URL to DGR
- influences the facility layout, methods of closure and seals etc.

Experiences and lessons learned in advanced programmes would help for planning of further RD&D activities including site characterisation in an early-stage programme

Summary of working group contributions

RD&D topics

- Research for offshore scenario development (RWM initiative)
- Use of the URL's in foreign countries to gain experience (e.g. Andra experience / Mt. Terri)
- How do we identify what is new in site investigations?
- Do we need to do more on driving technological development for siting?

- **Statement from Peter: Site investigation is not research!**

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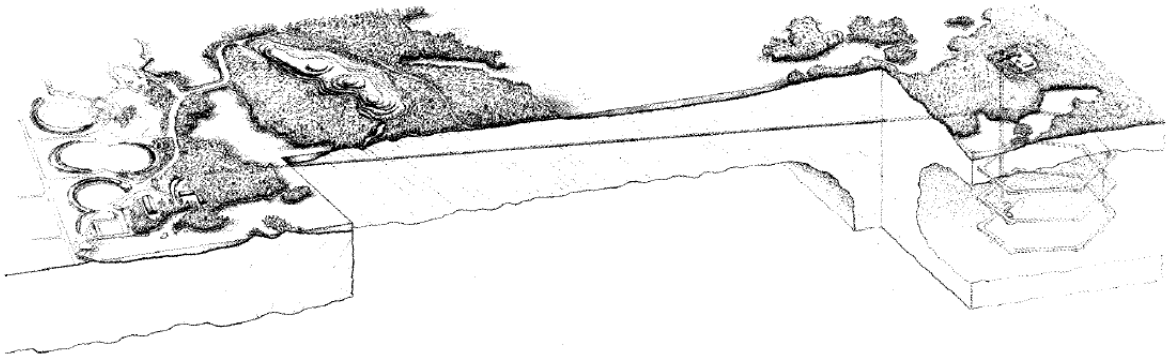
Stripa Mine Project 1977-1992

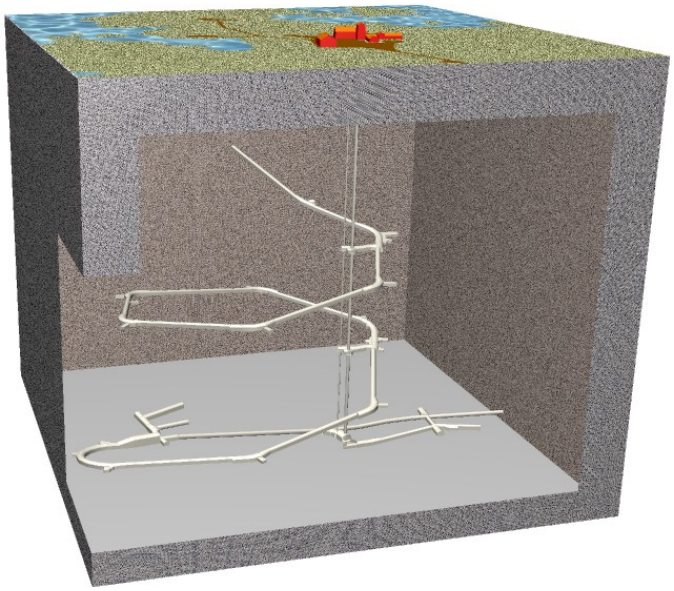
- Development of **characterization techniques and integrated characterization and modeling** of site data
- Fracture flow and transport modeling
- Basis for understanding of channeling and its importance for radionuclide transport
- Basic designs of engineered barriers (buffer, backfill and plugs) and basic understanding of their performance
- Successful international cooperation
  - Initiation of **Task Force on groundwater flow and transport**
  - Initiation of Task Force on Sealing materials and techniques
  - Knowledge transfer
- **Experience** essential **for later work at Äspö HRL** and other underground laboratories

Äspö Hard Rock Laboratory 1986-

The purpose of Äspö HRL

- Provide input to performance assessments
  - **in situ data from a previously non-disturbed rock mass**
  - process understanding
  - assessment of model validity
- **Develop, test and evaluate methods for investigation**, repository construction and waste emplacement
- Provide experience and training of staff





Summary of working group contributions

Management topics

- Practicalities how safety case and site description is linked.
- Establishment of the appropriate workflows.
- How to ensure data management?
- Keeping data accessible for decades?
- Permanent re-evaluation of own approaches – build-up of a learning organization actively and working physically together.

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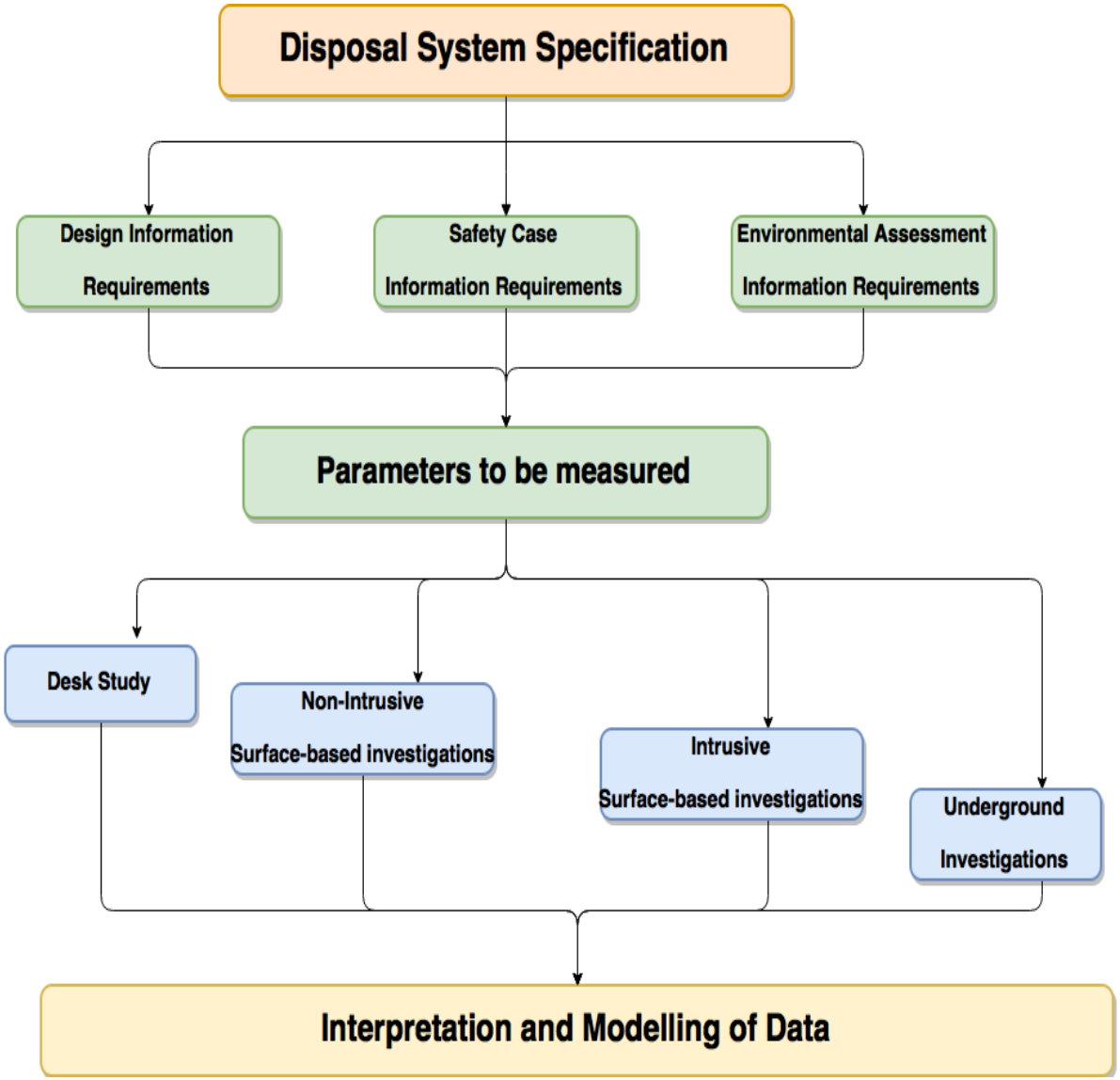


Radioactive Waste Management

Exploration boreholes – organisation, planning, tendering

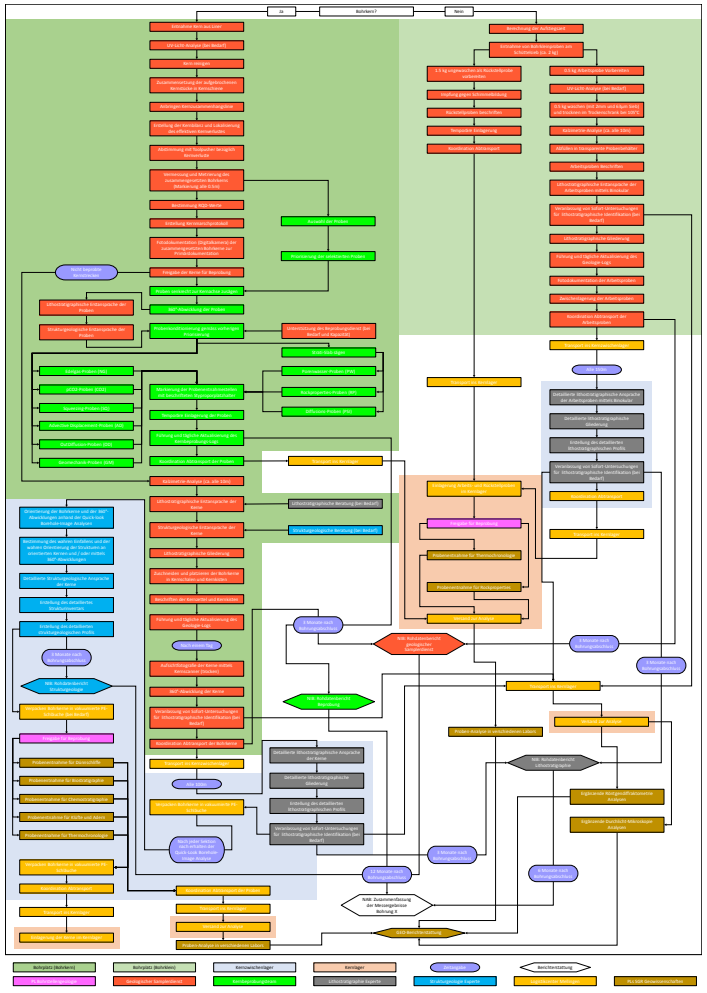
- Tendering of different work packages (not general contractor):
  - Drilling company
  - Logging services
  - Hydraulic Testing
  - On-site geological investigations (multiple work packages)
  - ….
- Drilling at 2 sites in parallel

- Management of each work package remains by Nagra
- Detailed planning as basis for tender a requirement
- Optimisation of the interaction of the individual teams critical (time, resources)

Borehole on-site geological investigations

Activities, flow diagram and interactions

Background colors indicate the different teams involved



Conclusion : Feed-back and lessons learnt

A progressive and converging stepwise approach for siting:

- *First step*, Geo-scientific arguments based on « qualitative » criteria (from safety guidance)
  - Geological stability, no fault, « good » hydrogeology », confinement, …

- *Following steps*, definition of geoscientific arguments based on « quantitative » criteria, derived from **geological investigations and increase of scientific knowledge** (Surveys, URL, numerical simulation)
  - Depth, thickness, head gradient, … mainly linked to long-term safety
    - ↳ More and more detailed and suitable area (from regional to local scale)

At each step of siting (about each 4 years), long-term safety assessment is carried out to check global safety

- Checking consistency between {science/safety/design}
  - Quantitative geoscientific arguments plays a major role,

However the characterisation programmes have to take into account local acceptance, local and national administrative requirements…

Conclusion : R&D activities … some thoughts

Horizontal activities

- **Networking (some example)**
  - An efficient way to learn is to visit the other sites and meet the people that operated the characterisation programmes
- **Knowledge transfer**

Technical improvements

- Drilling technical progresses (mud, tools, logging probes…)
  - Mont Terri DF experiment
- Survey technics, sampling and conditioning methods (QA procedures)
- Development of completions
  - Taking into account all the developments made in URL (Mont Terri, Bure and other…)
  - New transducers and new acquisition chains (Modern 2020)

Conclusions and suggested way forward

- Knowledge transfer --> first, the requirements need to be refined by those planning to use the knowledge.
- Possible options are:
  - Secondments: Go and learn
  - Workshop
  - Expert network creation
  - Web-based activities: webinar, platform discussion, Whatsapp groups

- **Recommended as a topic taken up by the EURAD knowledge management activities.**

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