SKB's RD&D priorities in the pre-construction and construction phases

IGD-TP Exchange Forum – Prague 2025

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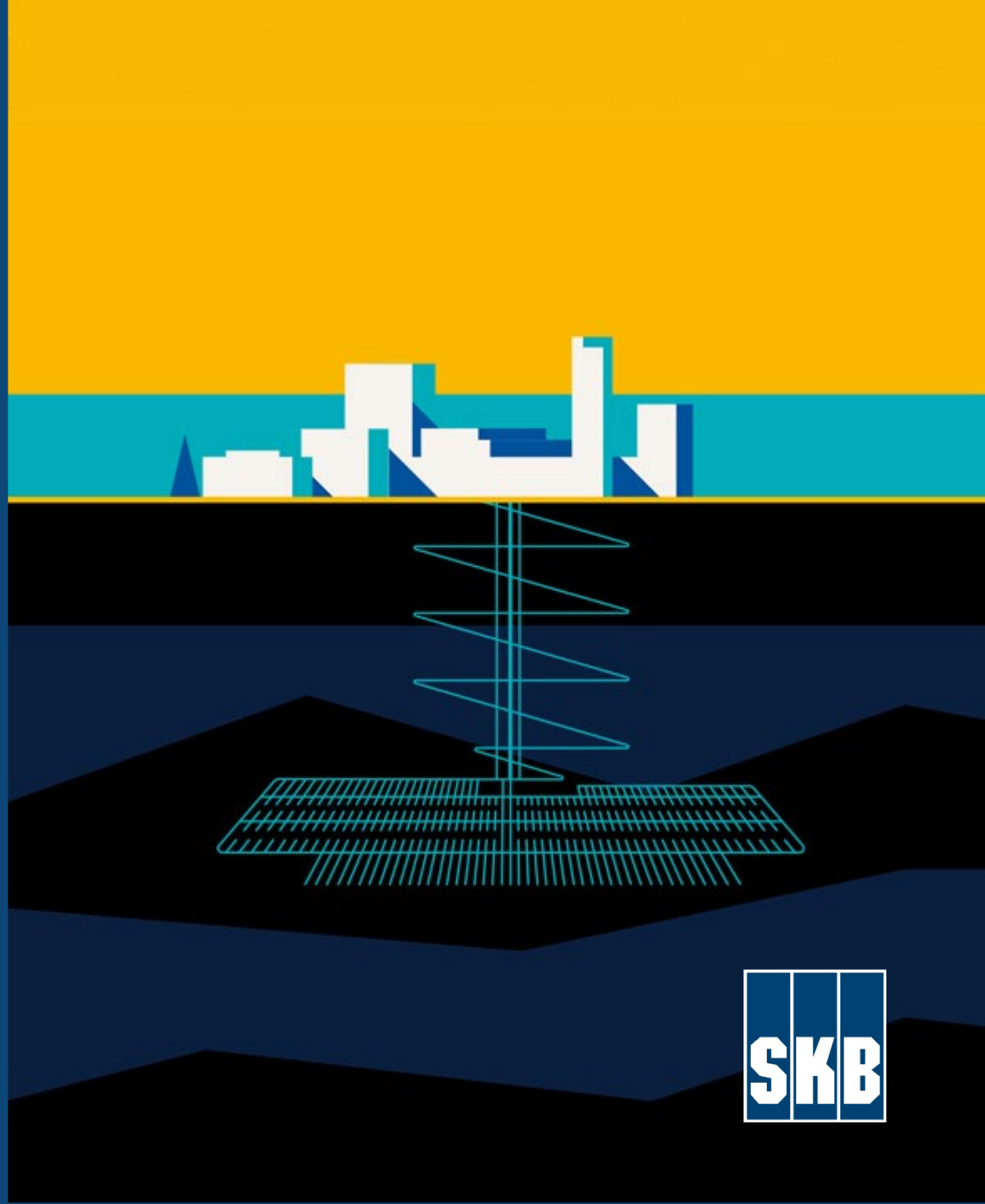

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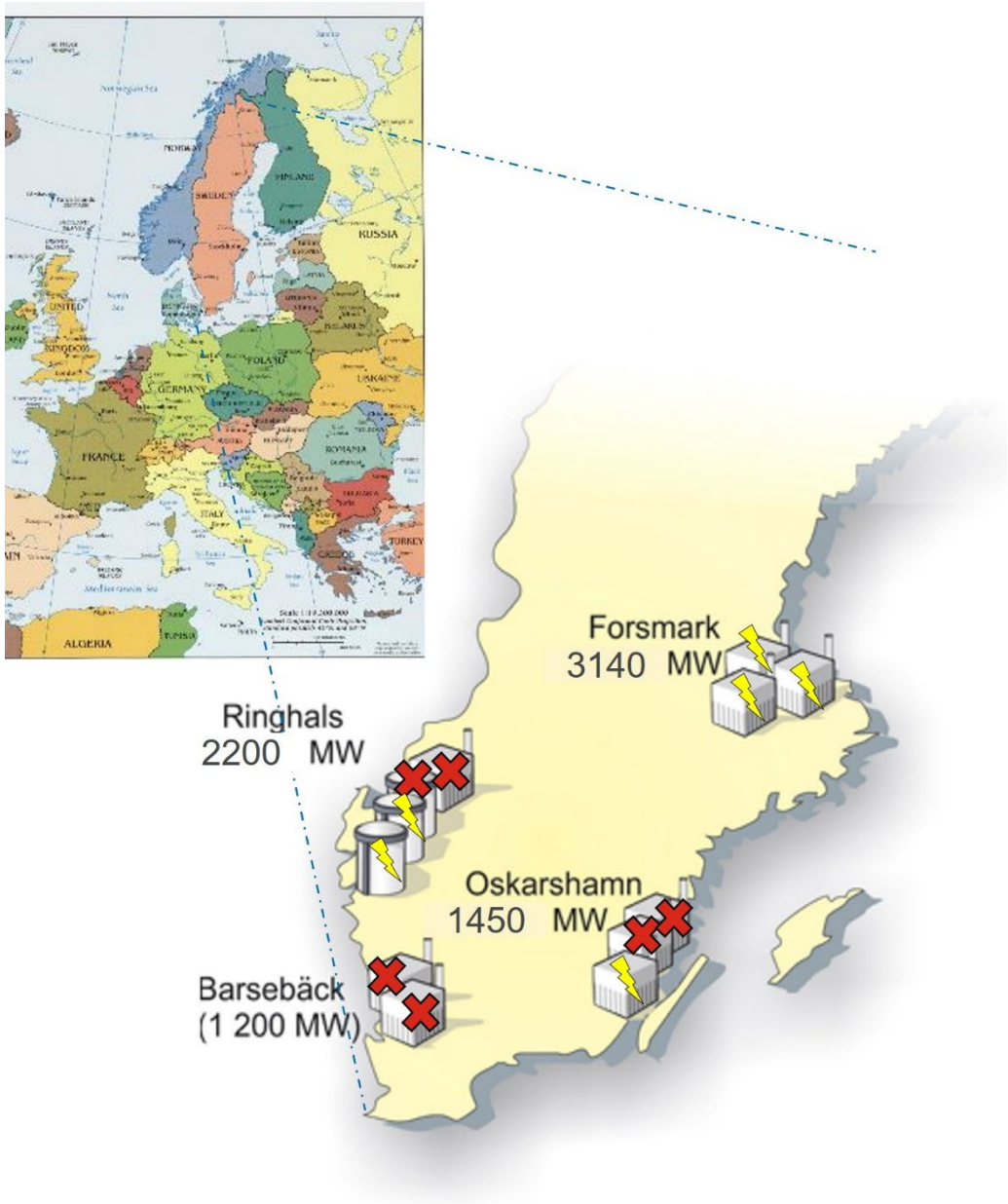
Nuclear power in Sweden – the basis for SKB's programme

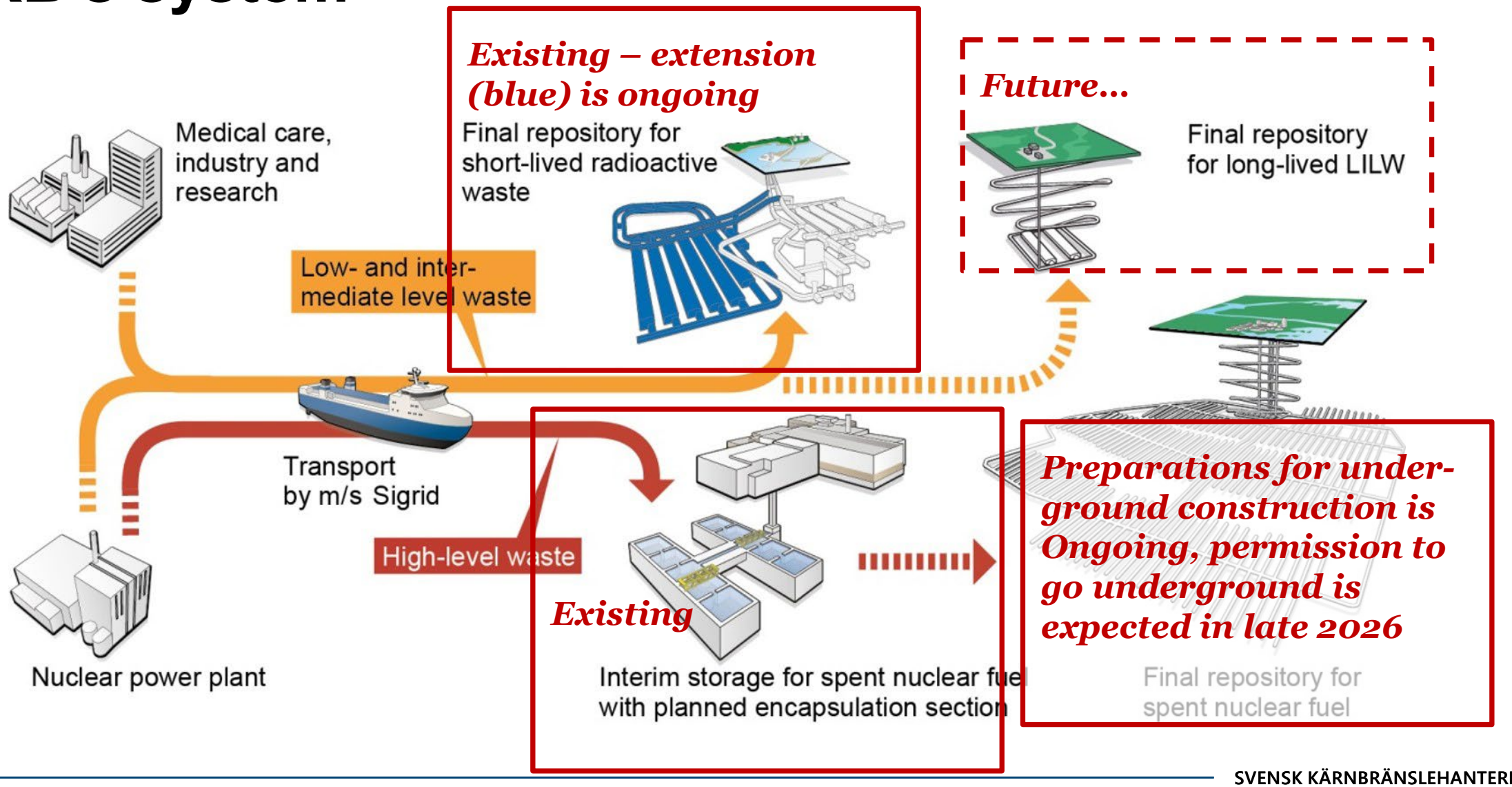
Power generation from nuclear today: 7 GWe, ~ 40 % of Sweden's electricity demand

SKB's facilities shall accommodate waste and spent fuel from the current nuclear fuel program:

- 6 operating reactor units at 3 sites
- 6 shut down reactors undergoing decommissioning
- Operation started between 1972 and 1985
- Remaining 6 reactors will operate until mid 2040's (60 years of planned operation)



SKB's system


Existing – extension (blue) is ongoing
Final repository for short-lived radioactive waste
Future…
Final repository for long-lived LILW
Medical care, industry and research
Low- and inter-mediate level waste
Transport by m/s Sigrid
High-level waste
Nuclear power plant
Existing
Interim storage for spent nuclear fuel with planned encapsulation section
Preparations for under-ground construction is Ongoing, permission to go underground is expected in late 2026
Final repository for spent nuclear fuel

Status of the RD&D programme

The goal for SKB's RD&D programme

Research

The goal is to provide the knowledge needed to assess post-closure safety

and

To give a design basis for continued development and optimisation of the technical solutions and the safe operation of disposal facilities

Development and demonstration

The goal is *firstly* to develop a reference configuration for the repository design and production,

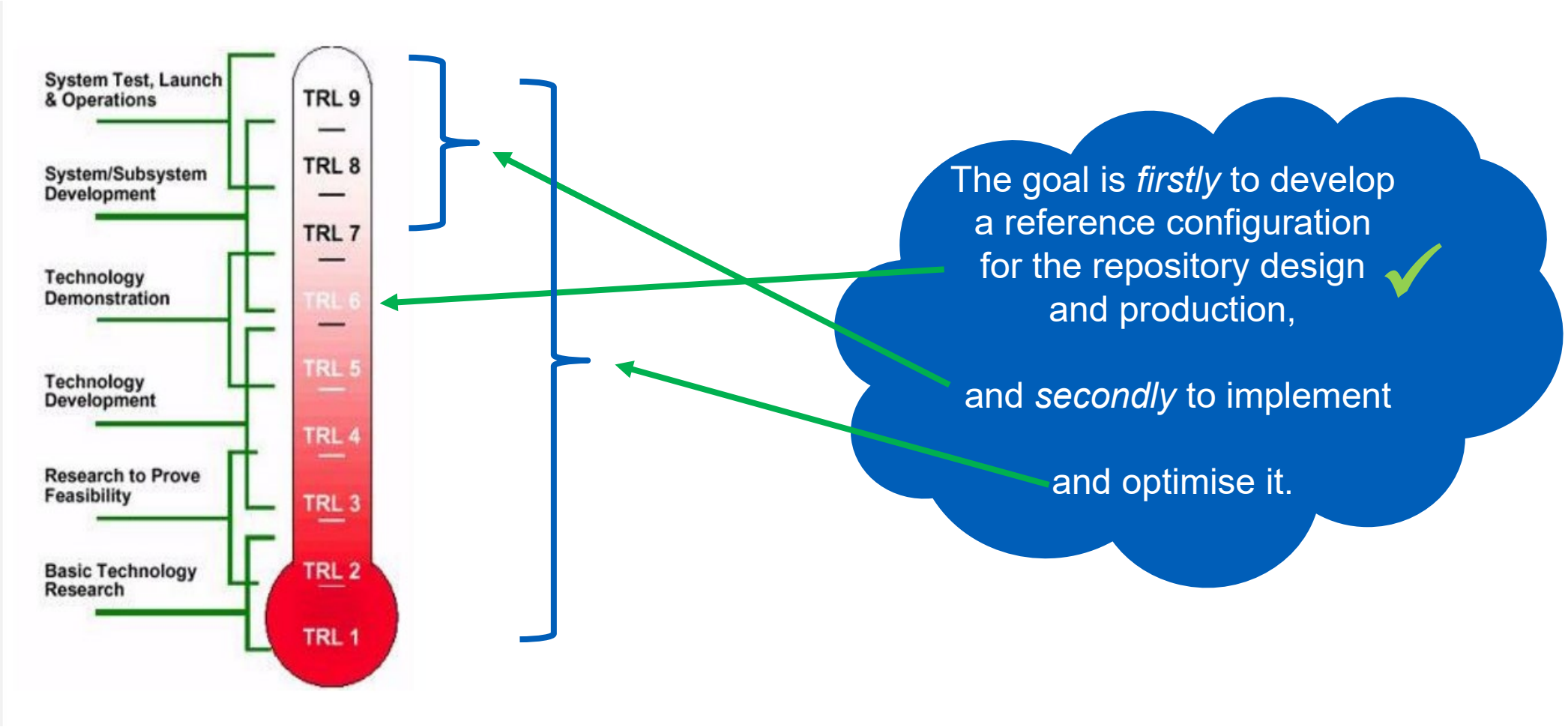
and *secondly* to implement and optimise it.

RD&D Programme status

Research programme status:

SKB has already the knowledge and understanding of the site to assess post closure safety. Also a reference design of the repository facilities exists. The remaining research is aimed at minimizing uncertainties and choosing the best method for an efficient safety assessment. There are no ”show stoppers” left.

Development and demonstration

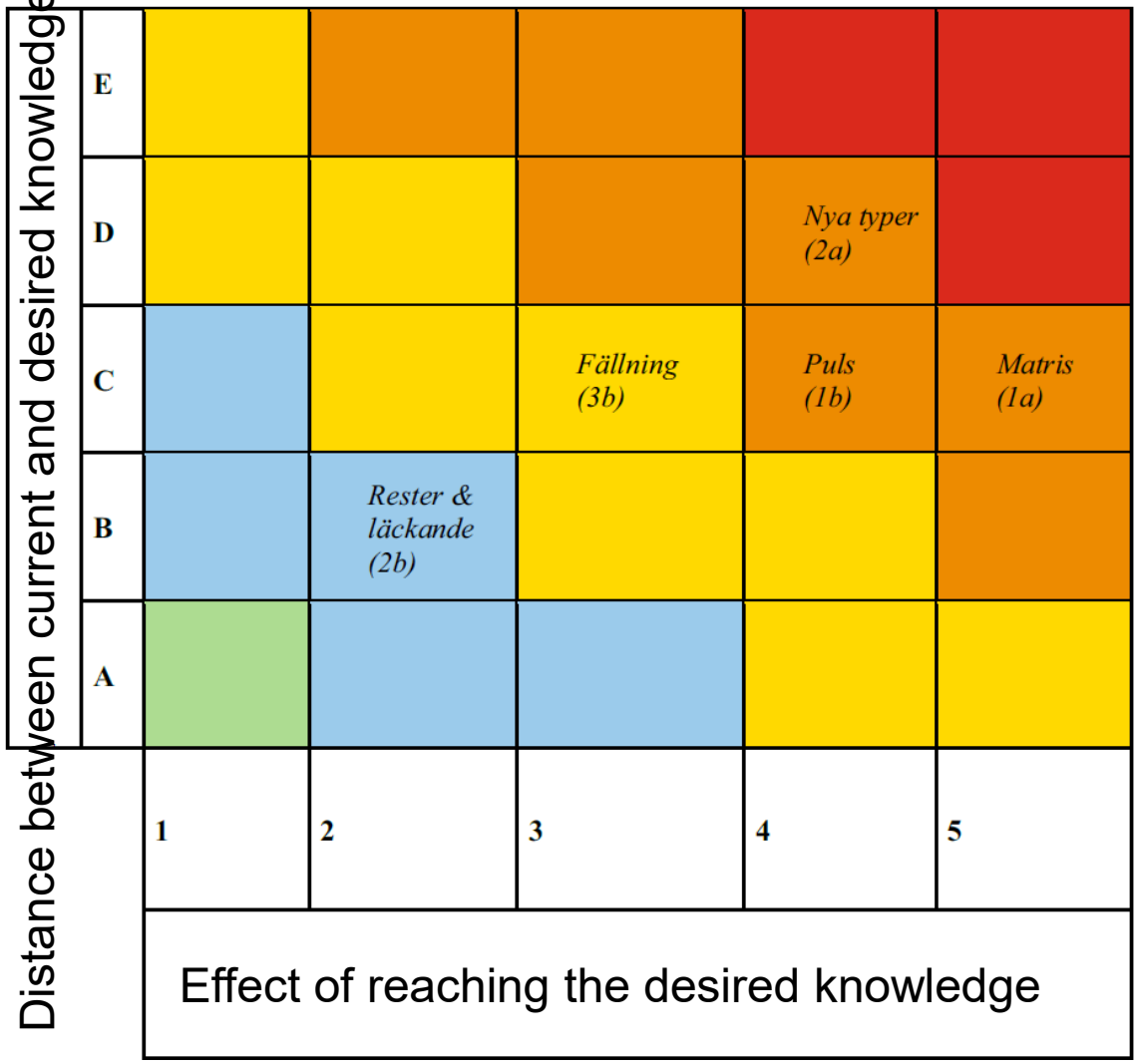


Current RD&D priorities

Prioritized topics in the research programme

Ongoing research priorities of SKB: The ones we need for the upcoming safety analysis projects – implementation of the knowledge gained since the last safety analysis reports for SFK and SFR.

- Fuel matrix dissolution modelling
- Bitumen swelling in contact with water
- Stress corrosion cracking of copper in the presence of sulfide
- Sulfide formation and sulfide transport in bentonite
- Colloid formation/erosion model development
- Chemical processes in concrete
- Project “Joint design basis”, collaboration with Posiva. Documentation of the background and justification of requirements from post-closure safety.

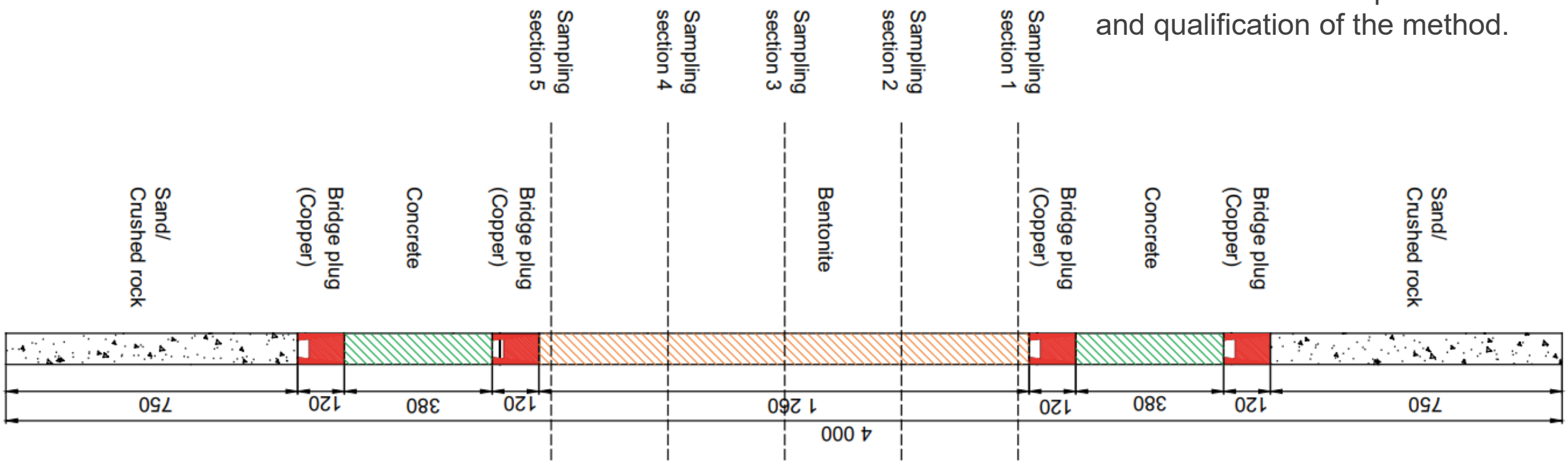


Ongoing development priorities

Implementation incl. optimisation:
Borehole closure – to be used in 2026

The method was developed to TRL6 in 2018 (see figure). Recent development has involved

- Simplification of the design (fewer components: no concrete)
- Simplification of installation process (optimising the copper expander component)
- Documentation of requirements and qualification of the method.



Ongoing development priorities

Optimisation:

New design of the canister insert (next slide)

- Advanced project, decision-making documentation being prepared.

Granular backfilling

- Safety assessment and other assessment completed. Specification of design and methods for manufacturing, etc. remains.
- Backfilling - largest now existing difference between Posiva's and SKB's concept.

Changed manufacturing of copper tubes (longitudinal welding of pipe halves)

- Wider supplier base for the components (copper plates)
- Joint development project with Posiva, recently started

New canister insert – Design

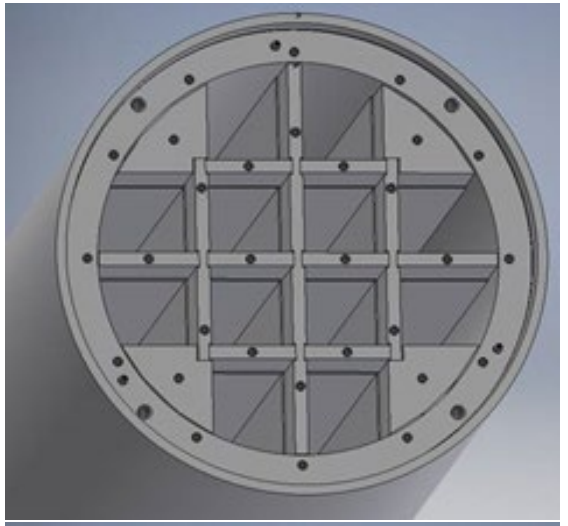
A robust, simple and cost-efficient insert design

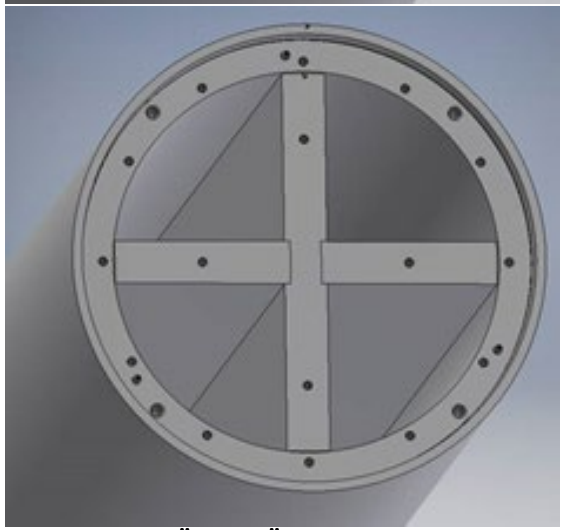
The design is based on the requirements with respect to the isostatic loads and fuel characteristics

- An outer shell – Steel tube, steel base and lid: Primary load-bearing function
- An internal independent framework – Steel plates: Prevent criticality and contribute to mechanical strength

Proven material – Manufacturing according to harmonised product standards

- Steel tube – P355NH
- Steel lid/base – P355GH+N
- Framework – S355J2+N





New canister insert – Demonstration

Verification of design

Post-closure safety report TR-25-05

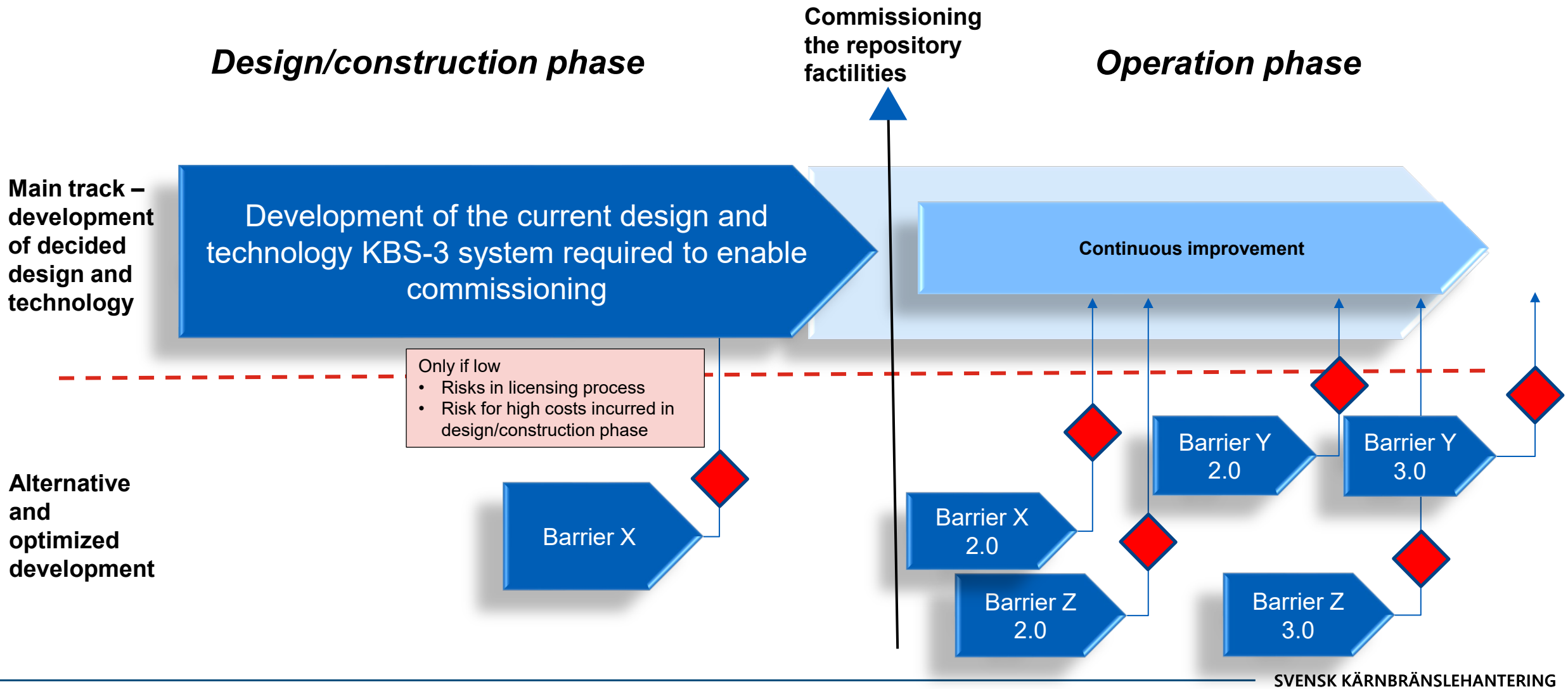
- Radiation effects
- Thermal and hydrological effects
- Radiolysis
- SCC, embrittlement, ageing
- Criticality
- Mechanical loads – Design analysis
  - Isostatic loads
  - Shear loads
  - Asymmetric loads
  - Probabilistic analysis of isostatic loads
  - Isostatic pressure test BWR+PWR

Demonstration of manufacturing

- Manufacturing of 12 steel tubes
  - Extensive testing
  - Statistic capability analysis
- Insert manufacturing in full-scale
  - 3 BWR + 3 PWR inserts

Outlook

Prioritizing changes and optimizations



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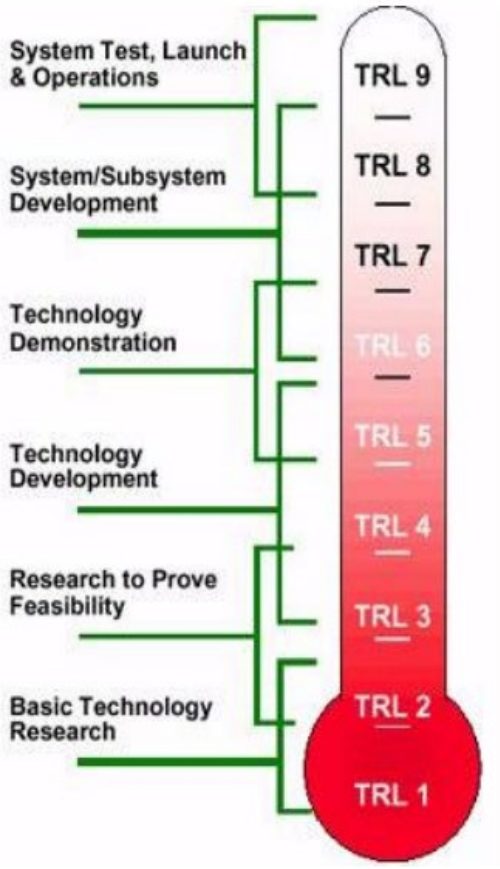
EXTRA MATERIAL

SKBs implementation of the TRL scale



TRL	Development phase	Main question
9	**Operation**	Has the construction and test operation been carried out according to requirements and expectations?
8	**Validation period**	Are the production and measurement processes qualified for construction and operation?
7	**Technology realization**	Are the methods/systems integrated and accepted on site? (Site Acceptance Test)
6	**Reference design**	Has the concept solution been evaluated sufficiently well in a realistic environment and at full scale?
5	**Demonstrated technical feasibility**	Has the concept solution been evaluated in a relevant environment and adapted scale?
4	**Acceptable analysis and simulation**	Have early concepts of individual components been simulated or tested in a laboratory environment?
3	**Specification of requirements and functionality**	Has the concept been investigated in a simulated environment (e.g. early safety evaluation) or in a laboratory environment?
2	**Concept proposal**	Have design concepts (or process concepts and equipment needs) been identified?
1	**Preparation of idea**	Have basic functional needs and possible technical solutions been identified?