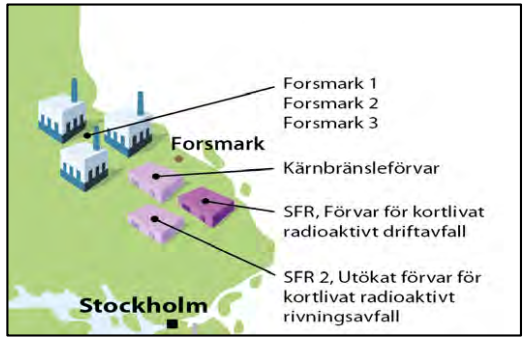

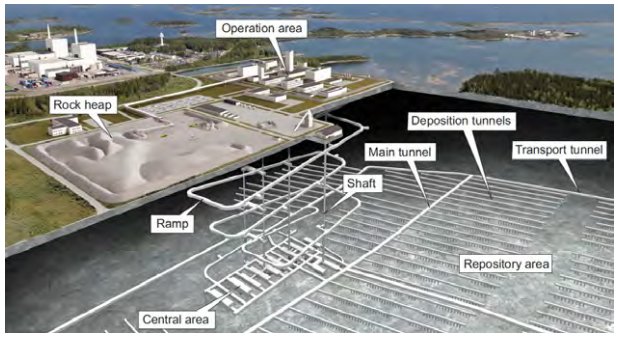

Nuclear Waste
A Problem that stays

INFORSE seminar, December 17, 2025

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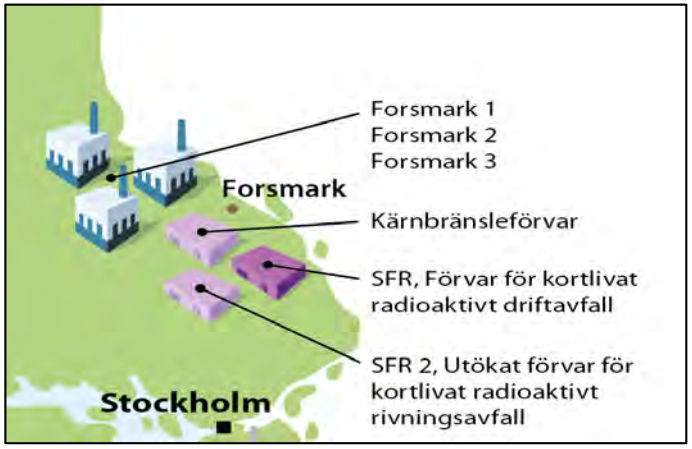
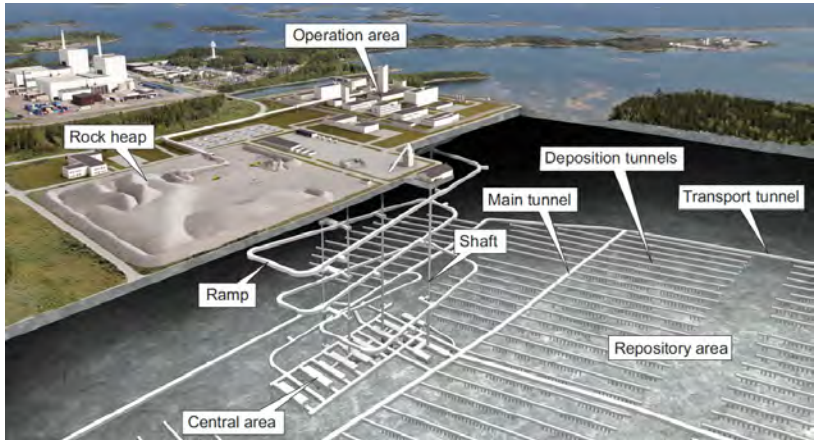
More information and Proceedings at https://inforse.org/europe/nuclear.htm

Content

- Reflections based on:
  - Nuclear power and nuclear waste in the World
  - The Swedish (and Finnish) case
  - The alternative very deep borehole disposal

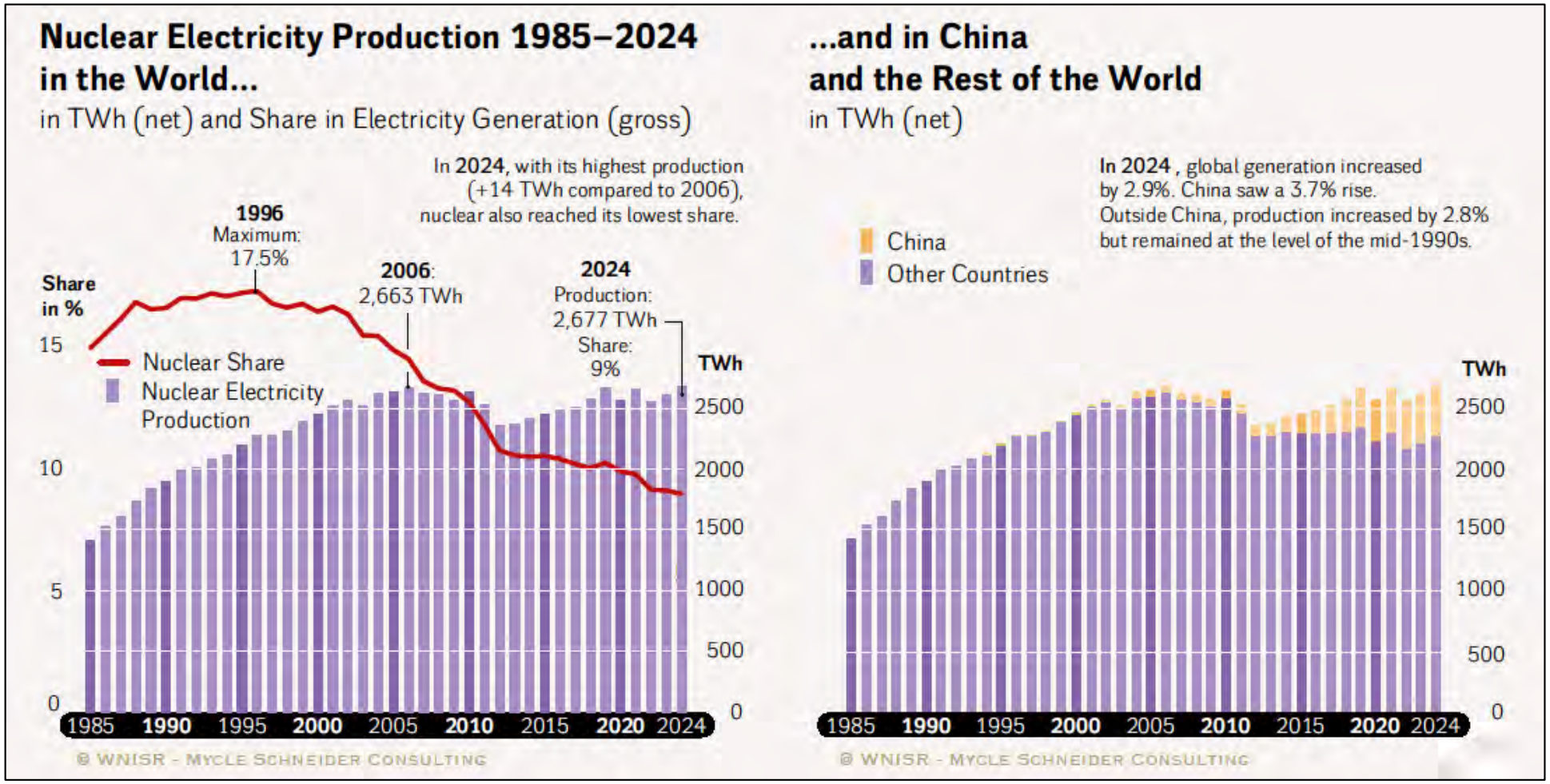


Source: MKG



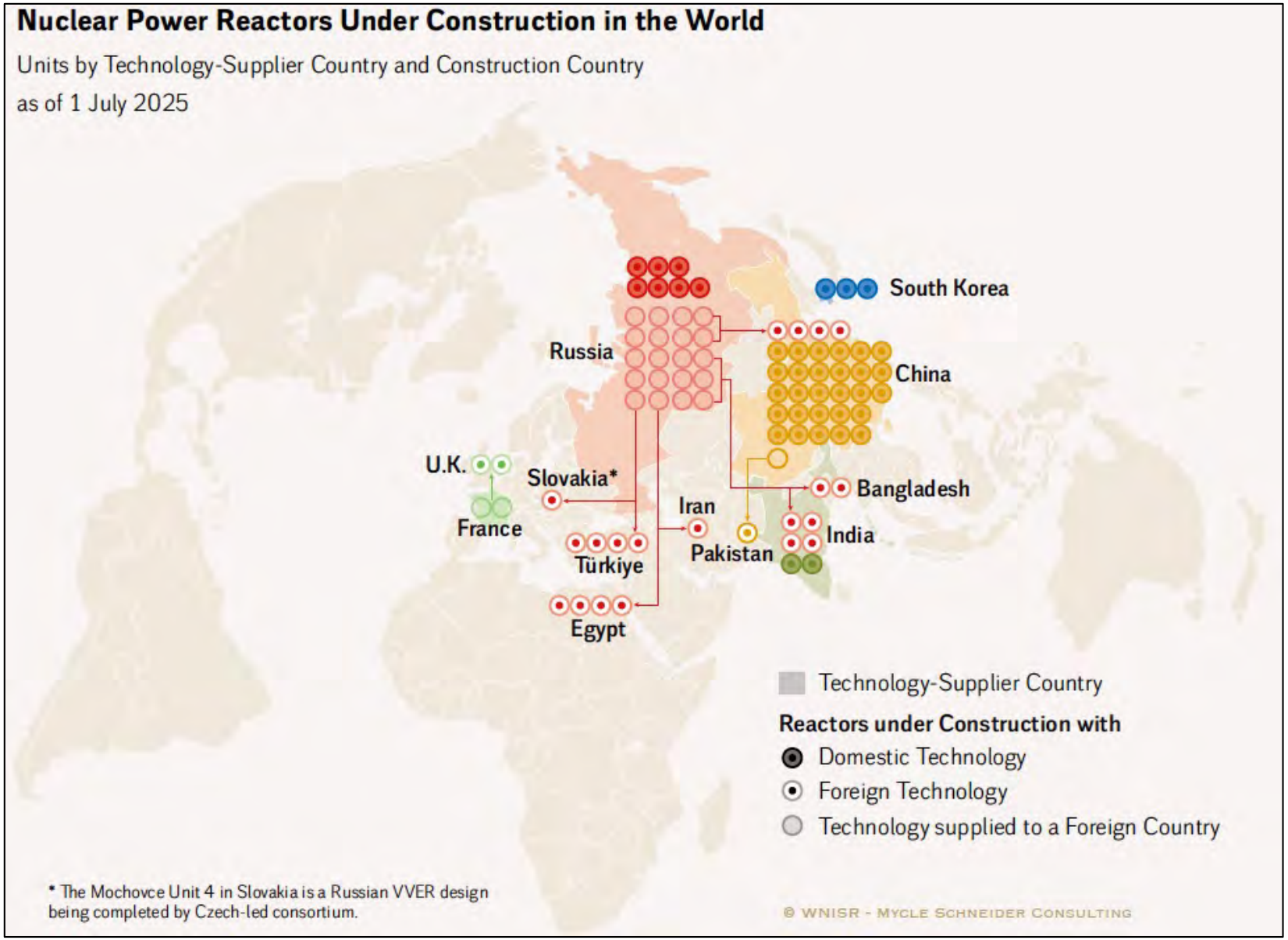
Source: SKB

Nuclear Power in The World (1)



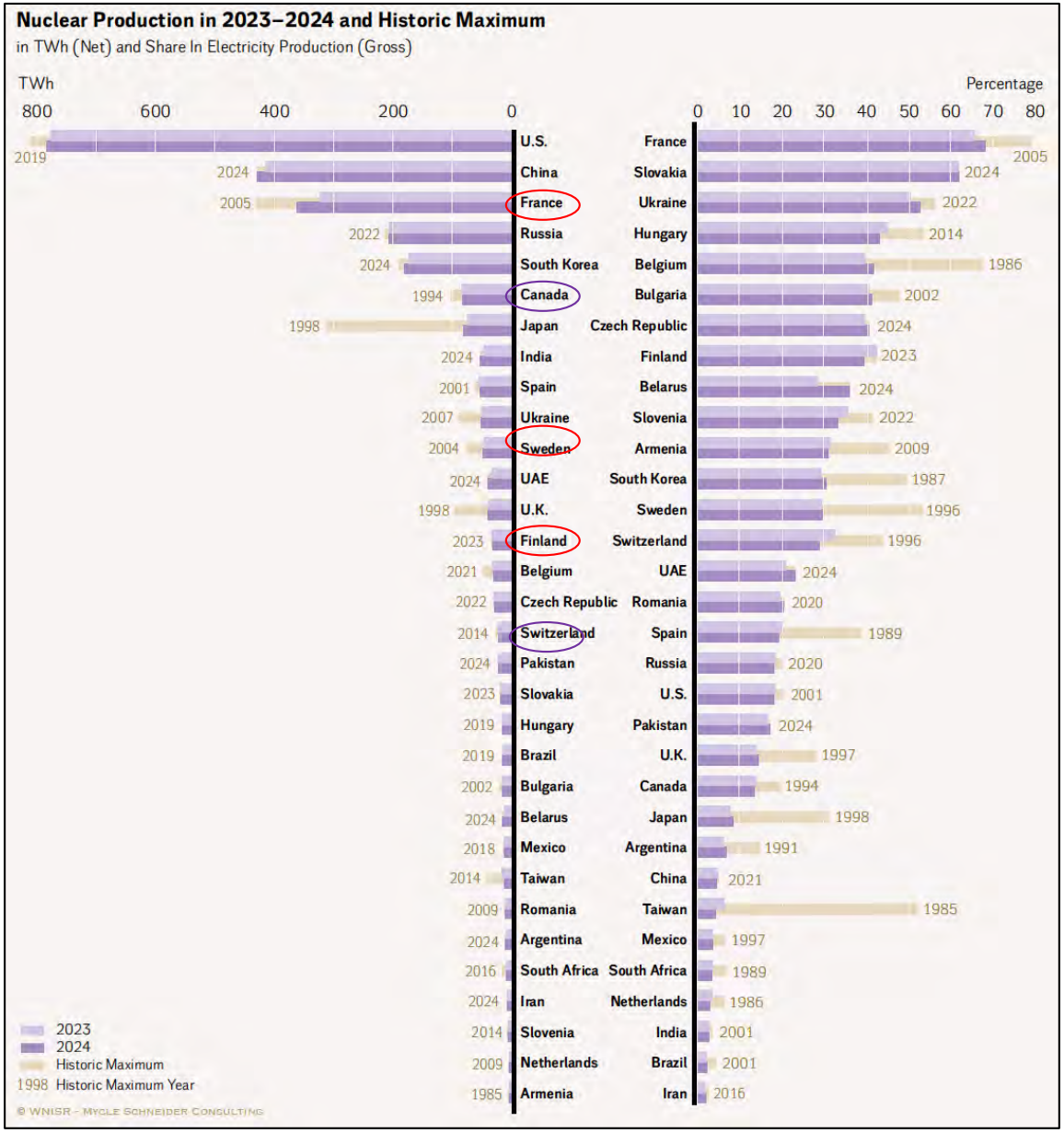
Source: World Nuclear Industry Status Report https://www.worldnuclearreport.org

Nuclear Power in the World (2)



Source: World Nuclear Industry Status Report https://www.worldnuclearreport.org

Nuclear Power and Nuclear Waste in the World (1)

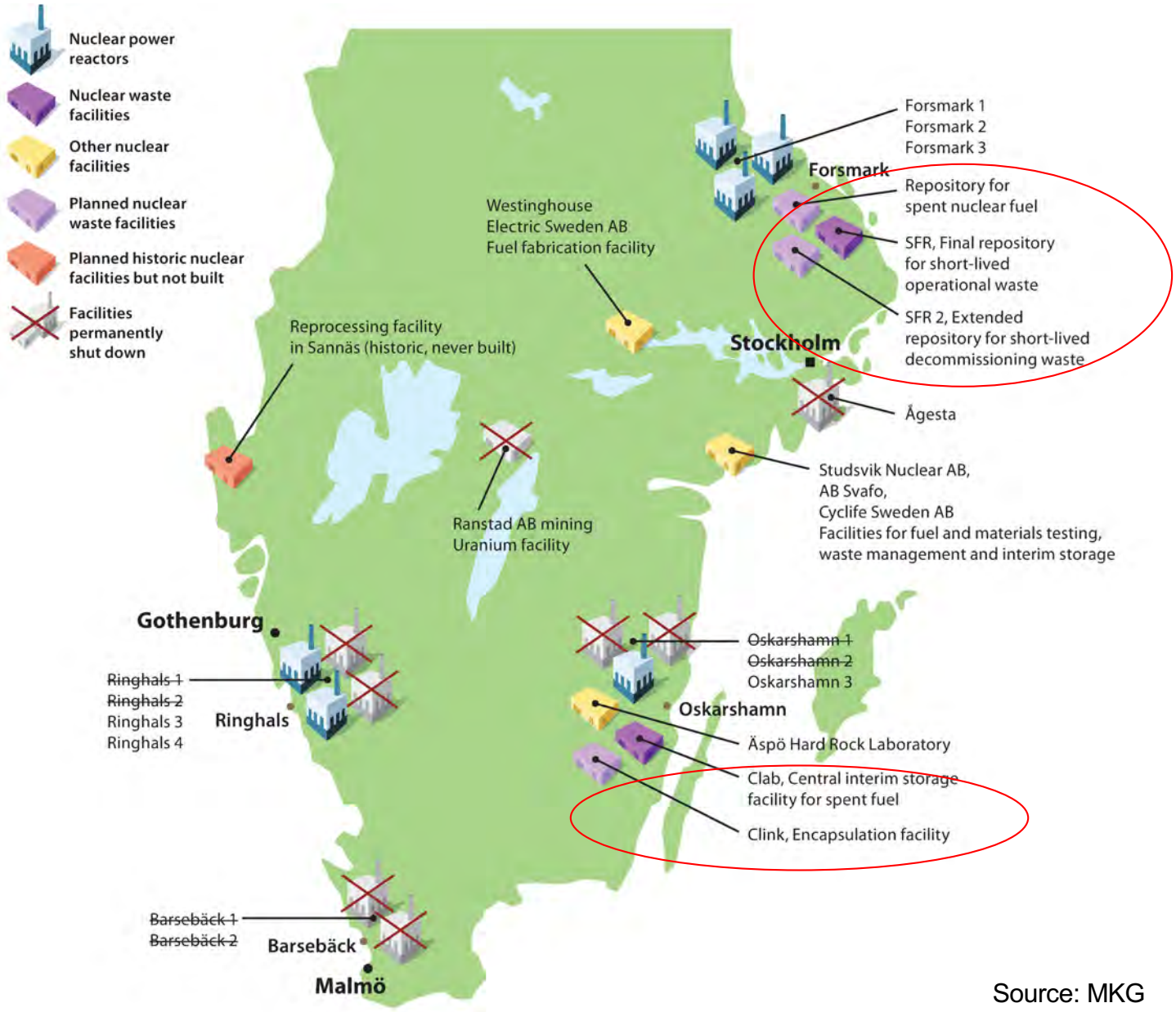


Source: World Nuclear Industry Status Report https://www.worldnuclearreport.org

Nuclear Power and Nuclear Waste in the World (2)

- 32 countries in the world have or have had nuclear power. A few new reactors are being built, but Russia is building reactors in three new countries. No (real) new small modular reactors (SMRs) are being built.
- A relatively large number of additional countries have only had nuclear power research that has left behind nuclear waste.
- Of all nuclear countries, most have very vague plans for how the high-level long-lived nuclear waste, usually spent nuclear fuel, will be disposed of. This is even though nuclear power has already been used for up to 75 years in some countries.
- Three countries in the world (France, Sweden, Finland) have gone so far as to select a site for a final repository for high-level long-lived nuclear waste/spent nuclear fuel and have submitted applications to build a repository. Two countries (Switzerland, Canada) have made site selections but are far from licensing.
- In two countries in the world, permission has been obtained to build a final repository for spent nuclear fuel in granite (Sweden, Finland).
- No country has received a permit to operate a repository for high-level long-lived nuclear waste/spent nuclear fuel, but Finland may soon be the first (summer of 2026?).

Nuclear Power and Nuclear Waste in Sweden



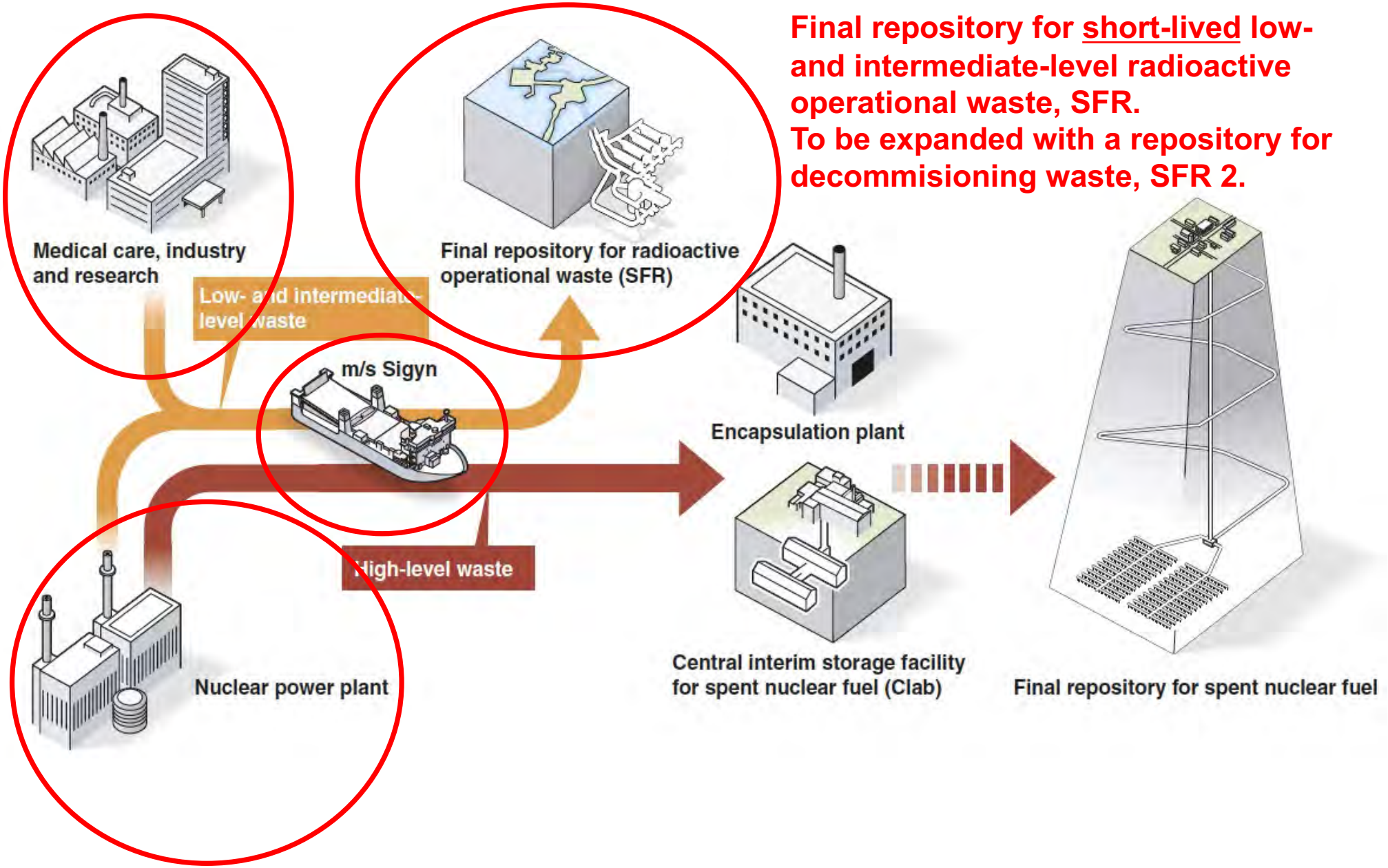
Source: MKG

Nuclear Waste in Sweden

- According to the legislation (Nuclear Activities Act), the nuclear power industry is responsible for finding long-term sustainable methods for the management and storage of Swedish nuclear waste.
- The Nuclear Waste Fund with a system of fees and securities has been established to guarantee the principle that the polluter (i.e. the industry) pays.
- The nuclear power industry has given responsibility for fulfilling the requirements of the legislation to the nuclear waste company Svensk Kärnbränslehantering AB, SKB.
- For 50 years, SKB has worked with only one method for long-term final disposal of spent nuclear fuel, the KBS method, where encapsulation in 5 cm copper, buffered by clay in granite rock is intended to guarantee long-term environmental safety for hundreds of thousands of years.
- Finland also intends to use this method and is closer in time than Sweden to starting to deposit copper canisters with spent nuclear fuel in a repository.
- [Canada is using the method but with a thin copper layer covering a steel canister. France and Switzerland plan repositories in clay with steel canisters.]

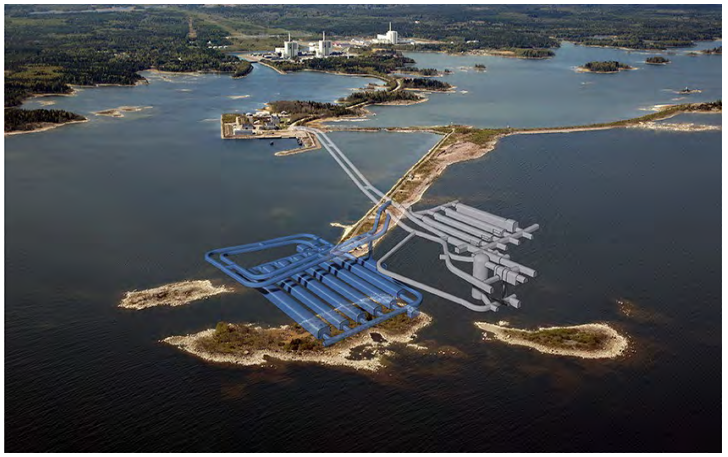
Final disposal of short-lived nuclear waste (1)

Final repository for short-lived low- and intermediate-level radioactive operational waste, SFR.
To be expanded with a repository for decommisioning waste, SFR 2.



Source: SKB

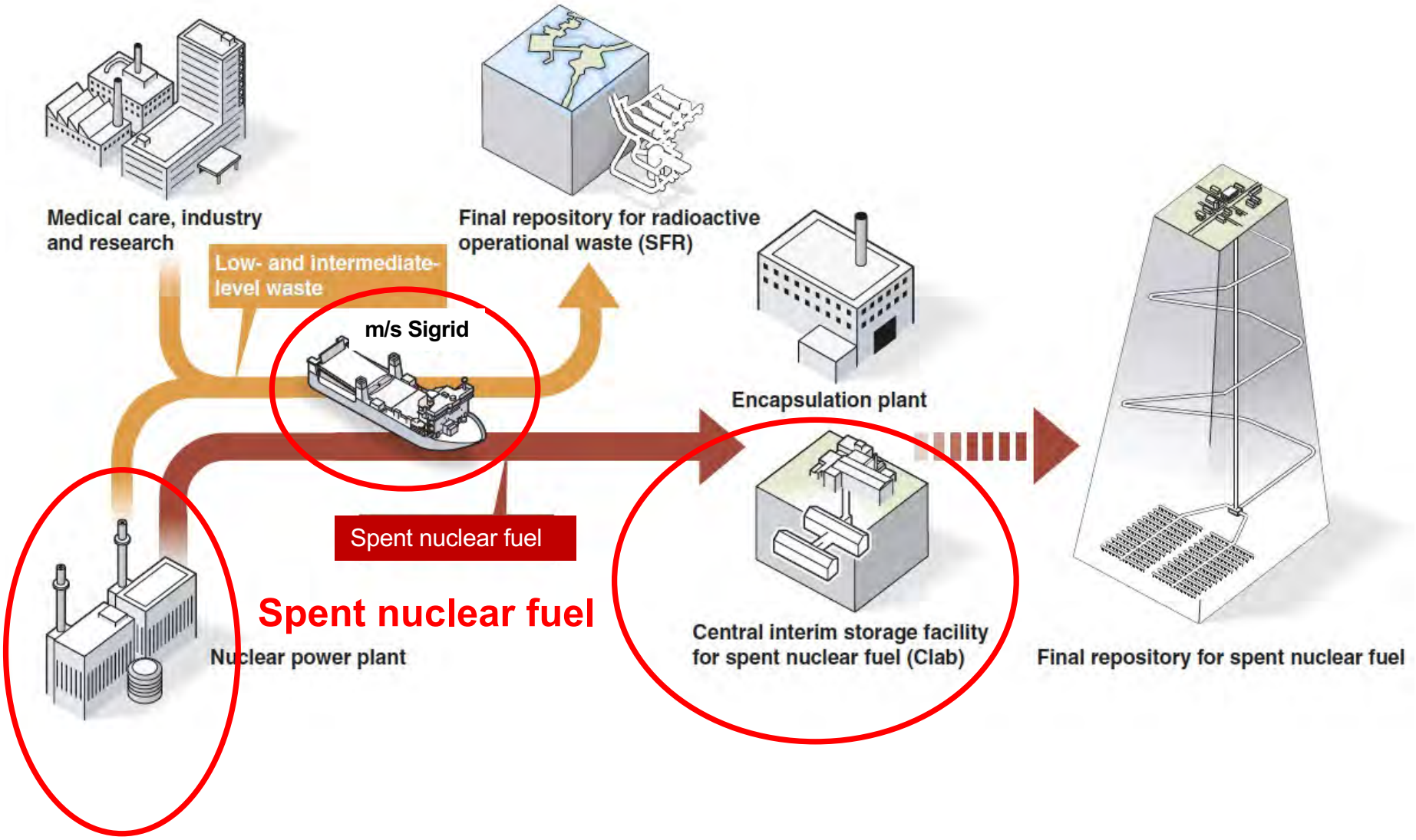
Final disposal of short-lived radioactive waste (2)



SFR – Final repository for short-lived low- and medium-level radioactive waste at the Forsmark nuclear power plant

Source: SKB

Interim storage of spent nuclear fuel (1)



Source: SKB

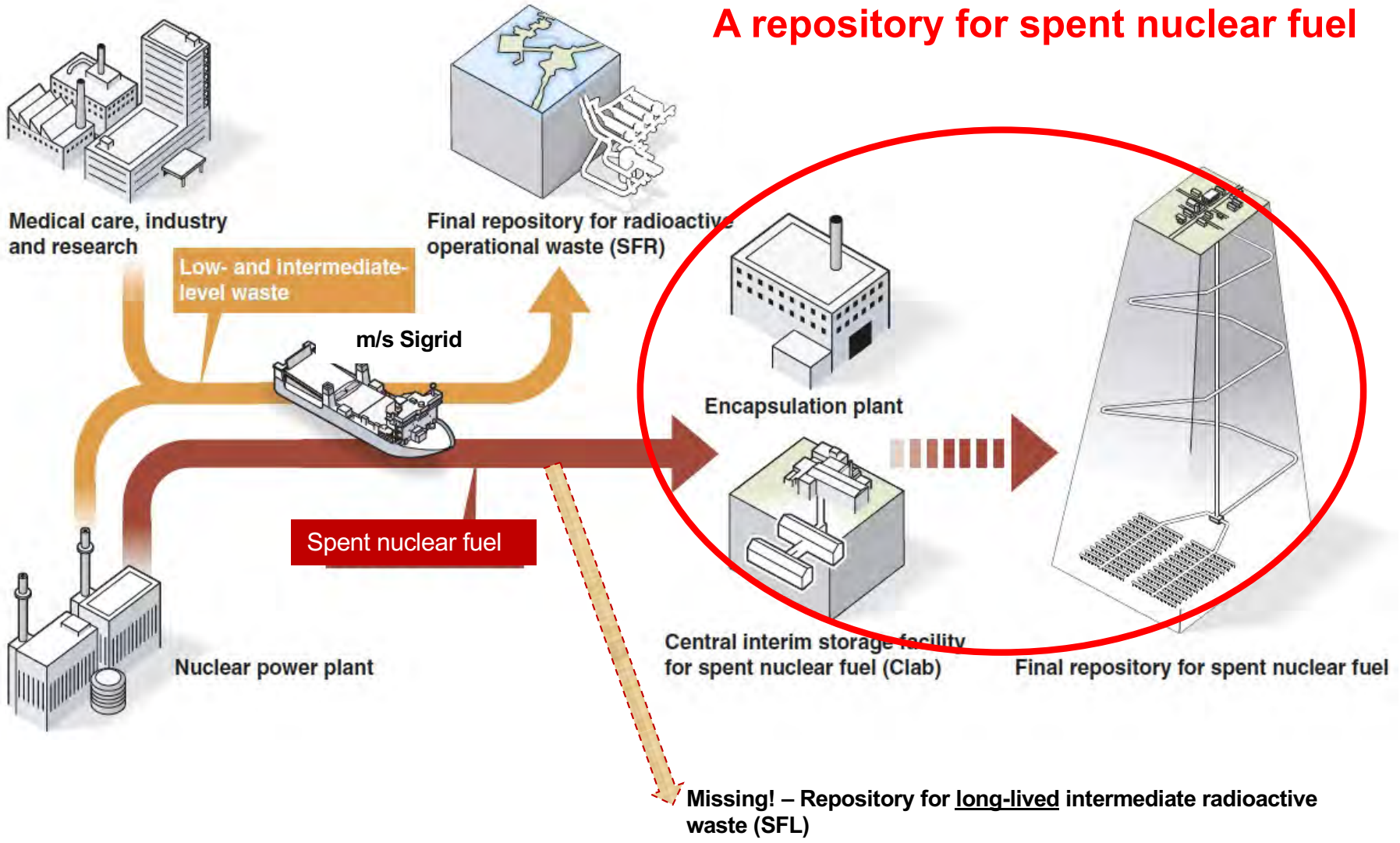
Interim storage of spent nuclear fuel (2)

Clab – Central interim storage of spent nuclear fuel at the Oskarshamn nuclear power plant

Source: SKB

Towards a repository for spent nuclear fuel (1)

Next step:
A repository for spent nuclear fuel



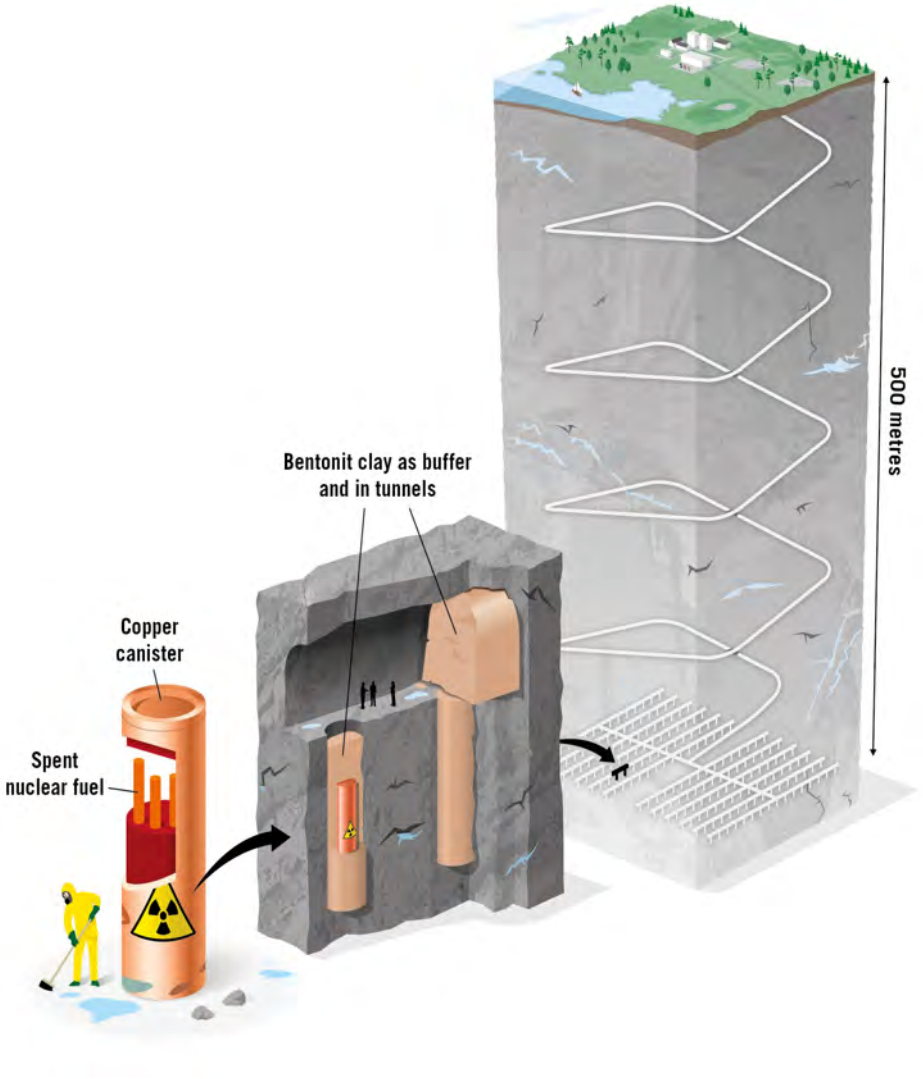
Source: SKB

Long-term environment and security concerns for a repository for spent nuclear fuel

- Risks from radioactive releases for hundreds of thousands of years
- Nuclear weapons proliferation and security risks: Problem for over a hundred thousand years (plutonium with a long half-life is in the final repository)
- Chemical environmental risks for all eternity

The KBS method for disposal of spent fuel

- The KBS method was developed in the mid-1970s.
- The concept is a repository for spent nuclear fuel at a depth of about 500 m in the Swedish bedrock.
- The long-term safety assessment is based on two artificial barriers – a 5 cm thick copper canister and a buffer of bentonite clay to protect the copper – to isolate the spent fuel for hundreds of thousands of years. There is also clay in the tunnels.
- Whether copper is a good choice as a canister material or not was already discussed in the 1980s. The issue resurfaced in 2007 and has been a controversy ever since.



Towards a repository for spent nuclear fuel (2)

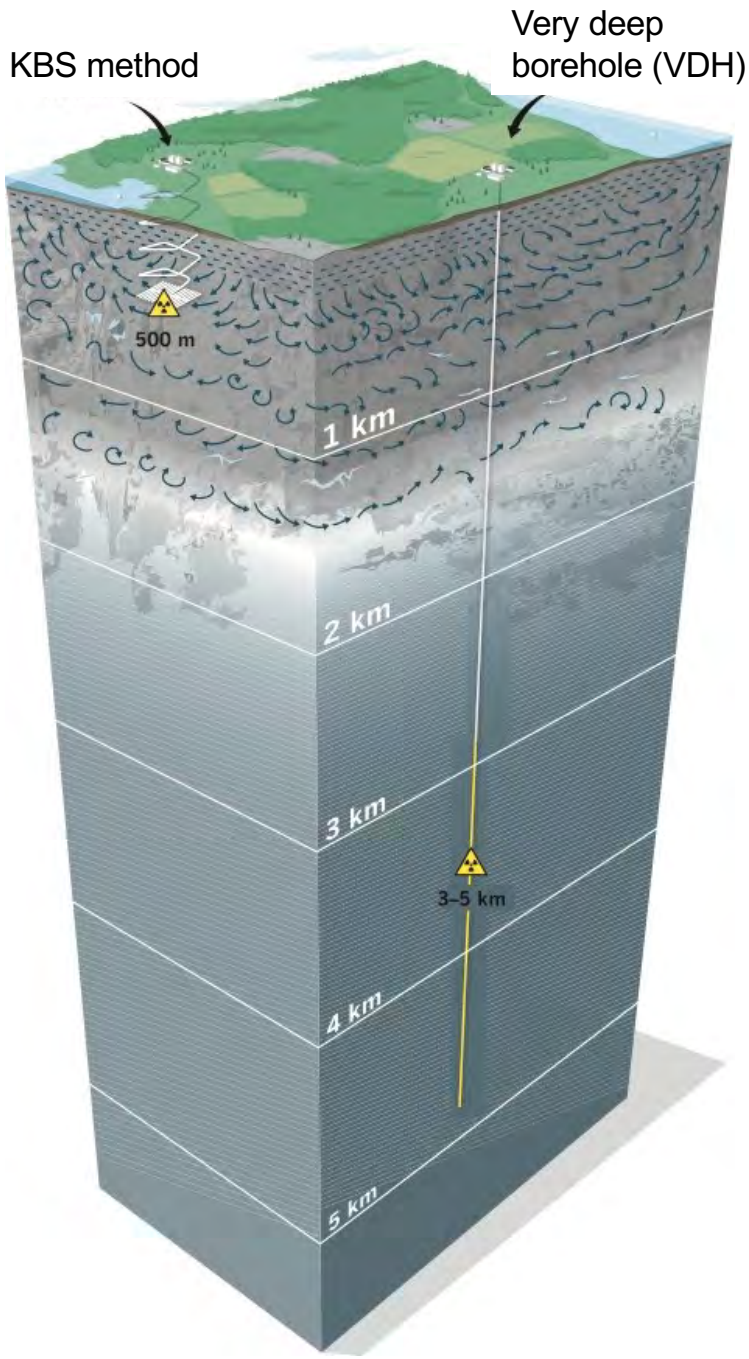
- A long and complicated siting process since the mid-1970s finally led to a site for the repository for spent nuclear fuel being selected in 2009, right next to the Forsmark nuclear power plant.
- In the early 2000s, the nuclear waste company SKB initiated consultations to prepare an application to build a repository for spent nuclear fuel in Forsmark, together with an encapsulation plant (Clink) as an above-ground expansion of the interim storage facility CLAB at the Oskarshamn nuclear power plant
- The company submitted a licence application for the repository and encapsulation plant on 16 March 2011.
- The application was reviewed by the Swedish Radiation Safety Authority (SSM) under the Nuclear Activities Act and by the Land and Environmental Court under the Environmental Code. Due to a possible weakness in the long-term safety case due to copper canister problems the court in January 2018 recommended that the Government say no.
- After a long review process of its own, the government took a decision in January 2022 on a licence under the Nuclear Activities Act and admissibility under the Environmental Code application.

Towards a repository for spent nuclear fuel (3)

- The Environmental Court gave a license under the Environmental Code in October 2024 and the nuclear waste company SKB “broke ground” and started work on surface facilities in January 2025.
- A decision from SSM to approve a new safety case (PSAR) is still needed to start underground construction. This could still take 2-3 years. The construction time is estimated to be upwards of 10 years. If everything goes as planned, the first copper canister could begin to be deposited in the second half of the 2030s. [Finland in 2026?]
- The question of whether copper is a good enough canister material is still not settled, and further advanced copper corrosion research by researchers at the Royal Institute of Technology (KTH) in Stockholm with international collaboration shows even larger problems.
- SSM (and thereby the Government) base their license decisions on the holistic view that the whole barrier system (copper canister, clay buffer and bedrock) will basically always guarantee long-term safety. Even if the copper canister does not work exactly as intended the other barriers will give enough safety. This is a very questionable approach.

Are very deep boreholes an alternative?

- In the alternative method very deep boreholes (VDH) nuclear waste is disposed of in a borehole at between 3-5 km depth, perhaps slightly less deep.
- The long-term environmental safety is based on a natural barrier that isolates stagnant groundwater at depth from flowing water down to 1-1,5 km depth.
- The method is also better from a nuclear proliferation point of view due to less risk of intrusion.
- Probably also less expensive.
- Feasibility has increased over time
  - Pilot project started in the USA during the Obama administration, stopped due to siting problems
  - Increased interest within the EU (EURAD) and internationally (IAEA)

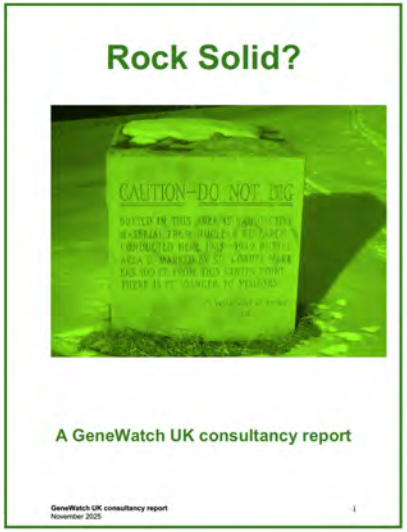


Further information

www.mkg.se/en

www.worldnuclearreport.org

worldnuclearwastereport.org



tinyurl.com/78jbazyu
(German summary with English report)

tinyurl.com/58vjxtfw
(EURAD/ROUTES Civil Society expert report with case studies on transparency and public participation)

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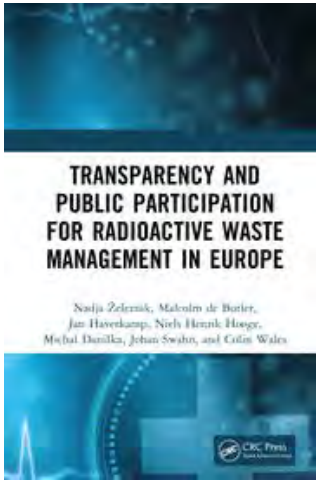

tinyurl.com/5dydeh7c

Thank you!

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