The Swedish NGO Office for
Nuclear Waste Review

Nuclear Waste: The Situation in Sweden

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Brief information about MKG

- **The Swedish NGO Office for Nuclear Waste Review** – Miljöorganisationernas kärnavfallsgranskning, **MKG** – is an **environmental organisation** working only with **nuclear waste issues**.
- The largest founding member in MKG is the **Swedish Society for Nature Conservation** – Naturskyddsföreningen – the largest environmental organisation in Sweden (≈ 170 000 members).
- MKG was founded in October 2004 and receives funding from **Swedish Nuclear Waste Fund** since January 2005 – four-year trial.
- The **aim** of MKG is to work for the **implementation of the environmentally best long-term option for the management of the Swedish nuclear waste**, with regards to choice of method and of siting.
- MKG takes an active part in the **legal environmental consultation process** on the Swedish nuclear waste arena.
- MKG has **not taken a stand in the choice of method or site** but wants the environmental courts, the regulatory bodies and the government to have the best available knowledge when taking decisions about a repository for spent nuclear fuel in Sweden.

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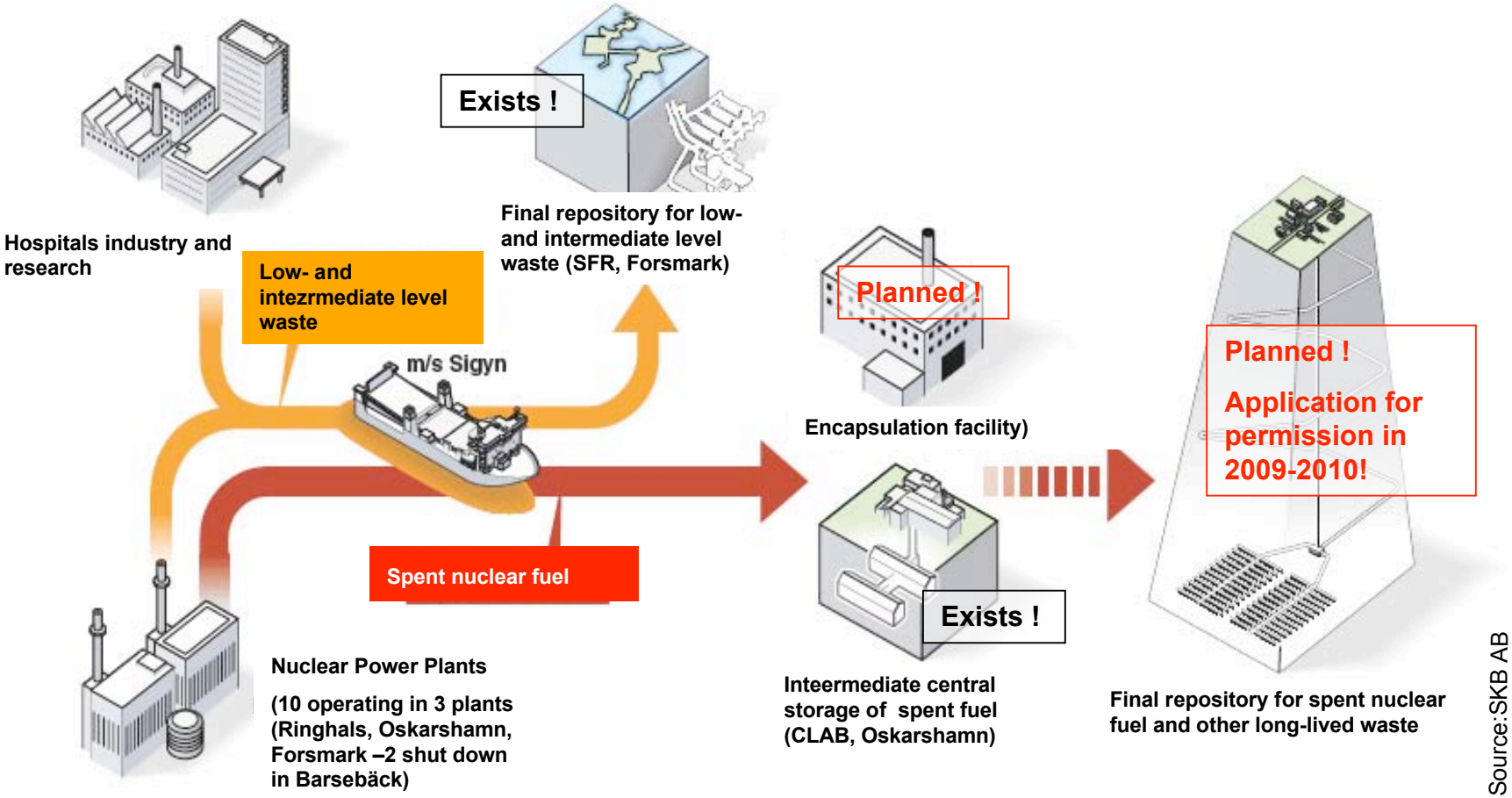
Management of Nuclear Waste in Sweden



Swedish System for Nuclear Waste Management

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Management of Nuclear Waste in Sweden

Source:SKB AB

SFR – Final Repository for Low- and Medium-level Nuclear Wasteat the Forsmark NPP

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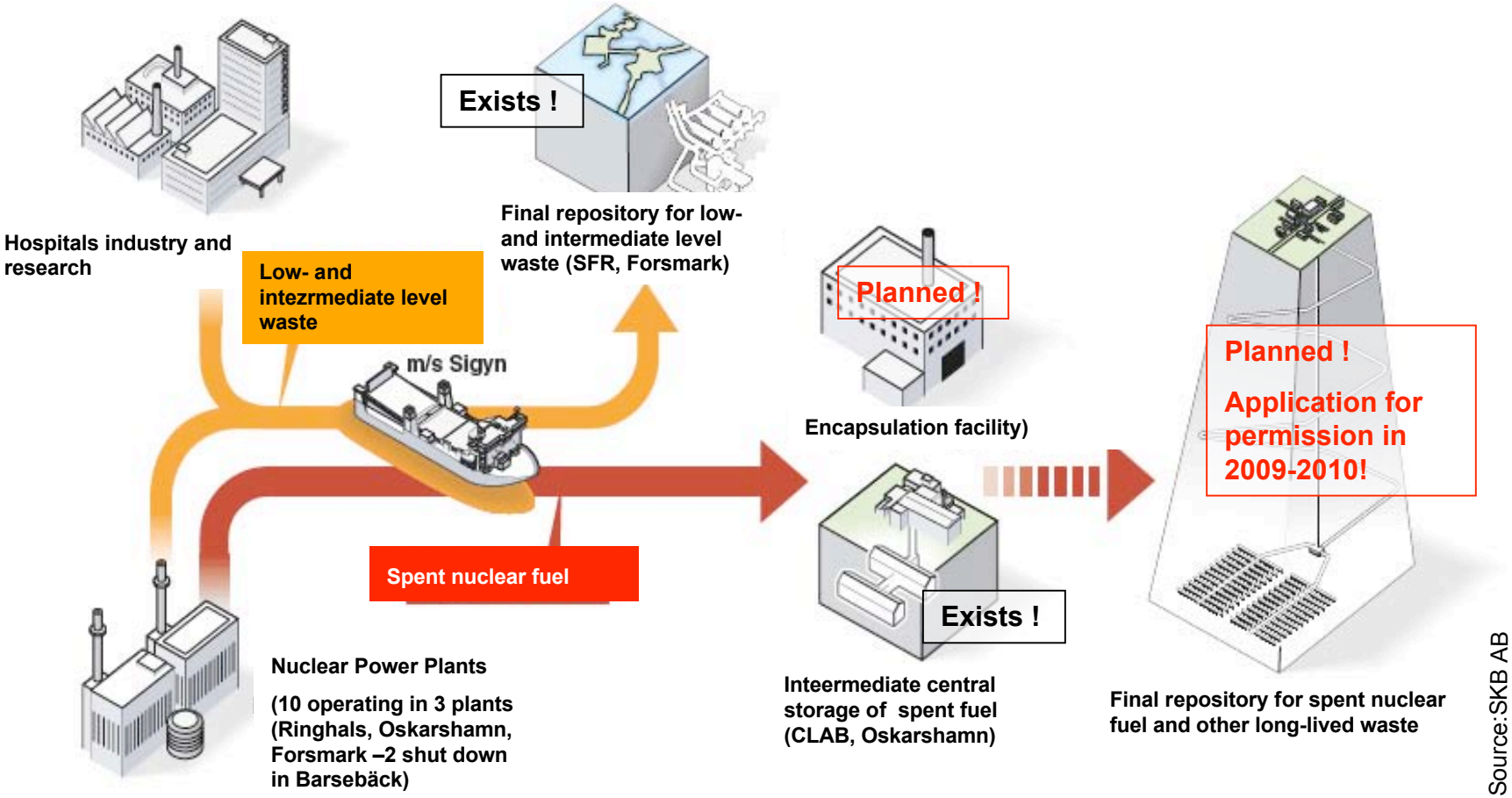
Management of Nuclear Waste in Sweden



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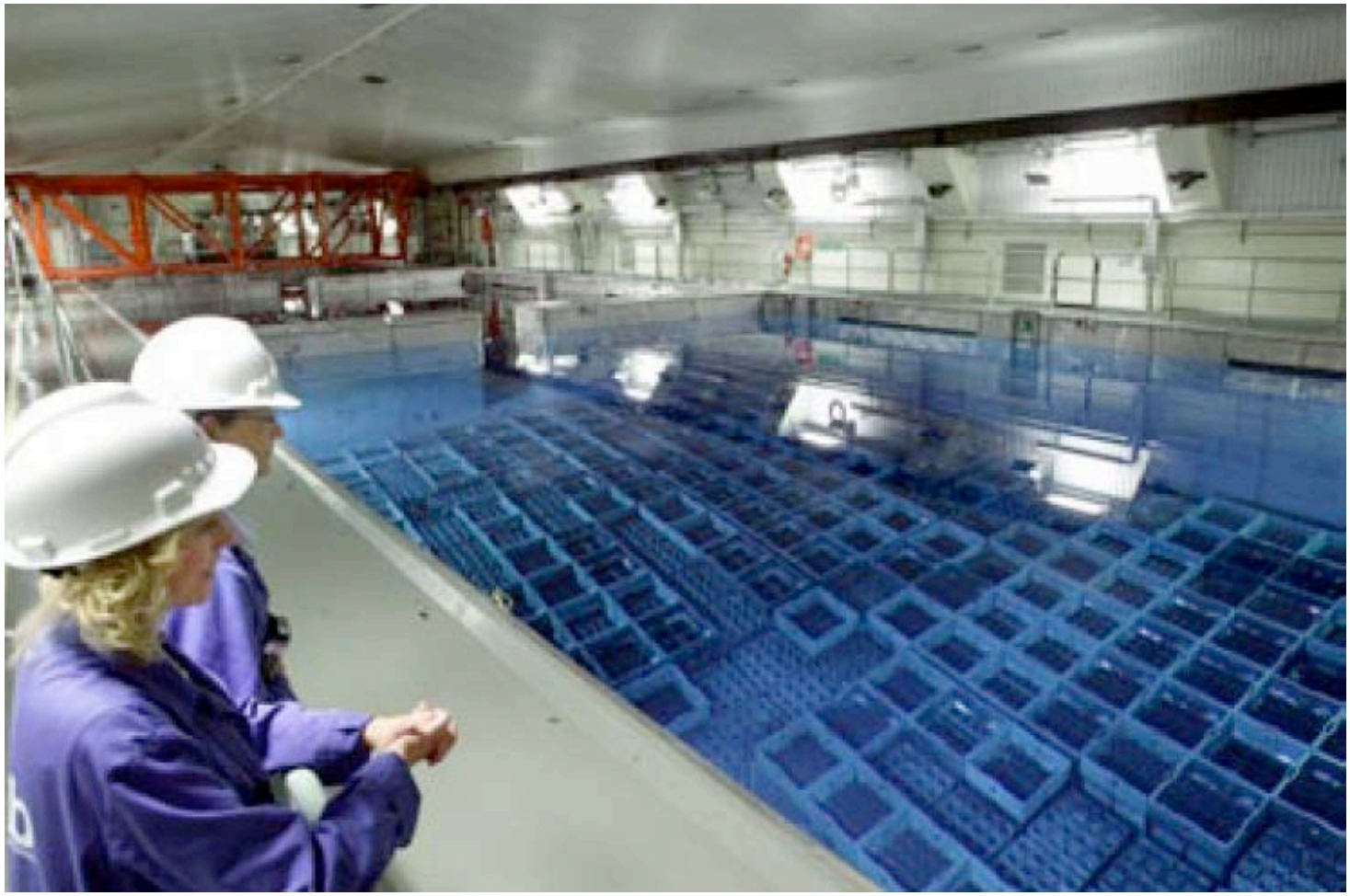

Source:SKB AB

CLAB – Intermediate Central Storage of Spent Fuel at the Oskarshamn NPP

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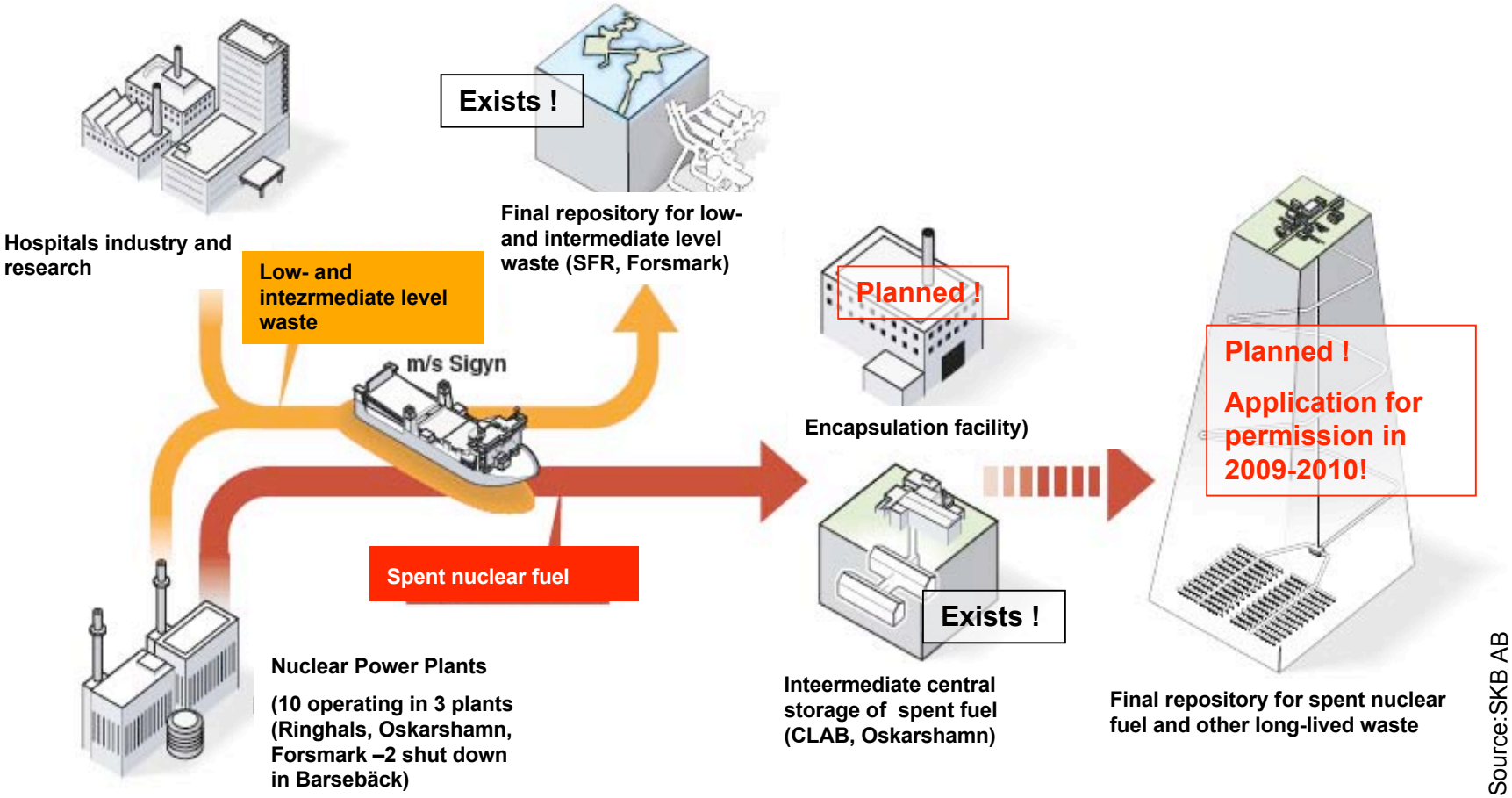
Management of Nuclear Waste in Sweden



Swedish System for Nuclear Waste Management

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Management of Nuclear Waste in Sweden

- All Swedish **spent nuclear fuel** is to be **directly disposed** in a final repository
- The nuclear industry has for **30 years** been developing the KBS method for final disposal of spent nuclear fuel. The **industry's nuclear waste company, SKB AB**, is responsible for this work.
- The KBS method was originally chosen in a **different environmental era** – "bury and disperse", "out of sight - out of mind".
- The progress of the development of the KBS method and the repository siting work has been **regularly reviewed** by the **regulatory authorities and the Government** but a **"lock-in" process** is very evident – operation of nuclear power plants requires that the waste problem "is solved".
- The **environmental movement** in Sweden has since the 1970s been **deeply critical** to the development of methods for nuclear waste management – both with regard to choice of method and the siting process.

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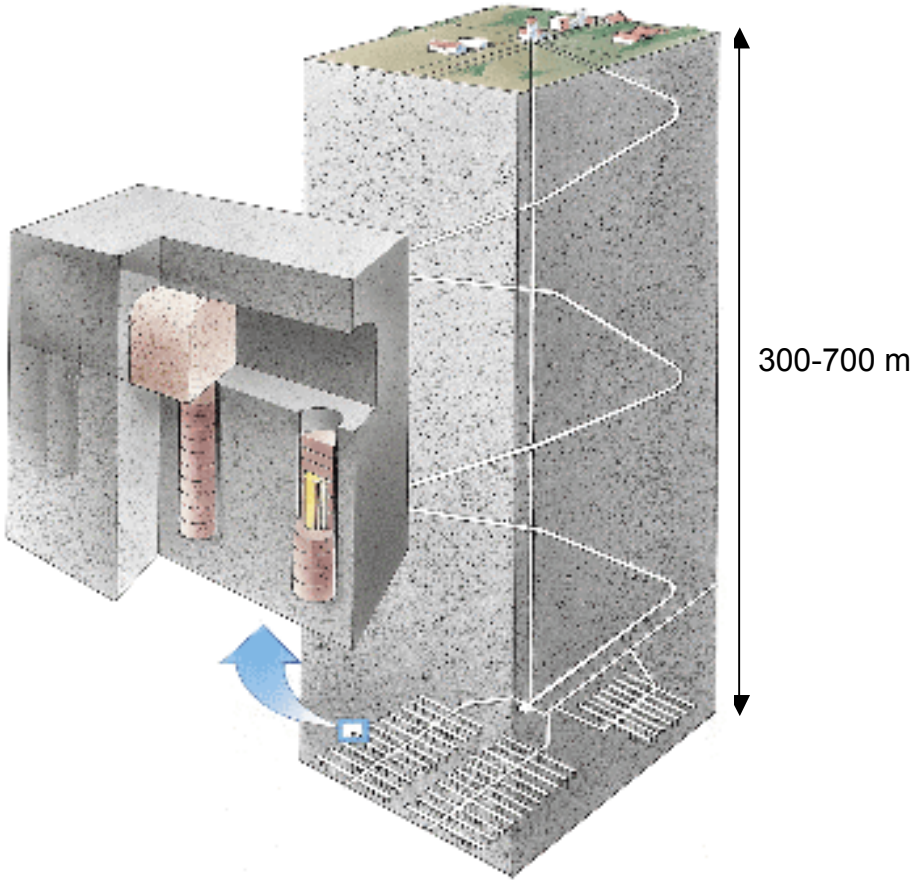
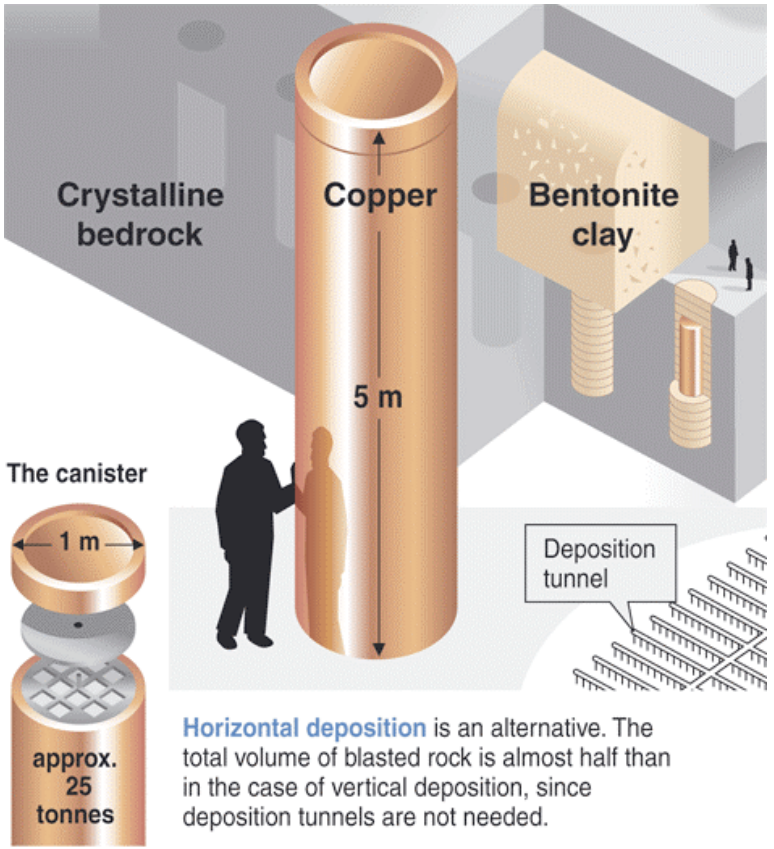
The KBS Method



Source:SKB AB/ Jan M Rojmar - Grafiska Illustrationer



Source:SKB AB/Mats Jerndahl

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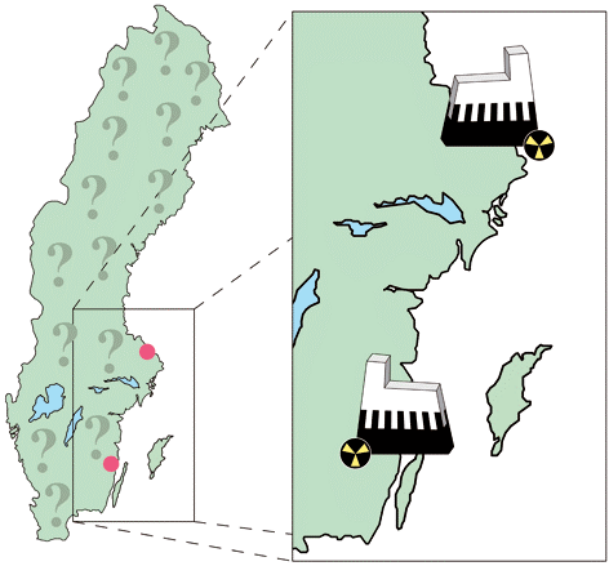
Choice of Site

- The nuclear industry is presently carrying out **site investigations** at two sites, both right **adjacent to a nuclear power plant**.



Forsmark nuclear power plant

Oskarshamn nuclear power plant

Source: MKG/Mikael Kårelind, Ummagumma

- The nuclear industry is preparing to **apply for permission** to implement the KBS method at one of these sites in **2009-2010**.

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The KBS Method: Long-term Environmental Concerns (I)

- A final repository for **spent nuclear fuel** can **not be allowed** to **release radioactivity that harms the ecosystems** for a period of **several hundreds of thousands of years**.
- A geologic repository in Swedish bedrock at a depth of 500 m has **groundwater flowing through the repository**.
- A repository using the **KBS method** therefore has to **rely on man-made barriers** (clay and copper) to isolate the nuclear waste from the environment.
- The **chemical environment** will in the long term **interact** with the **biological environment** in ways that are **difficult to foresee**.

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The KBS Method: Long-term Environmental Concerns (I)

- In Sweden there will be several **ice-ages** during the next 100,000 years. This will lead to **very large variations in the chemical and biological environment** that will affect the man-made barriers.
- **Glaciation** during ice ages will likely also **physically damage** a repository (lateral movement and major earthquakes).
- The uncertainties of long-term physical, chemical and biochemical impact on **a KBS repository** means that there are **still a number of uncertainties** in the safety analysis. **Enough uncertainties to make the implementation of the method highly questionable will always remain.**
- Spent nuclear fuel contains **plutonium** that poses a **long-term nuclear weapons proliferation risk** for over 100 000 years.

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The Siting of a KBS Repository: Environmental Concerns

- The nuclear industry **initially focused on finding the best site** in Sweden for a KBS repository. The focus is **now on finding a site that is "good enough"**, i.e., satisfies the industry's own criteria for bedrock stability and groundwater flow.
- The **two sites presently being examined** by the nuclear industry are **on the Baltic Sea coast**.
- The **salinity of the groundwater** at repository depths is higher on the coast compared to inland sites which **threatens the buffer.**
- During a **glaciation** cycle only **inland sites are not covered by sea**.
- The **time for a leak to reach the surface** (breakthrough time) can be **much longer** (perhaps over 50 000 years) at **an inland site** compared to 50-100 years on the coast.

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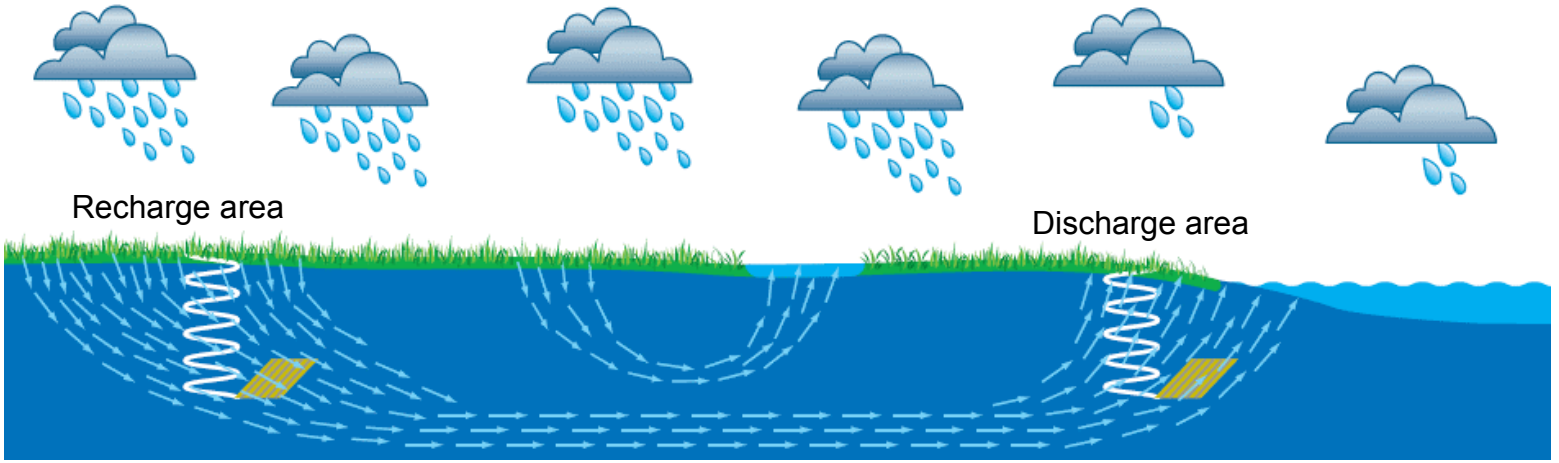
The Siting of a KBS Repository: Environmental Concerns



Source: MKG/Mikael Kårelind, Ummagumma

- **If the KBS method is to be used**, the repository should be placed **as deeply as possible** (700-1000 m) in a **recharge area for ground water** at an **inland location**. This would provide a **better long-term environmental security** than a more shallow coastal siting.

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Very Deep Boreholes: An Alternative Method for Geologic Disposal of High-level Waste

- An **alternative method** for geologic disposal of spent nuclear fuel or other high-level nuclear waste is disposal in **very deep boreholes** at **depths of between 3 and 5 km**.
- Ground water salinity increases with depths and creates **a barrier effect** at between 1 and 2 km depth. **Ground water at depth has no contact with the surface and can be millions of years old**, despite a number of ice ages. Modelling shows that the barrier would be intact after disposal of waste canisters in the boreholes.
- Waste **canisters** and **packing material** can provide **additional man-made barriers**.
- **Advances in drilling and emplacement technology** has made the **safe implementation and cost** for nuclear waste disposal **much more feasible than 20-30 years ago**.

Johan Swahn, The Swedish NGO Office for Nuclear Waste Review, MKG

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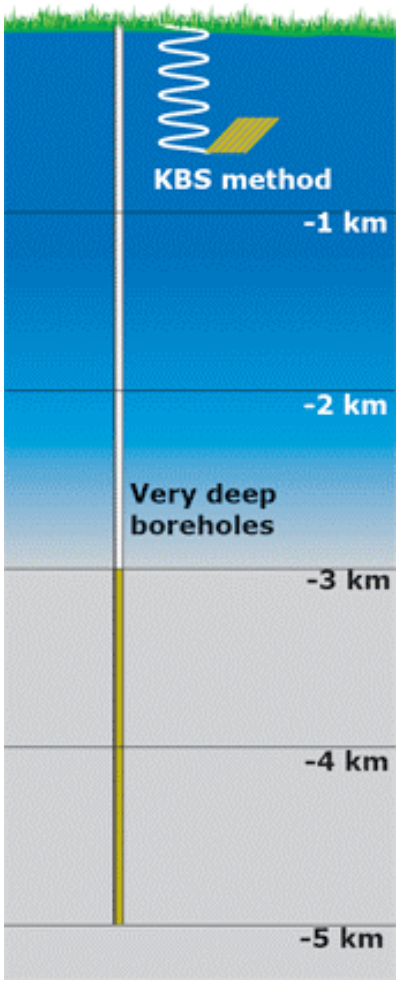

Source: MKG/Mikael Kårelind, Ummagumma

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Very deep boreholes: An alternative method for geologic disposal

- It is possible that using the alternative method **very deep boreholes** for final disposal of spent nuclear fuel and other high-level nuclear waste **may provide a better long-term environmental security than using a mined repository**, i.e., the KBS method.
- Using the method **very deep boreholes** could also provide a **higher level of physical protection** (safeguards) against **long-term risks of nuclear weapons proliferation** compared to using a mined repository.

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Summary of Environmental Issues: Final Disposal of Swedish Spent Nuclear Fuel

- The uncertainties of long-term physical, chemical and biochemical impact on **a KBS repository** means that there are **still a number of uncertainties** in the safety analysis. **Enough uncertainties to make the implementation of the method highly questionable will always remain.**
- **If the KBS method is to be used**, the repository should be placed **as deeply as possible** (700-1000 m) in a **recharge area for ground water** at an **inland location**. This would provide a **better long-term environmental security** than a more shallow coastal siting.
- It is possible that using the alternative method **very deep boreholes** for final disposal of spent nuclear fuel and other high-level nuclear waste **may provide a better long-term environmental security than using a mined repository**, i.e., the KBS method.
- Using the method **very deep boreholes** could also provide a **higher level of physical protection** (safeguards) against **long-term risks of nuclear weapons proliferation** compared to using a mined repository.

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The Coming Years?

- Review of the latest safety analysis SR-CAN
- Review of the industry´s latest reserach plan – FUD 2007 – leads to a Government decision late 2008 or early 2009
- A transparency project driven by the Swedish National Council for Nuclear Waste (Kärnavfallsrådet, earlier KASAM)
- Increased discussion in society about the aim of the repository project
- Further studies of alternatives – the industry is not interested!
- An application from the industry for permission to build a KBS repository (including final choice of site) in 2009-10 (?) to the Environmental Court
- Court deliberations and review by the regulatory authorities with recommendations to Government
- Government decision in 2013 (?)
- Construction start 2017 (?) after further legal deliberation about the terms for the permission

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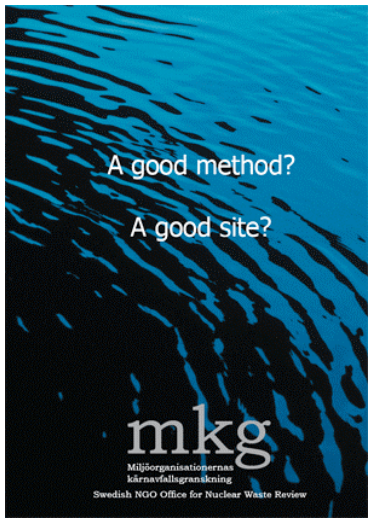
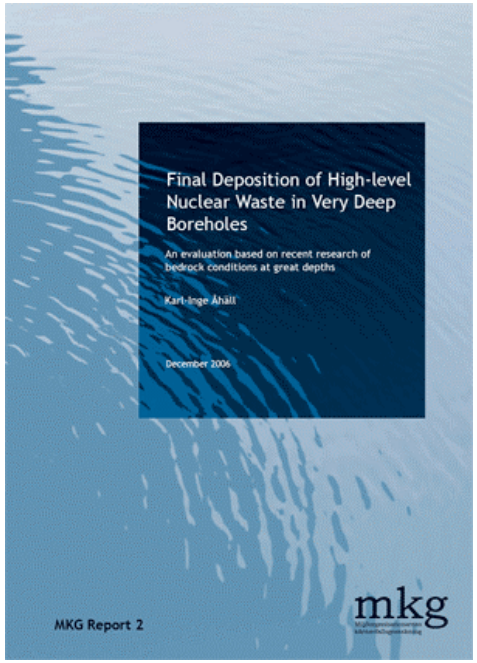
For more information ...





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