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The Swedish NGO Office for
Nuclear Waste Review

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Nuclear Waste: The Unresolved Environmental Issue

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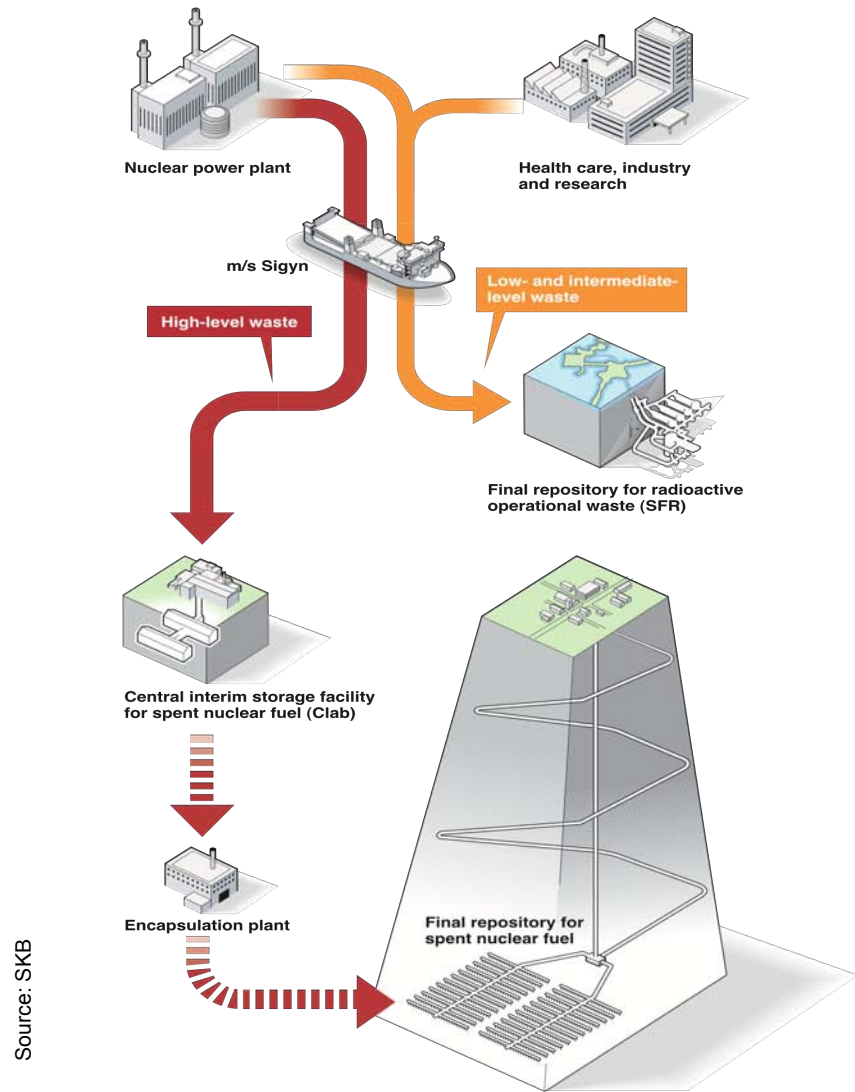
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Brief information about MKG

- The Swedish NGO Office for Nuclear Waste Review – Miljöorganisationernas kärnavfallsgranskning, MKG, is an environmental organisation working only with nuclear waste issues.
- The largest founding partner in MKG is the Swedish Society for Nature Conservation – Naturskyddsföreningen – the largest environmental organisation in Sweden (181 000 members).
- The Swedish Society for Nature Conservation – Naturskyddsföreningen – is a strong lobby organisation working against nuclear power in Sweden.
- MKG was founded in October 2004 and receives funding from Swedish Nuclear Waste Fund since January 2005.
- 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.
- MKG takes an active part in the environmental consultation process on the Swedish nuclear waste arena.
- MKG does not recommend any specific method for nuclear waste.

The Swedish Nuclear Waste System

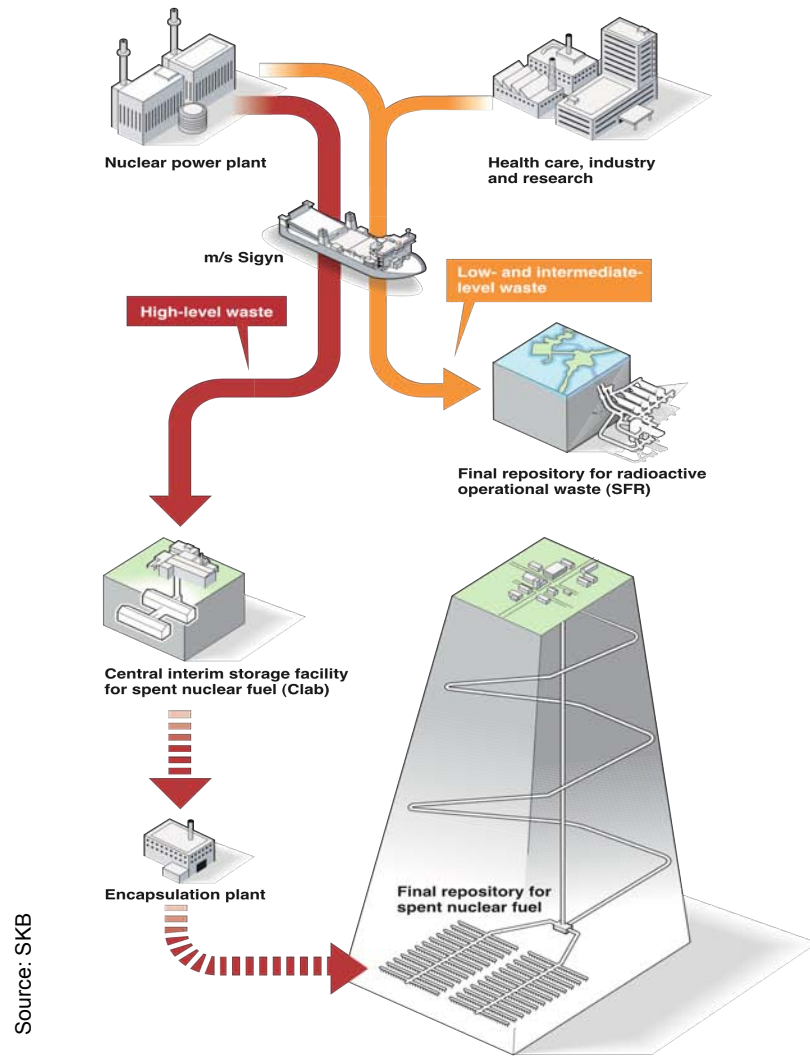


Swedish System for Nuclear Waste Management



SFR – Final Repository for Low- and Medium-level Nuclear Waste at the Forsmark Nuclear Power Plant

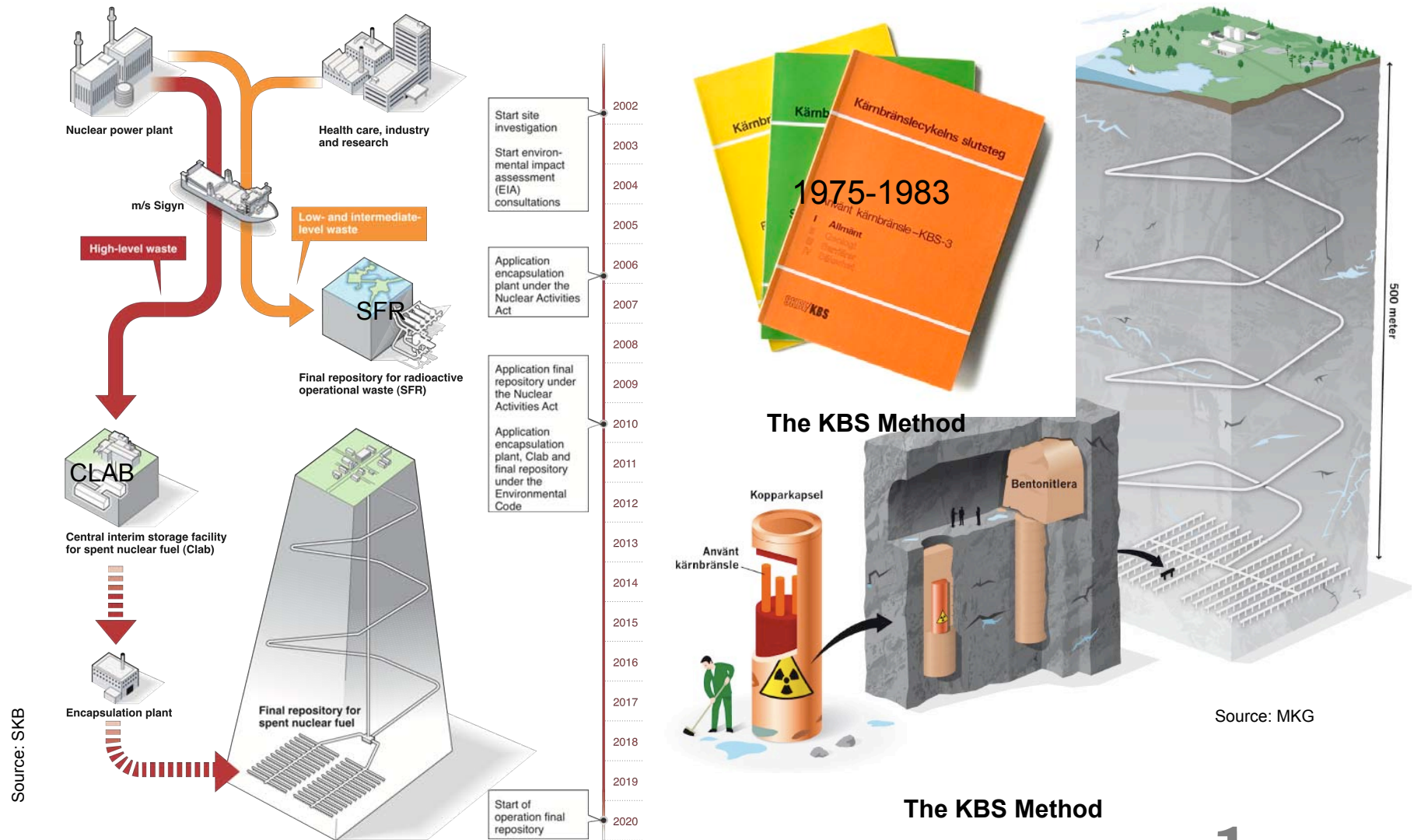
The Swedish Nuclear Waste System



CLAB – Intermediate Storage of Spent Fuel at the Oskarshamn Nuclear Power Plant

Swedish System for Nuclear Waste Management

The Swedish Nuclear Waste System

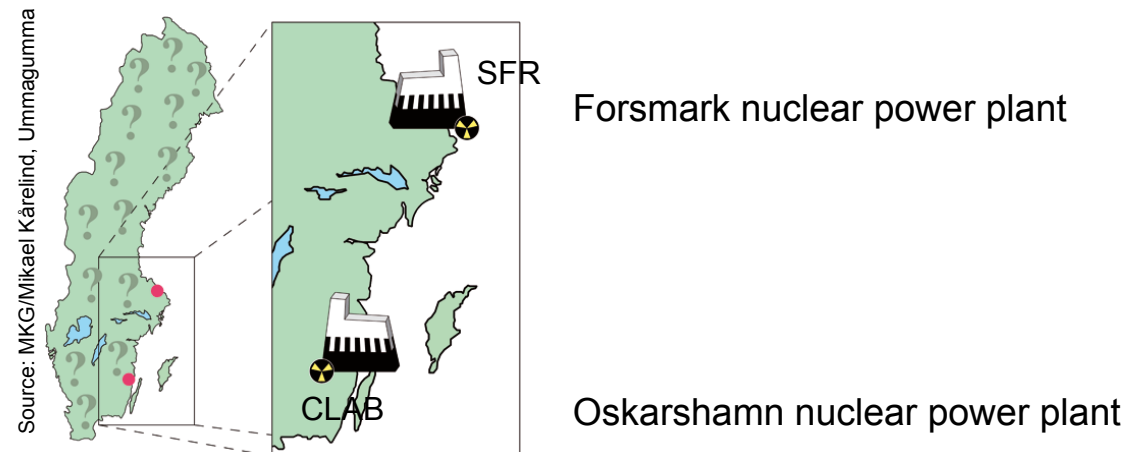


Swedish System for Nuclear Waste Management

Management of spent nuclear fuel in Sweden

Siting issues

- The nuclear industry have been carrying out site investigations at two sites, both right adjacent to a nuclear power plant.
- In June 2009 Forsmark was chosen.



- The nuclear industry is preparing to apply for permission at the end of 2010 to implement the KBS method at Forsmark.

Management of Nuclear Waste in Sweden: A Summary

- All Swedish spent nuclear fuel is to be directly disposed in a final repository.
- Centralised interim storage is implemented in water basins 50 m underground in the CLAB facility close to the Oskarshamn nuclear power plant.
- 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 by law entirely responsible for this work.
- The progress of the development of the KBS method and the repository siting work has been regularly reviewed by the regulatory bodies and the Government.
- But, the KBS system is in deep trouble.

The KBS method: Long-term environmental concerns (I)

- Radiation risks för 100 000 years and longer
- Nuclear weapons proliferation risks for over 100 000 years
- Chemical risks for all future



The KBS method: Long-term environmental concerns (II)

- A final repository for spent nuclear fuel can not be allowed to release radioactivity that harms the ecosystems for a period of over 100,000 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 and biological environment will in the long term threaten the artificial barriers of copper and clay in ways that are difficult to foresee.

The KBS method: Long-term environmental concerns (III)

- In Sweden there will be one or more ice-ages during the next 100,000 years.
- Glaciation will lead to variations in the chemical and biological environment that will affect the man-made barriers.
- Glaciation during ice ages will physically affect a repository (lateral movement, major earthquakes, permafrost).
- The uncertainties of long-term physical, chemical and biochemical impact on a KBS repository means that there are still a number of unanswered questions in the safety analysis.

And do not forget ...

- Spent nuclear fuel contains plutonium that poses a long-term nuclear weapons proliferation risk for over 100 000 years.

“New” problems with copper corrosion ?

Source: Peter Szakalos, Royal Institute of Technology, Stockholm



FIGURE 1 – Appearance of copper after 15 years of exposure in distilled water at room-temperature. Hydrogen from corrosion can escape from the left container but not from the container to the right. The water volume was equal in the flasks in beginning of the exposure.

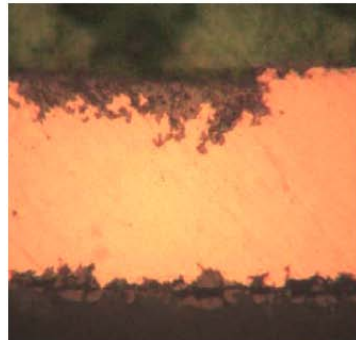


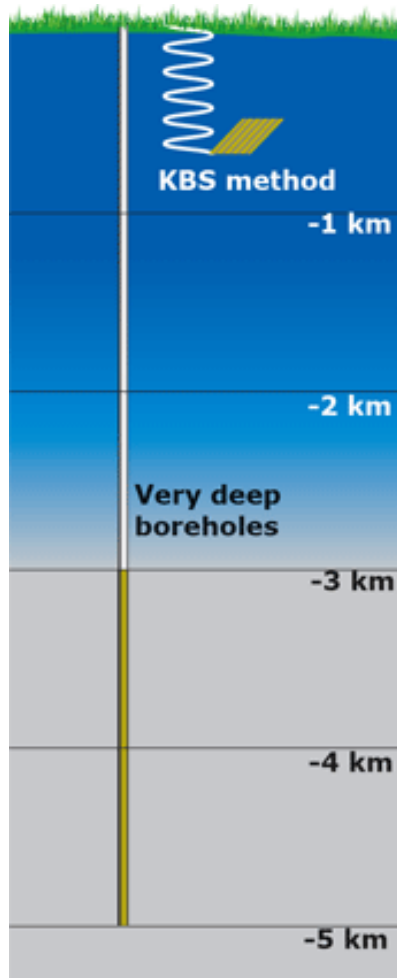
FIGURE 2 – Light optical cross-section of the initially 100µm metallic copper foil after 15 years exposure in distilled water. Localised corrosion attack is clearly visible.

- The scientific hypothesis that anoxic water does not corrode copper may be false.
- Copper in a KBS-repository may corrode at much larger speeds than acceptable.
- Copper canisters could release radioactivity within 1000 years.
- The copper corrosion problem is deeply contested by the nuclear industry.

The Swedish nuclear waste management system has to be entirely overhauled

- The KBS-method has to be stopped.
- The Swedish model for responsibility has to be evaluated.
- Alternative management alternatives have to be evaluated.
- MKG wants the alternative method very deep boreholes to be further evaluated.
- Methods for long-term storage have to be re-examined (CLAB and alternatives).
- [Transmutation can only play a role in a post-nuclear world.]

Very deep boreholes: An alternative method for geologic disposal



Source: MKG/Mikael Kärelind, Ummagurmma

- 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.
- Groundwater salinity increases with depths and creates a barrier effect at between 1 and 2 km depth. Ground water beneath these depths has no contact with the surface. There is a “natural barrier”.
- 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.

Very deep boreholes: Better long-term safety ?

- 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) compared to using a mined repository.
- Still a number of uncertainties that need to be resolved before enough is known to be able to do an in-depth safety analysis of the method.

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 unanswered questions in the safety analysis.
- The KBS method relying on engineered methods has to be abandoned.
- The Swedish nuclear waste management system has to be entirely overhauled
- 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 and could also provide a higher level of physical protection (safeguards against nuclear weapons proliferation) compared to using a mined repository.

KÄRNAVFALL



For more information ...



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