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Miljöorganisationernas  
kärnavfallsgranskning

The Swedish NGO Office for  
Nuclear Waste Review



# The Scandinavian Nuclear Waste Strategies

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# 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 of MKG is the Swedish Society for Nature Conservation – Naturskyddsföreningen – the largest environmental organisation in Sweden (181 000 members).
- The work of MKG is financed by the Swedish Nuclear Waste Fund.
- MKG takes an active part in the environmental consultation process involved in the eventual licensing of a repository for Swedish high-level nuclear waste (direct disposal of spent nuclear fuel).

# Scandinavian NW Strategies: An overview

- Sweden has worked with nuclear waste management strategies since nuclear power became a strong political issue in the mid-1970s. Finland had to restart nuclear waste management work in the 1990s after Russian reprocessing of spent nuclear fuel was lost as an alternative and has basically copied the Swedish programme.
- The Swedish (and Finnish) nuclear waste programmes are sometimes regarded as good examples but the repository programmes for spent nuclear fuel have yet to be licensed and approved.
- The Swedish KBS method for a repository for spent nuclear fuel is unique in its reliance on artificial barriers (copper canister and clay buffer) for long term environmental safety. The method is now strongly questioned and may not survive the upcoming licensing process.

# A reminder: There are Long-term Environmental and Security Concerns !

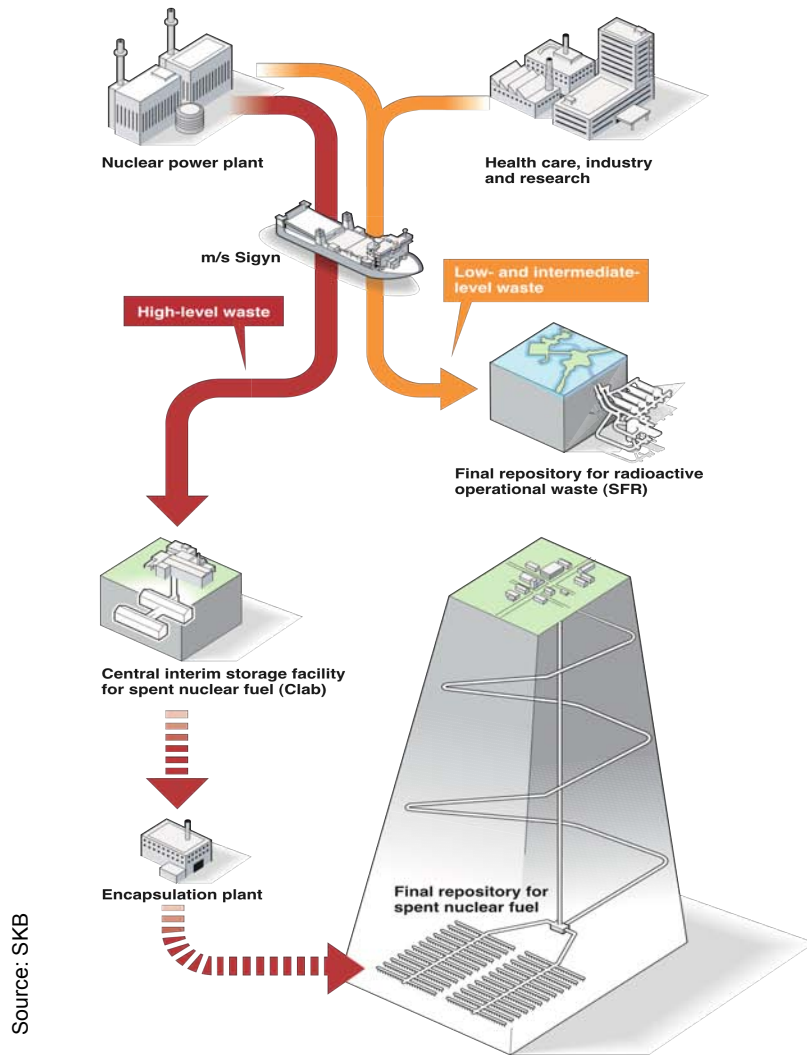
- Radiation risks for hundreds of thousands of years, up to a million years
- Nuclear weapons proliferation risks for over one hundred thousand years
- Chemical risks for all future



# Management of Spent Nuclear Fuel in Sweden

- All Swedish spent nuclear fuel is to be directly disposed of 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 fuel can stay there for 100-200 years.
- 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. Funding is managed by the Swedish Nuclear Waste Fund.
- An underground hard rock laboratory has been built at Äspö near the Oskarshamn nuclear power plant.
- 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.

# The Swedish Nuclear Waste System



Source: SKB

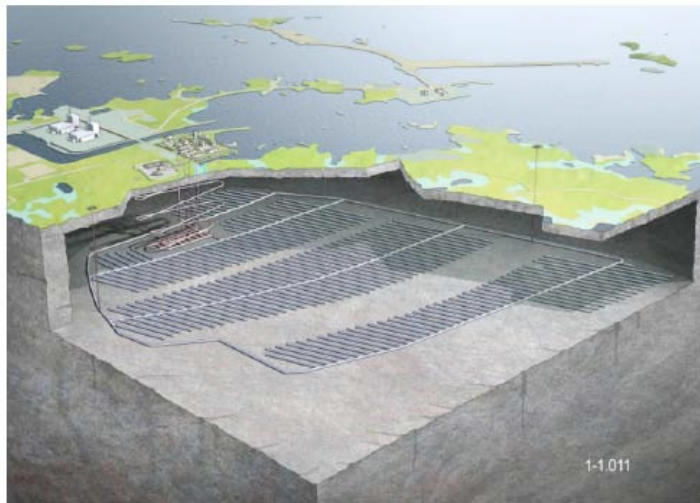
## CLAB – Intermediate Storage of Spent Fuel at the Oskarshamn Nuclear Power Plant

Swedish System for Nuclear Waste Management

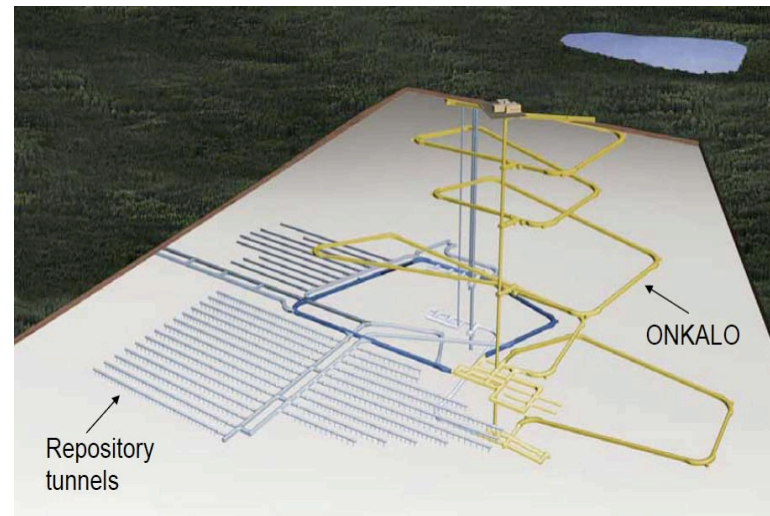
# The KBS method for a final disposal of spent nuclear fuel



- The development of the KBS method for final disposal of spent nuclear fuel was started in Sweden in 1977. Finland is implementing a copy of this system.
- The method is still not approved/licensed in Sweden, but an application for a licence is due in 2010.

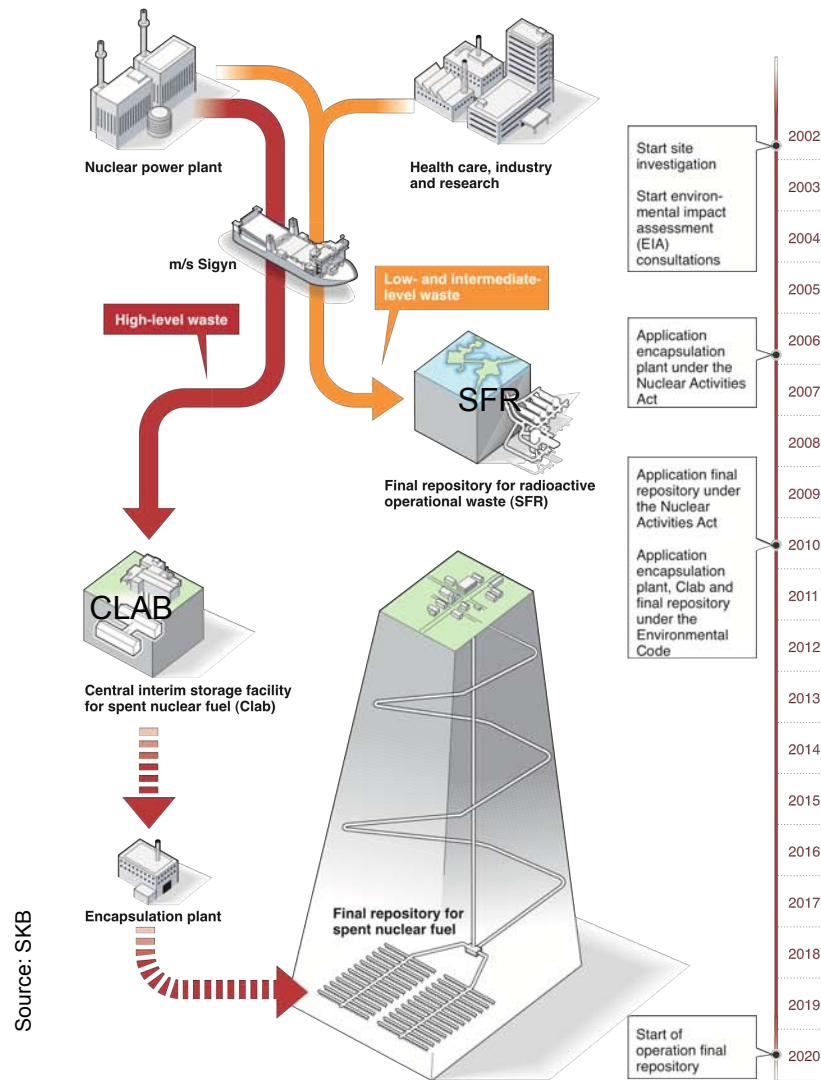


Planned repository in Forsmark in Sweden

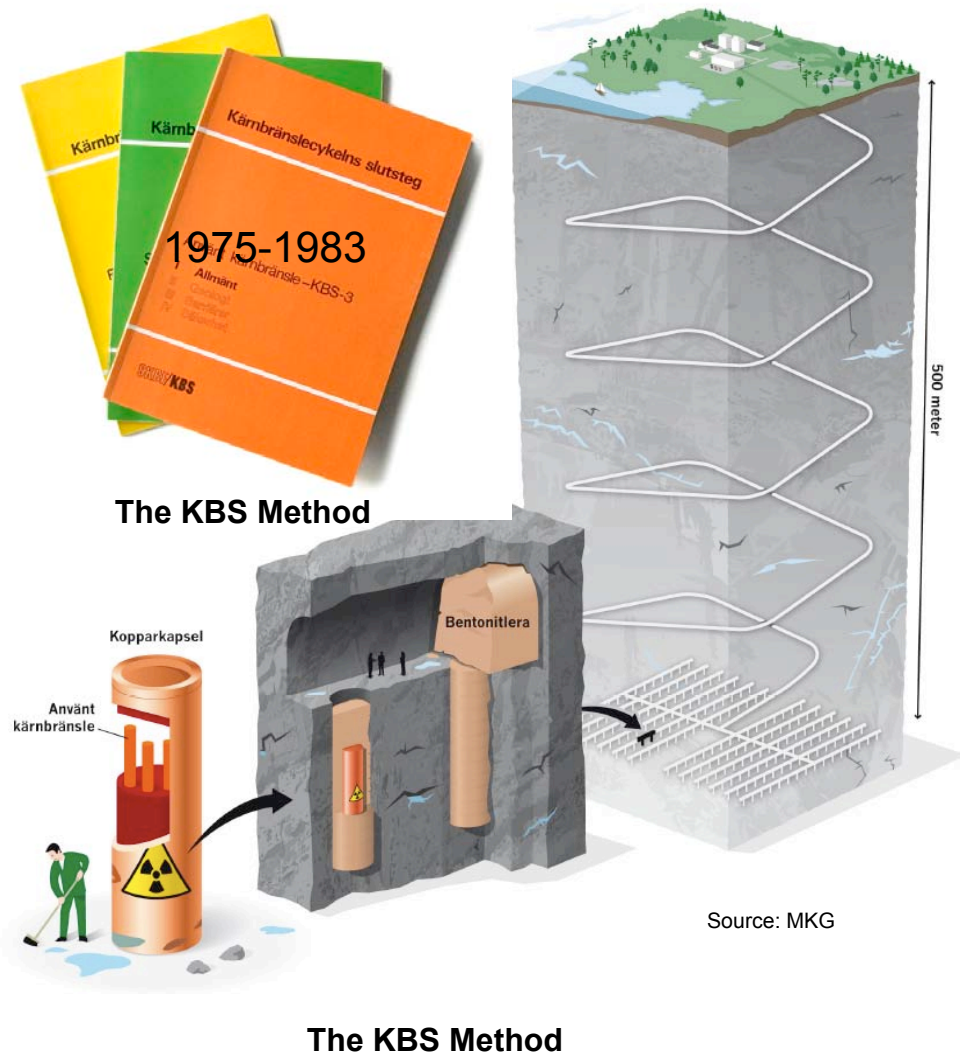


Planned repository in Olkiluoto in Finland

# The Swedish KBS Method



Swedish System for Nuclear Waste Management



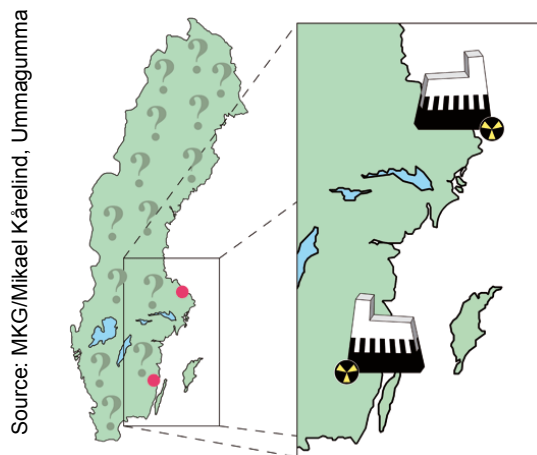
The KBS Method

The KBS Method

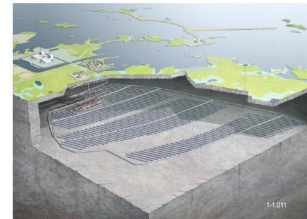
Source: MKG

# Present Developments in Sweden

- In June 2009 the nuclear waste company SKB decided for siting of a KBS repository at the Forsmark nuclear power plant. “Siting of KBS repository is OK in almost any bedrock”.
- The nuclear industry is preparing to apply for permission at the end of 2010 to implement the KBS method
- The review and decision-making will take 3-5 years.
- All may look well, but the Swedish KBS system may be heading for troubling times. There is severe criticism of the long term environmental safety case !



Forsmark nuclear power plant



# Present Developments in Finland

- The Finnish nuclear waste company Posiva is copying the work done by SKB in Sweden. The regulator STUK is technically much weaker than the Swedish Nuclear Safety Authority, SSM
- Posiva has chosen the site for an underground hard rock laboratory (Onkalo) at the Olkilouto nuclear power plant and wants to use the site for a repository even though the site has not undergone only a very primitive site evaluation.
- There is a plan for a Finnish application for a repository in 2012 after the Swedish safety analysis report from the Swedish application in 2010 has been converted into a Finnish version.
- At all times the Finnish nuclear industry is talking about the Finnish spent fuel repository project as being an independent and national method. This is what the Finnish public and politicians believe.
- There will be no Finnish project if the Swedish KBS-project has big problems ! The Scandinavian repository development for spent fuel is only one uncertain programme !

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

- 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 relatively dry rock (for the KBS method) chosen by SKB in Forsmark puts stress on the clay barrier and opens up for new questions on copper corrosion processes.
- In Sweden there will be one or more ice-ages during the next 100,000 years and glaciation will lead to variations in the chemical and biological environment that will affect the man-made barriers.

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

- Glaciation during ice ages will also 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.
- It has still not been shown that the safety case for a final repository for spent nuclear fuel or high-level nuclear waste that relies on artificial engineered barriers can be made.

And do not forget ...

- Spent nuclear fuel contains plutonium that poses a long-term nuclear weapons proliferation risk for over 100 000 years. This means there will be monitoring and surveillance demands for an indeterminate future.

# “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.

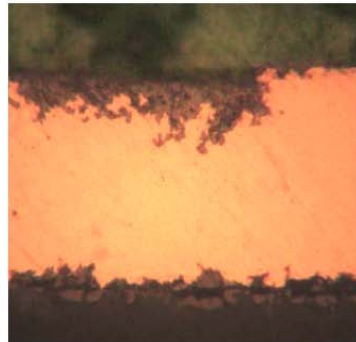
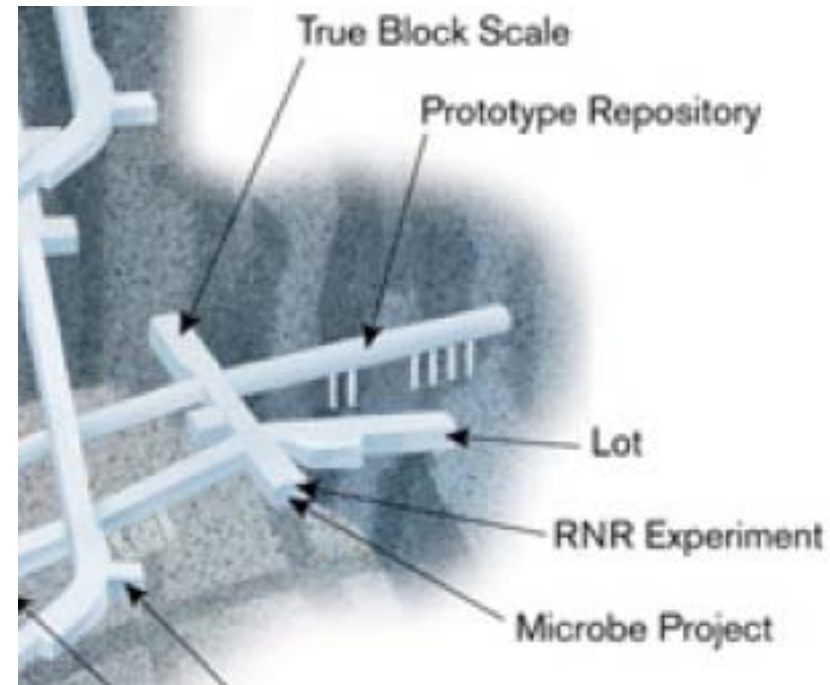
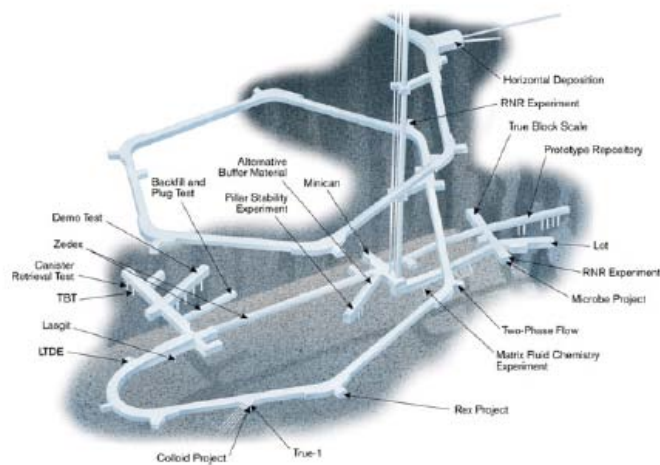


FIGURE 2 – Light optical cross-section of the initially 100µm metallic copper foil after 15 years exposure in distilled water. Localised corrosion attack is clearly visible.

- The scientific hypothesis that anoxic (oxygen-free) water does not corrode copper in a repository may be false.
- Copper in a KBS-repository may corrode at much larger rates than acceptable.
- Copper canisters could release radioactivity within 1 000 years.
- The copper corrosion problem is deeply contested by the Swedish nuclear waste company, SKB.

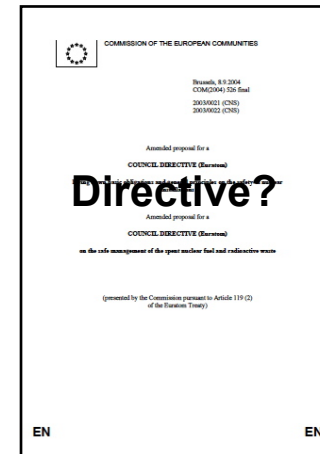
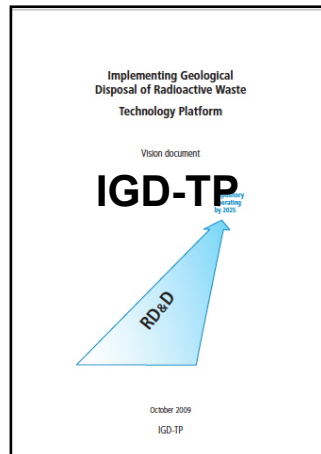
# Confirmation of Copper Corrosion Problems at the Hard Rock Laboratory in Äspö ?



# Summary of issues

- Geologic disposal is the favoured method for disposal of spent nuclear and high-level nuclear waste, but no repository has so far been implemented
- Methods relying on natural geologic barriers may have siting difficulties due to lack of public acceptance , which could be less of a problem for the KBS method (higher possibility for siting at nuclear facilities)
- The safety case for Swedish (Finnish) KBS method is severely questioned and licensing is uncertain.
- The problems for the KBS method has opened up for questioning whether disposal methods relying on artificial engineered barriers should be implemented at all.
- The Swedish and Finnish repository programmes for spent nuclear are entirely interdependent. If the Swedish programme fails, so does automatically the Finnish.

# Relevance for Europe ??



- Work on “Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP)” is led by SKB and Posiva and relies heavily on the KBS method
- EC Joint Research Centre report “Geological Disposal of radioactive Waste - Moving Towards Implementation - JRC Reference Report 2009-10” also leans heavily on the SKB method
- The work on the proposed EU Nuclear Waste Directive should use a cautionary approach with regards to the Swedish (Finnish) KBS method.

# For more information ...



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