Perspectives from Sweden
Going from licence application to repository implementation

Christopher Eckerberg
President

Swedish Nuclear Fuel and Waste Management Co.
Nuclear in Sweden – a changing landscape

- Originally 12 reactors units at 4 sites started between 1972 and 1985
- 2 reactor units in Barsebäck closed down around 2000 for political reasons
- Decision to close another 4 units in Oskarshamn and Ringhals around 2020 for commercial reasons
- Remaining 6 reactor units to operate for approx. 60 years
- Only minor implications on waste management programme
The Swedish back-end system

Medical care, industry and research

Low- and intermediate level waste

Transport by M/S Sigrid

Nuclear power plant

Final repository for short-lived radioactive waste

Interim storage for spent nuclear fuel with planned encapsulation section

Final repository for long-lived waste

Final repository for spent nuclear fuel

Licensing: Deep geological repository for spent fuel at Forsmark
Encapsulate plant at Oskarshamn
Extension of short-lived repository for decom. waste at Forsmark
The Swedish system – How did we get there

- **Methodology development**
  - 1976
  - 1985
  - SFR in operation
  - 1990
  - Clab in operation
  - m/s Sigyn in operation

- **Feasibility studies and development of scientific basis**
  - 1990
  - 1995

- **Site investigations, Technology development**
  - 2000

- **Technology implementation, licensing and building of encapsulation plant and repository**
  - 2005

- **Application to build a final repository and an encapsulation plant**
  - 2010

- **Site selection Forsmark**
  - 2015
  - m/s Sigrid in operation

- **Bentonite Laboratory**

- **Canister Laboratory**
  - Äspö Hard Rock Laboratory

- **RD&D programme reviewed and approved every third year since 1986**
  - Latest September 2016

- **Deposition begins**
  - 2030

**Timeline**
- 1985
- 1988
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015
- 2020
- 2030
Complicated licensing review - Two laws
Two parallel processes with interactions

SKB’s spent fuel applications

One according to Environmental Code

Two according to Nuclear Act

Court hearings

Nacka Tingsrätt

Osthammars kommun - en del av Rååagen

Oskarshamns kommun

Court conclusions

Safety review results

Review

Strål säkerhets myndigheten

Swedish Radiation Safety Authority

Permit and conditions

Regeringskansliet

Decides

Approves Safety Report

Approves or disapproves

Regeringskansliet
### Licensing process – what has happened

**March 2011**  
Application for licenses

**Nuclear Act**  
2011 – 2012  
NEA Peer review of safety case

2012 – 2015  
Several rounds of requests for complementary information from SSM after two rounds of public consultations

**Autumn 2015**  
Preliminary conclusions from SSM

**June 2016**  
Positive statement from SSM to Environmental Court on site, method and safety

**Environmental Code**  
2012- 2015  
Two rounds of public reviews leading to requests for complementary information

**January 2016**  
Official announcement of application and court procedure

**Sep 2017?**  
Environmental court hearing
Main review comments on SKB-applications

- **Scope of Environmental Code Application and Environmental Impact Assessment**
  - Level of detail with respect to nuclear safety issues

- **Scope of documentation of other disposal methods**
  - Deep boreholes
  - Spent fuel as a resource

- **Site selection**
  - Process, alternative sites, e.g. inland

- **Long term safety issues**
  - Canister integrity
  - Detailed technical issues – mainly from SSM

- **“Conventional” environmental consequences**
  - Discharges to water, endangered species, traffic, noise
  - Management of rock from excavation
Challenges during the review process

• Two parallel and partly overlapping reviews

• Extended duration of the review process
  • Two review phases 1) “Completeness” of application 2) De facto issues in application
  • Review by stakeholders – Responses by SKB – Review – SKB response …

• Large number of questions raised in review process
  • Take all questions seriously
  • Clearly explain SKB’s position
  • Each stakeholder should be able to identify the response to their requests

• This is the first step of a stepwise licensing process
  • F-PSAR for Government approval
  • PSAR for construction start
  • SAR for operation license
  • Technology development and research will continue in parallel
  • How much must be proven at this step – what can be left for next step
Basis for continued research and technology development

• The need for an increased **process understanding**
  − Judge the importance for post-closure safety
    - Remaining uncertainties
    - Less pessimistic assumptions

• The need for knowledge and competence around **design, construction, manufacture and installation** of the components
  − From conceptual design to working facilities

• The need for knowledge and competence around **inspection and testing**
  − verify that the barriers and components are produced and installed according to approved specifications and thereby satisfy the requirements
Preparing for implementation

• SKB has established a technically feasible reference design and layout

• Detailed designs need to be developed adapted to an industrialised process designed to fulfilling specific requirements on quality, cost and efficiency.

• Examples:
  • Rock investigation and excavation technology to be optimized
  • Canister detailed design and manufacturing verified against requirements, tested and qualified
  • Buffer and backfill production facility, block manufacturing, emplacement technology and control methods to be optimized
Full scale underground testing

• **Commissioning tests of the entire KBS-3 system**
  – required input to operational license applications
  – quality control – products and organization
  – canister manufacturing and covering all steps needed until a deposition tunnel is backfilled and plugged, are required

• **Integration test before commissioning test needed**
  – ensure that the equipment and technological systems work together as intended would be needed
  – followed by modifications of the system (tools; procedures; organization)
Concluding remarks

• The road from license application to repository implementation is long and winding
• Complicated licensing process following two acts in parallel ensures strong public involvement
• Good progress – no showstoppers
• Remaining challenges
  • Final approval by authorities, municipalities and government
  • Going from theory to practice – Industrialization
  • Keeping public confidence
Thanks for your attention!