

5th Review Meeting of the Joint Convention

Swedish Presentation (Country Group 4)

Vienna, 13 May, 2015



Sweden's 5th National Report

- Progress in repository programme
- Resource challenges
- Development of regulations
- Update on nuclear power
- Plans for decommissioning





Swedish delegation

- ➔ **Mr. Mats Persson**, Director General, SSM
- ➔ **Mr. Johan Anderberg**, Director, SSM
- ➔ **Mr. Erik Lindfors**, Minister Counsellor at the Embassy and the Permanent Mission of Sweden to the UN
- ➔ **Mr. Henrik Melin**, Intern, Permanent Mission of Sweden to the UN
- ➔ **Ms. Anna Sanell**, Deputy director, Ministry of Environment and Energy
- ➔ **Ms. Ansi Gerhardsson**, Head of Section, SSM
- ➔ **Ms. Monica Hammarström**, Senior Manager, SKB
- ➔ **Mr. Björn Dverstorp**, Senior Advisor, SSM
- ➔ **Mr. Tomas Löfgren**, Senior Legal Advisor, SSM
- ➔ **Mr. Ervin Liszka**, Senior Advisor, SSM
- ➔ **Mr. Bengt Hedberg**, Senior Advisor, SSM
- ➔ **Ms. Erica Brewitz**, Senior Specialist, SSM
- ➔ **Mr. Jan Johansson**, Senior Specialist, SSM
- ➔ **Mr. Michael Egan**, Analyst, SSM
- ➔ **Mr. Anders Wiebert**, Analyst, SSM
- ➔ **Ms. Lena Sonnerfelt**, Analyst, SSM
- ➔ **Mr. Simon Carroll**, Analyst, SSM



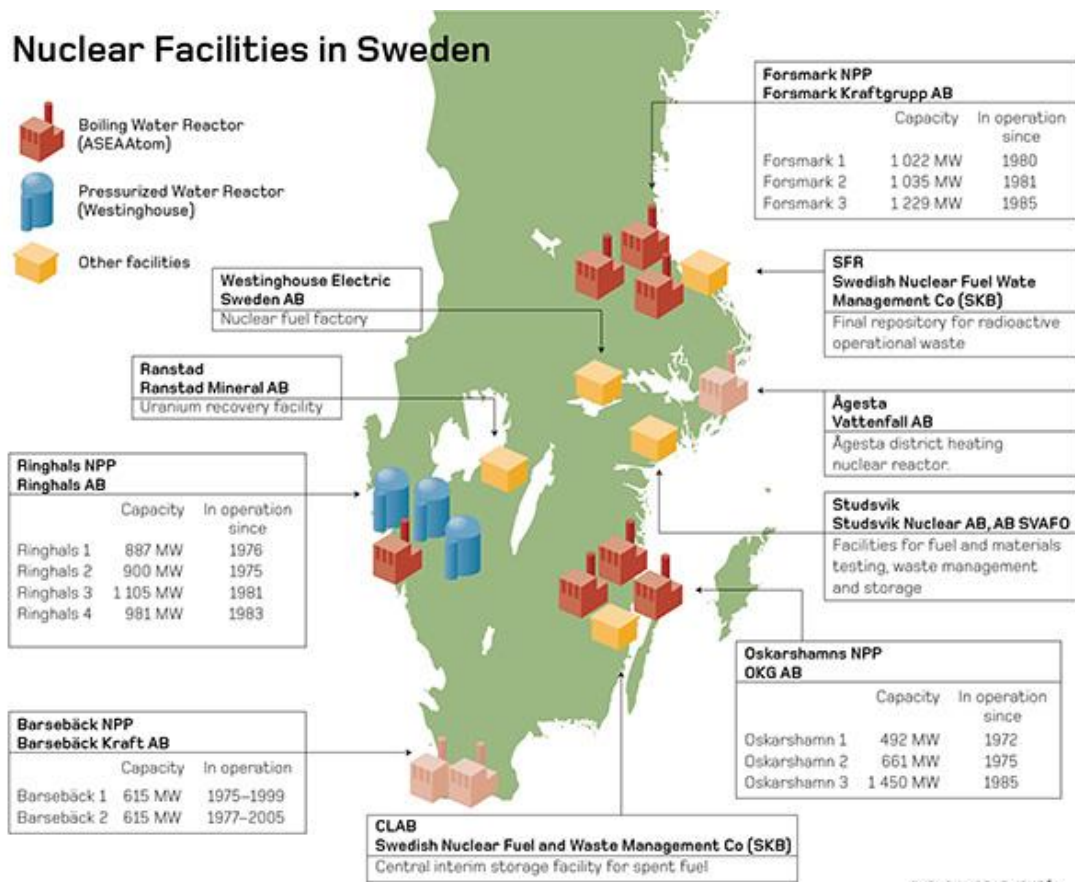
Presentation outline

1. *Introduction and context*
2. Summary results from the 4th review meeting
3. Developments since the 4th review meeting
4. National legal and organisational framework
5. National system for the management of spent fuel and radioactive waste (SKB)
6. General efforts to improve safety
7. Licensing review of a spent fuel repository application
8. Strong features, major challenges and areas for improvement
9. Main questions raised to Sweden in the 5th review
10. Conclusions



The Swedish nuclear programme

Nuclear facilities and locations



- Ten reactors in operation (Forsmark, Ringhals, Oskarshamn)
- Four closed down reactors (Barsebäck, Ågesta, Studsvik)
- Central storage facility for spent fuel (Clab)
- Central repository for short-lived LIL waste (SFR)
- Fuel factory (Västerås)
- Research facilities (Studsvik)
- Closed down uranium extraction facility (Ranstad)



The Swedish nuclear programme

Sea based transport system





Non-nuclear radioactive waste

- Disused sealed sources
- Orphan sources
- Naturally occurring radioactive material (NORM)
- Contaminated industrial sites





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Good practices

From the 4th review meeting

- ➔ Responsibilities for spent fuel and waste safety are clearly defined in the legal framework
- ➔ Financing arrangements in place related to spent fuel and radioactive waste management as well as decommissioning
- ➔ A funding mechanism is available for costs for orphan sources and other legacy waste
- ➔ A long-term strategy is in place for disposal of spent fuel and nuclear fuel cycle wastes, with defined milestones
- ➔ Provisions for transparency and an extensive public consultation in the decision making process
- ➔ Constructive communication regulator / licensees



Challenges and planned measures to improve safety

Follow-up from the 4th review meeting

- Licensing of an encapsulation plant and a repository for spent nuclear fuel
- Licensing of a disposal facility for decommissioning waste
- Development of waste acceptance criteria for long-lived waste
- Safety reassessments (stress tests) of nuclear power reactors and the Clab storage facility for spent fuel as a consequence of the Fukushima Daichii accident
- Improvements as a result of the 2012 IRRS mission
- Continued implementation of the national action plan for radioactive waste



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National programme

Revised overview of rapporteur's matrix

TYPE OF LIABILITY	LONG-TERM MANAGEMENT POLICY	FUNDING OF LIABILITIES	CURRENT PRACTICE / FACILITIES	PLANNED FACILITIES
SPENT FUEL	NPP licensees responsible. Strategy in place for disposal.	Funded by fees on nuclear energy, accumulated in the Nuclear Waste Fund.	Stored on site initially, then transferred to the central interim storage facility (Clab) pending disposal.	Licence application for an encapsulation plant and a spent nuclear fuel repository under review.
NUCLEAR FUEL CYCLE WASTES	NPP licensees responsible. Strategy in place for disposal.	Mainly funded by fees on nuclear energy.	Short-lived LILW disposal at existing repository (SFR);	Licence application for extension of SFR under review.
		Disposal of operational LILW waste (SFR) from NPPs paid for directly by owners.	Shallow land burial sites for VLLW exist at NPP sites.	Long-lived LILW to be disposed of in the planned repository for long-lived LILW nuclear fuel cycle waste (SFL). Licence application expected in 2030.
NON-POWER WASTES	Disposal at fuel cycle waste facilities when appropriate, further actions ongoing.	Financed by producers / owners of waste.	Disposal at fuel cycle waste repository (SFR) or interim storage pending disposal in the planned repository for long-lived LILW nuclear fuel cycle waste (SFL).	Licence application for extension of the existing repository for short-lived LILW (SFR) under review.
		Government funding available for legacy wastes.		Long-lived LILW to be disposed of in the planned repository for long-lived LILW nuclear fuel cycle waste (SFL). Licence application expected in 2030.
DECOMMISSIONING	Licensee is responsible.	Mainly funded by fees on nuclear energy production, accumulated in the Nuclear Waste Fund.	Preliminary plans for decommissioning exist for all nuclear facilities, more detailed plans for those approaching or undergoing decommissioning.	Licence application for extension of the existing repository for short-lived LILW (SFR) to accommodate decommissioning waste from nuclear facilities under review.
			Reviews of the adequacy of funding every three years.	Long-lived LILW to be disposed of in the planned repository for long-lived LILW nuclear fuel cycle waste (SFL). Licence application expected in 2030.
DISUSED SEALED SOURCES	Returned to manufacturer.	Financed by producers / owners of waste.	Returned to manufacturer or disposed of in SFR or in interim storage pending disposal in the planned repository for long-lived LILW nuclear fuel cycle waste (SFL).	To be disposed of in repositories for nuclear fuel cycle wastes, SFR or SFL (if not returned to manufacturer).
		Government funding available for orphan sources.		



Developments

Developments since the 4th review meeting

- Application submitted 2012 for one or two new nuclear power reactors – on hold since 2015
- Planned closure of three operating reactors communicated
- Decommissioning and dismantling of Studsvik research reactors has been initiated – to be finished 2019
- Decommissioning of Ranstad uranium milling facility ongoing – to be finished 2017
- Government decision on SKB's tenth RD&D programme
- Government decision to double the nuclear waste fee
- Licence application for an extension of the SFR facility to accommodate decommissioning waste
- Plutonium transfers



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National Policy

Fundamental principles

- The licensees have the prime responsibility to manage and dispose of SNF/NW
- The costs should be covered by revenues from the energy production giving rise to SNF/NW
- Swedish SNF/NW should be disposed of in Sweden - only by exception is the disposal of foreign NW allowed in Sweden
- The State has the ultimate responsibility

also

- Swedish SNF should not be reprocessed, in Sweden nor elsewhere



Legislative and Regulatory Framework

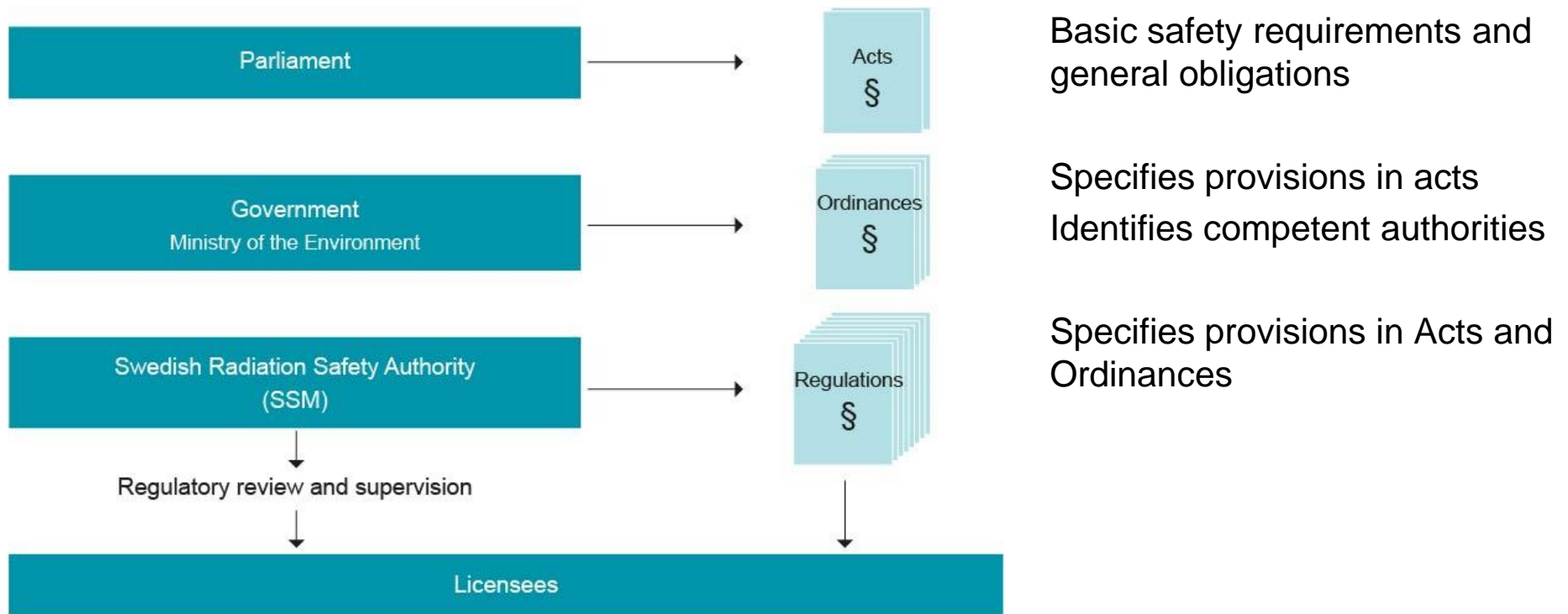
Main legislative instruments

- The Act (1984:3) on Nuclear Activities
- The Radiation Protection Act (1988:220)
- The Act (2006:647) on Financing of Management of Residual Products from Nuclear Activities
- The Act (1988:1597) on Financing of Certain Radioactive Waste (the Studsvik Act)
- The Environmental Code



Legislative and Regulatory Framework

Hierarchical structure

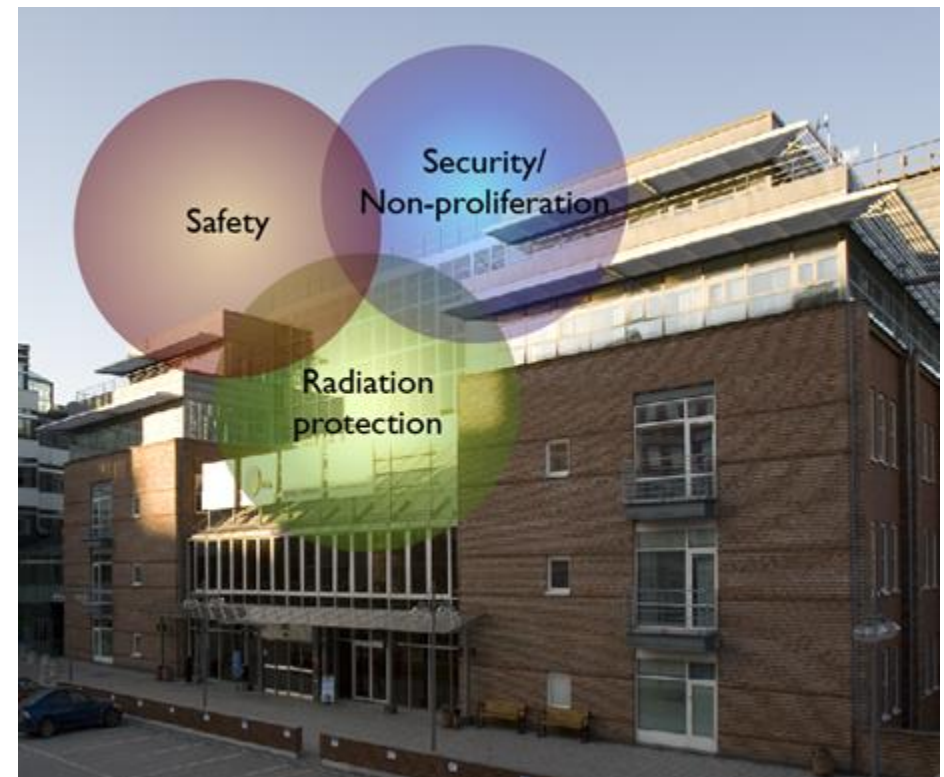




Legislative and Regulatory Framework

SSM roles and responsibilities

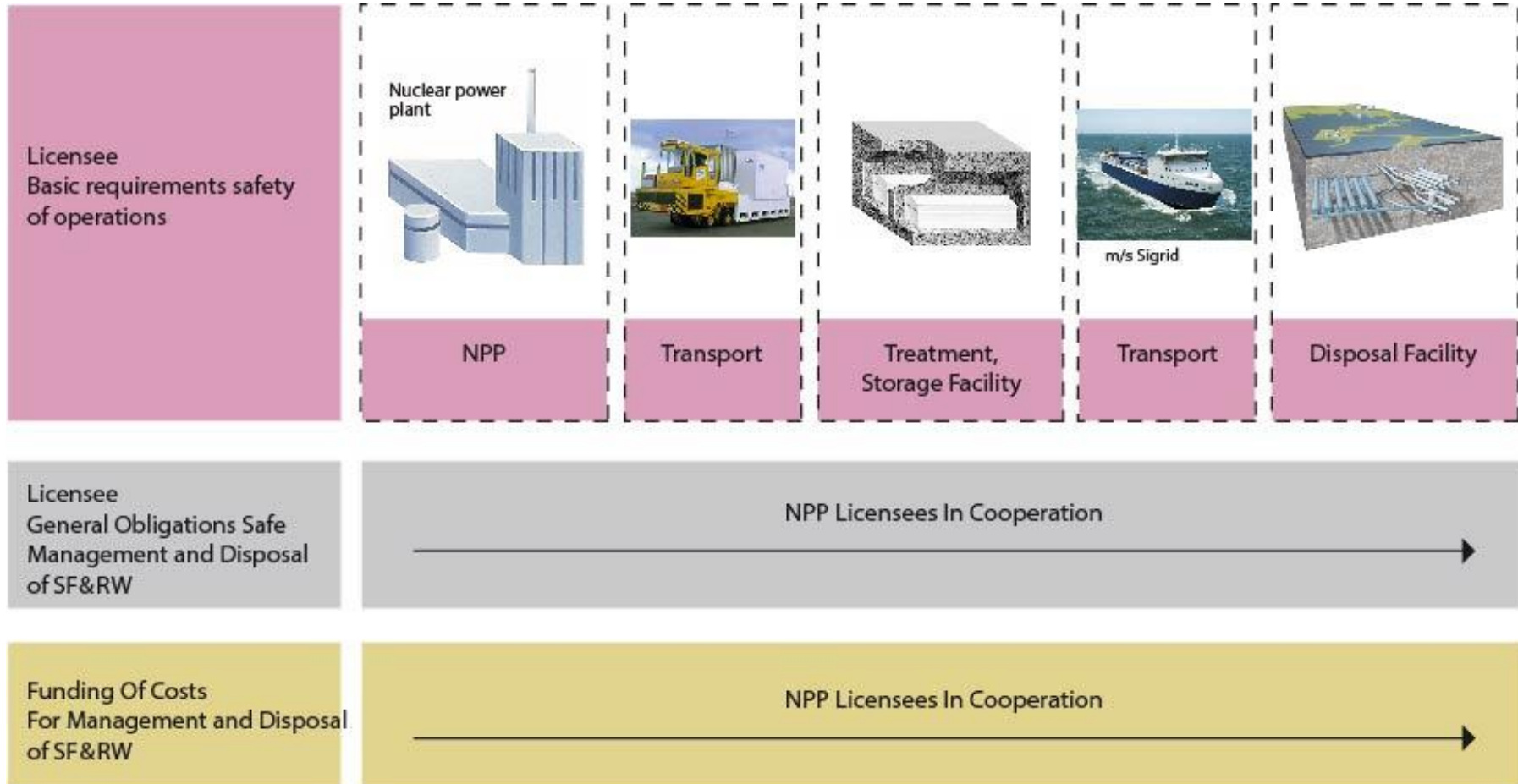
- ➔ Regulatory authority
- ➔ Licensing authority
 - SSM decisions
 - Government decisions
- ➔ Supervisory authority
 - Reviews
 - Inspections
 - Enforcement
- ➔ Authority for emergency preparedness and response
- ➔ Expert authority





Legislative and Regulatory Framework

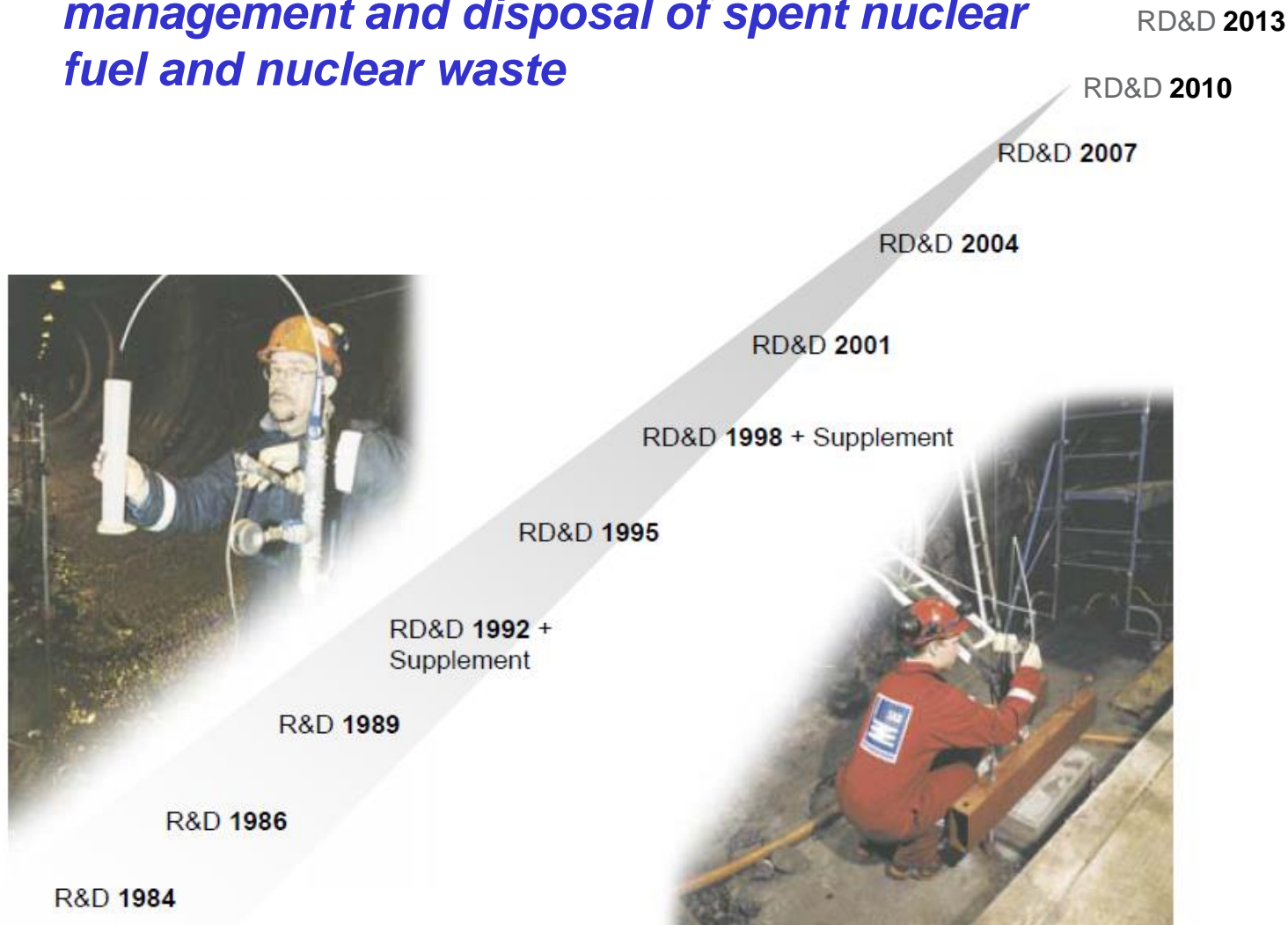
Basic requirements and general obligations





Legislative and Regulatory Framework

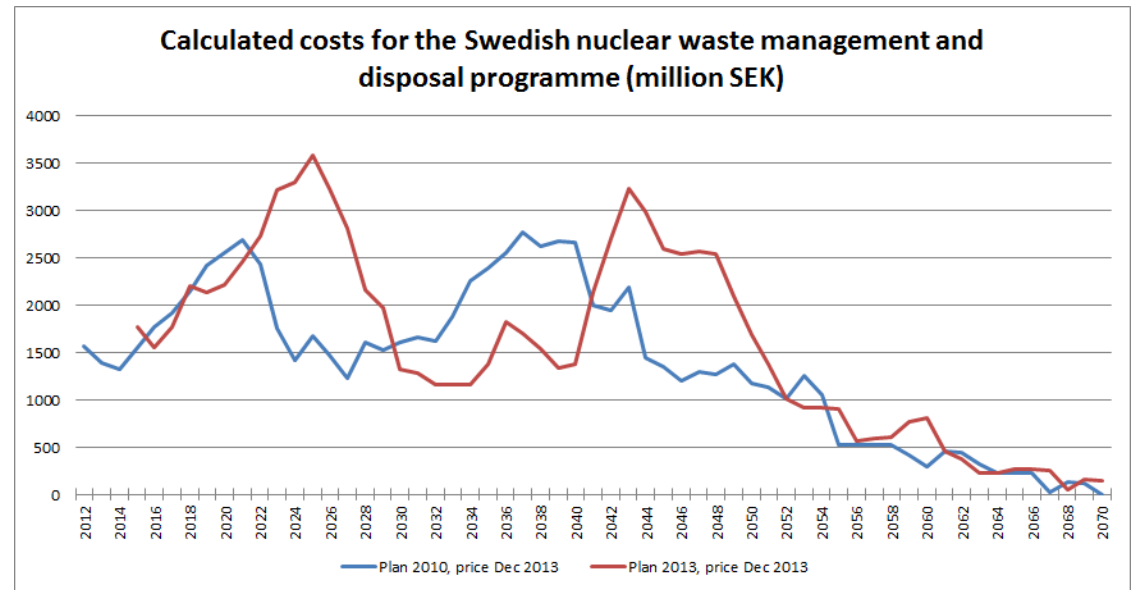
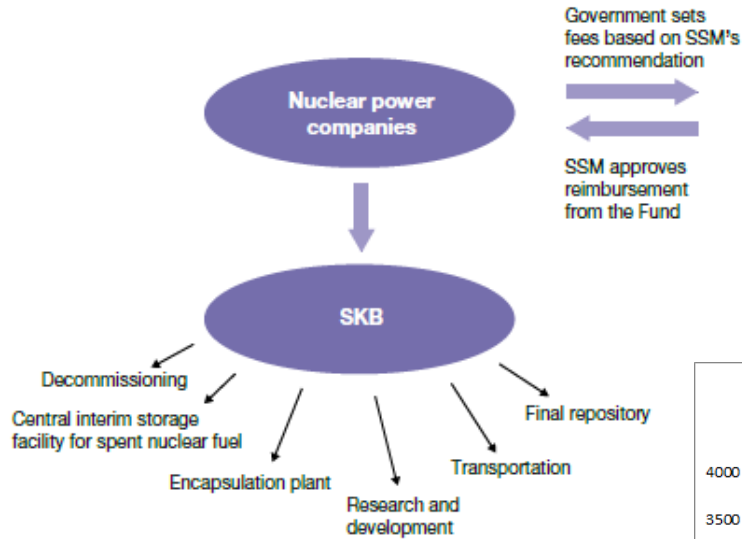
Continuous R&D-programme for the safe management and disposal of spent nuclear fuel and nuclear waste





Legislative and Regulatory Framework

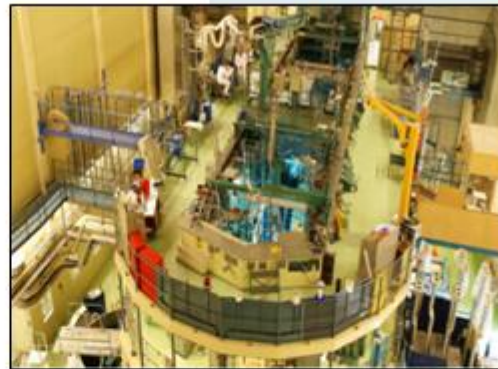
The Financing System





Legislative and Regulatory Framework

The Financing System – Legacy Waste



Studsvik research reactor



Ranstad uranium mining and milling facility



Legislative and Regulatory Framework

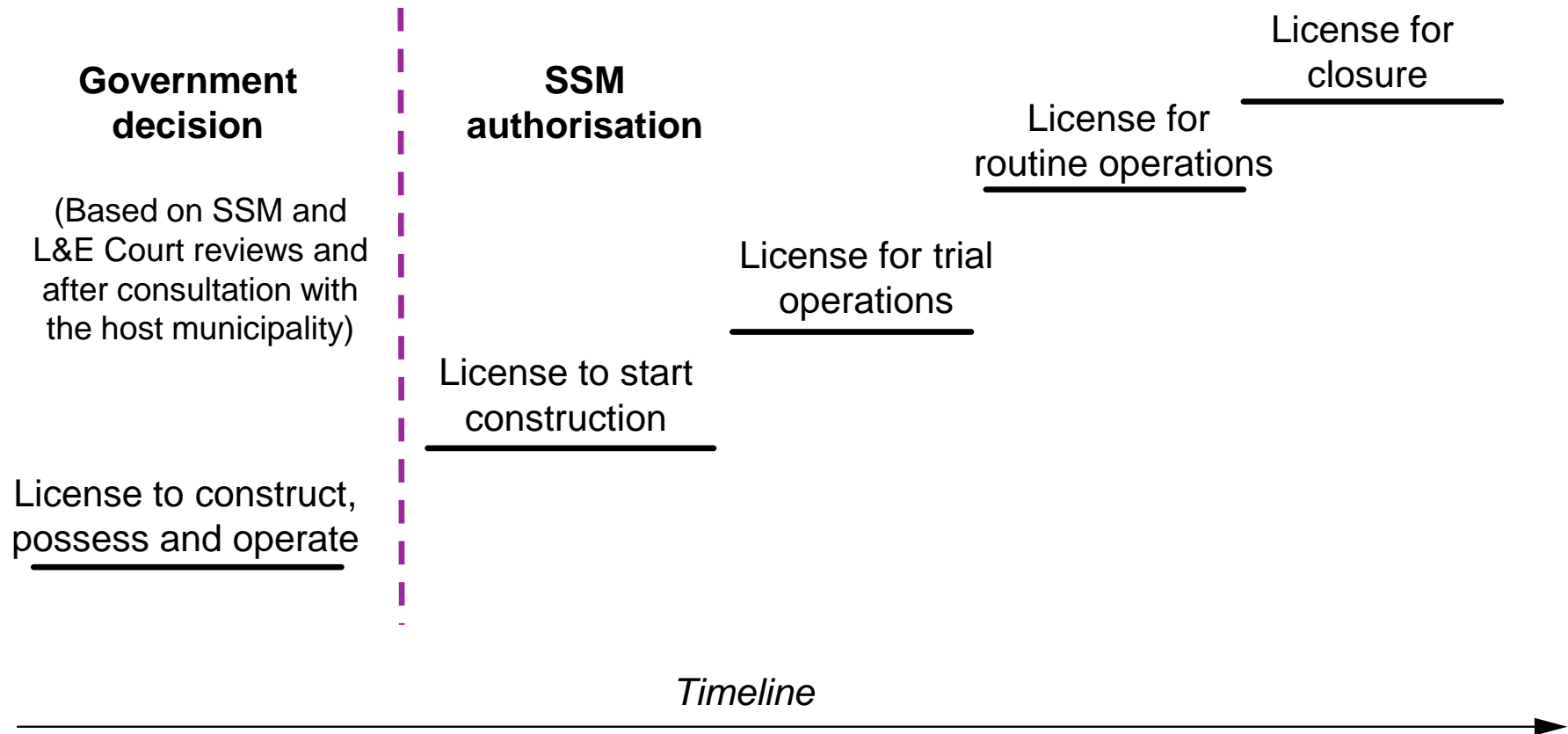
The Financing System – Non Nuclear Activities





Legislative and Regulatory Framework

A step-wise licensing process





Legislative and Regulatory Framework

Legal provisions for transparency and public participation

- RD&D programme consultations over 30 years
- Open and predictable step-wise siting and licensing process
- Environmental Impact Statement consultations
- Active involvement of stakeholders with financial support to NGO's
- Local communities right to veto Government licensing decision
- Integrity and independence of the regulator
- Public insight into regulatory activities
- Right to access information

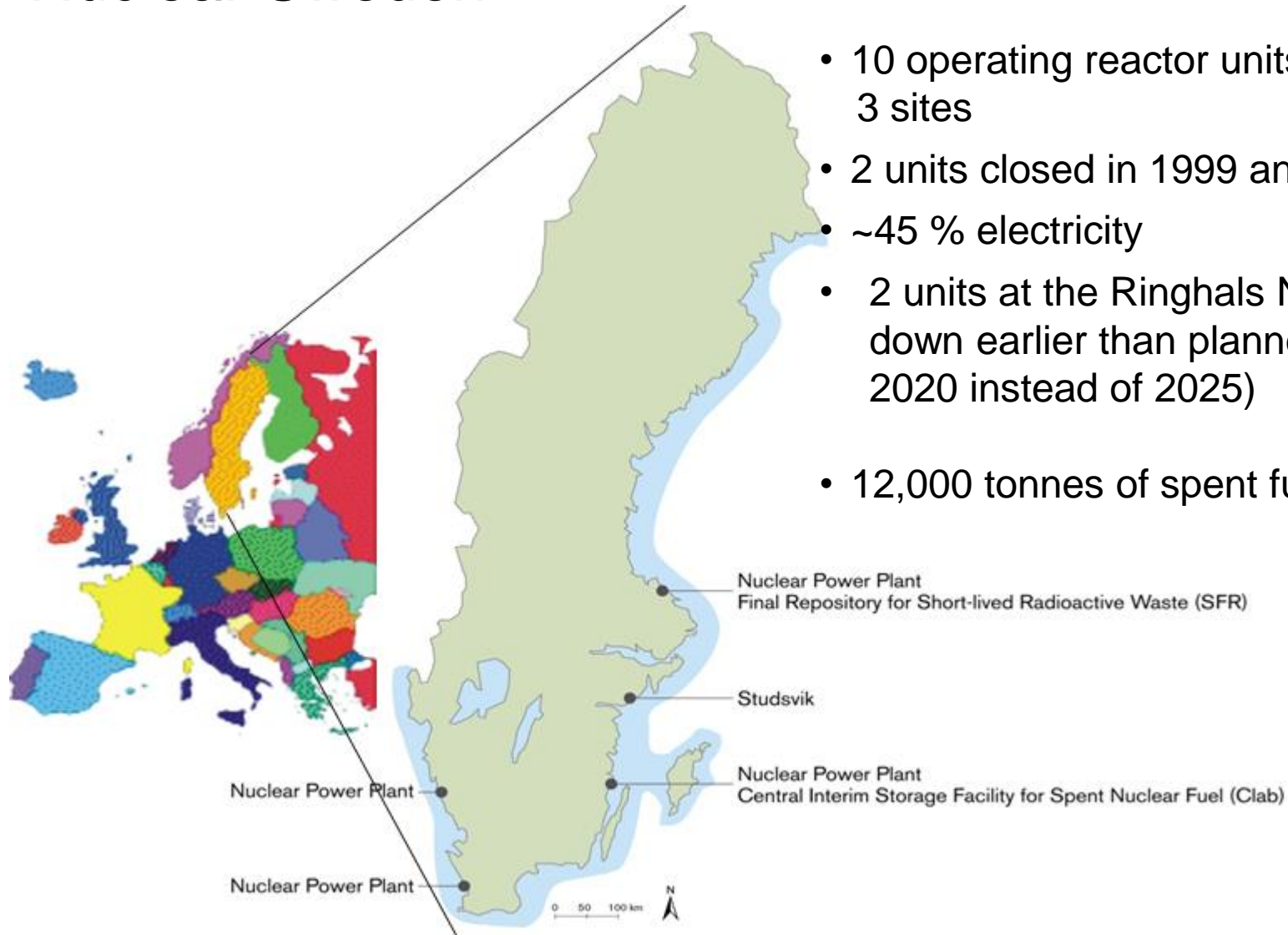




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Nuclear Sweden



- 10 operating reactor units at 3 sites
- 2 units closed in 1999 and 2005
- ~45 % electricity
- 2 units at the Ringhals NPP will be shut down earlier than planned. (2018 and 2020 instead of 2025)
- 12,000 tonnes of spent fuel

SKB's system

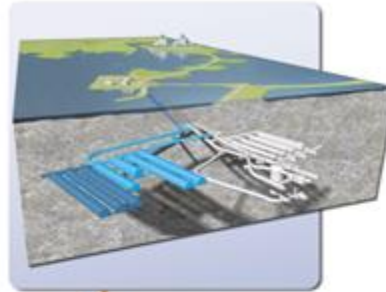
Medical care, industry and research



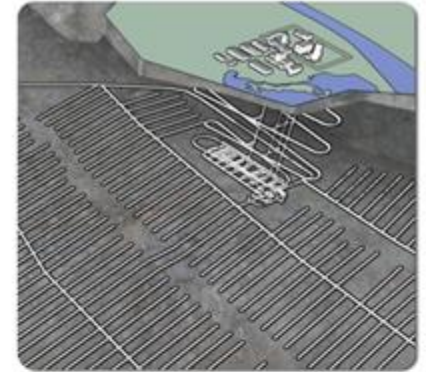
Operational waste

Spent nuclear fuel

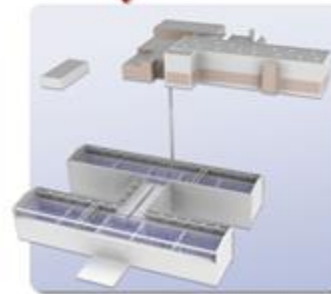
Final repository for short-lived radioactive waste



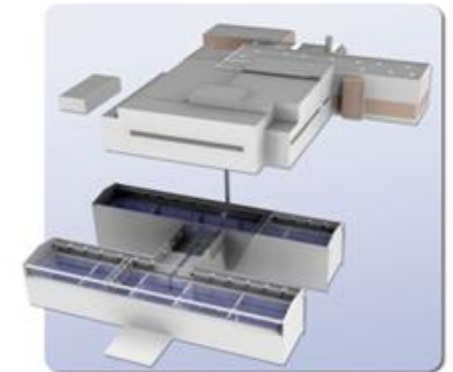
Final repository for spent nuclear fuel in Forsmark



Nuclear power plant



Central interim storage for spent nuclear fuel (Clab)

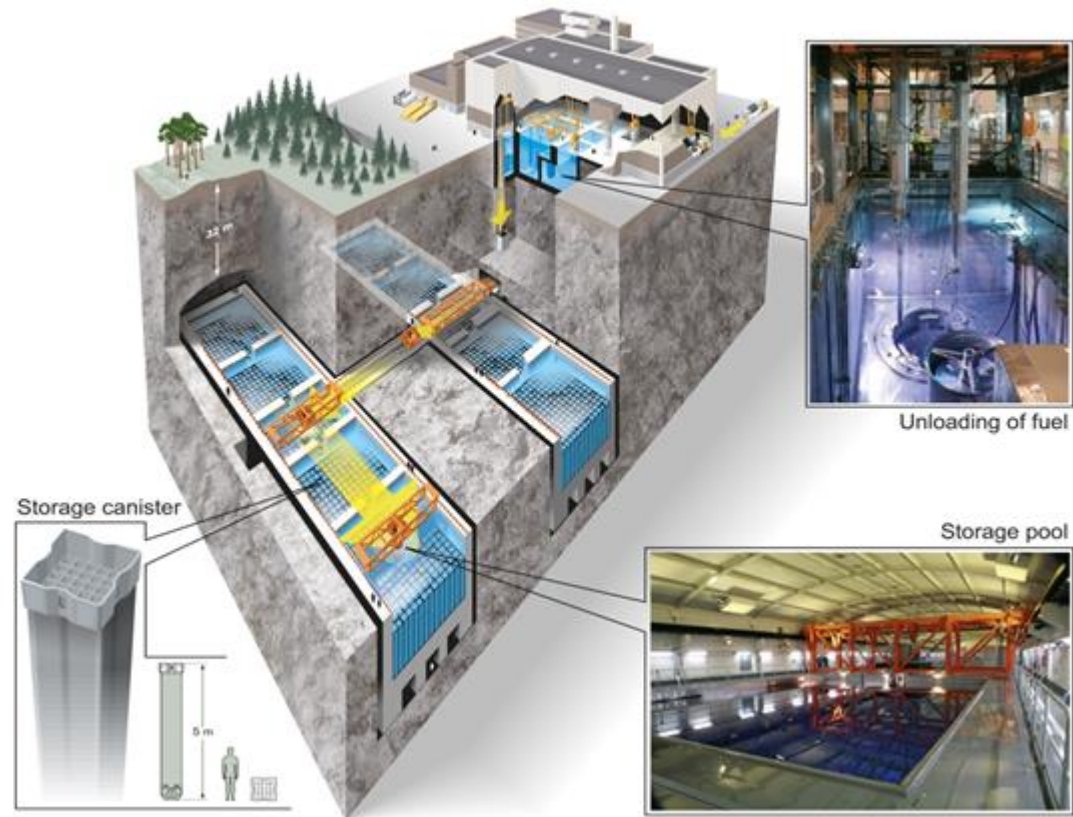


Encapsulation plant in Oskarshamn



Central interim storage facility, Clab

- SKB has submitted an application to increase the storage capacity in Clab from 8000 tonnes to 11000 tonnes



Stress tests of Clab

Analysis identified areas for improvement regarding the facility's resistance and ability to withstand:

earthquakes	Analysis show that requirments are fulfilled
flooding	
consequences of loss of safety functions: <ol style="list-style-type: none">1. loss of electrical power (including station blackout),2. loss of the ultimate heat sink,3. combination of both of the above	Backup power and pumps have been purchased
severe accident management issues	
extreme weather.	Instructions regarding heavy snowloads and trombs have been developed

Interim storage capacity

- A study has been carried out to evaluate different measures to ensure interim storage capacity

Conclusions:

- There are combinations of measures ensuring capacity in Clab until 2036
 - Achieved by denser packing of the fuel and moving core components
 - Requires that the KBS-3 system is in operation 2035
- If start of operation of the KBS-3 system is delayed storage capacity will not be sufficient.
 - Increased wet storage or dry storage solutions
 - Lead time to develop new capacity is needed in order to estimate time for decision



SFR

Final repository for short-lived radioactive waste

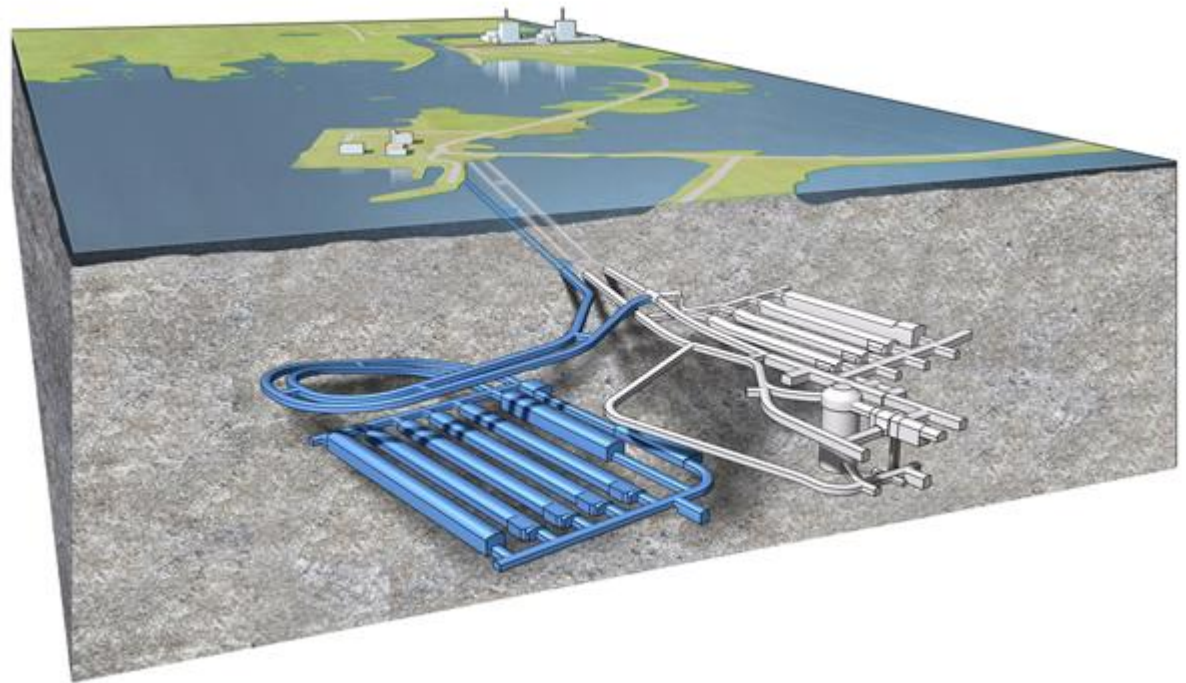
Integrated facility after extension

License application in 2014

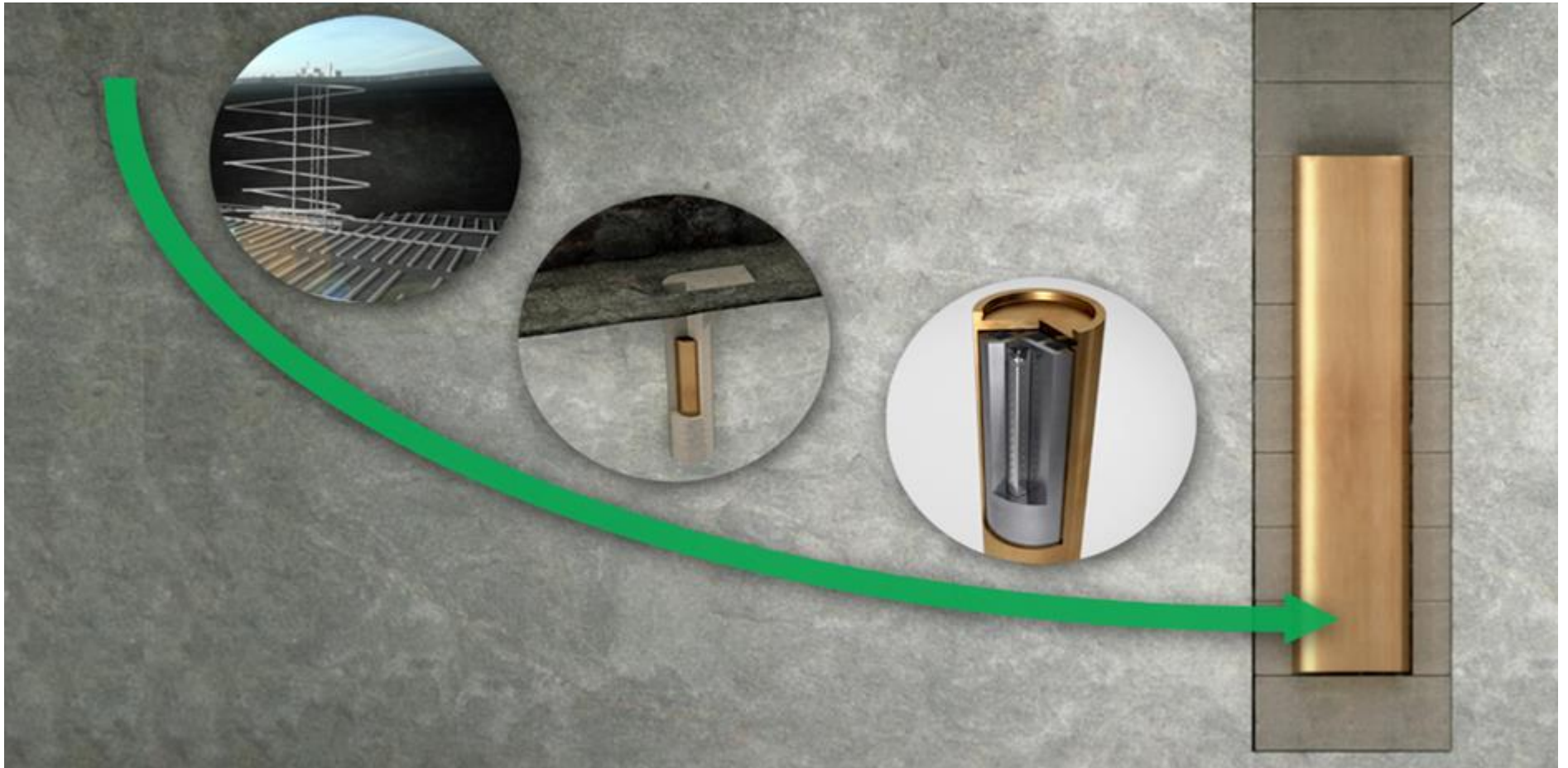
Start of construction in 2019

Start of operation in 2024

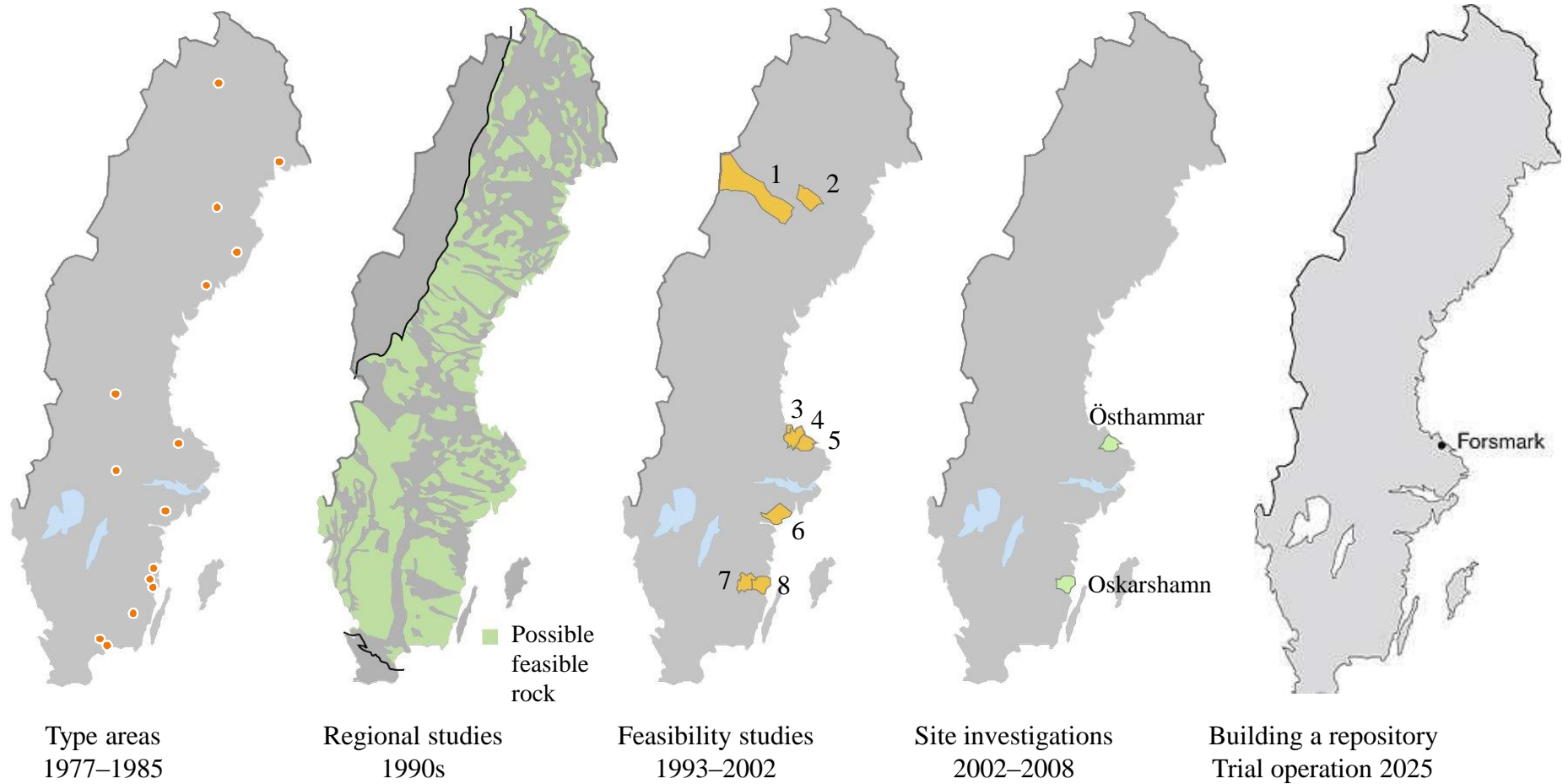
Approximately 130 000 m³
of which 50 000 m³ ILW



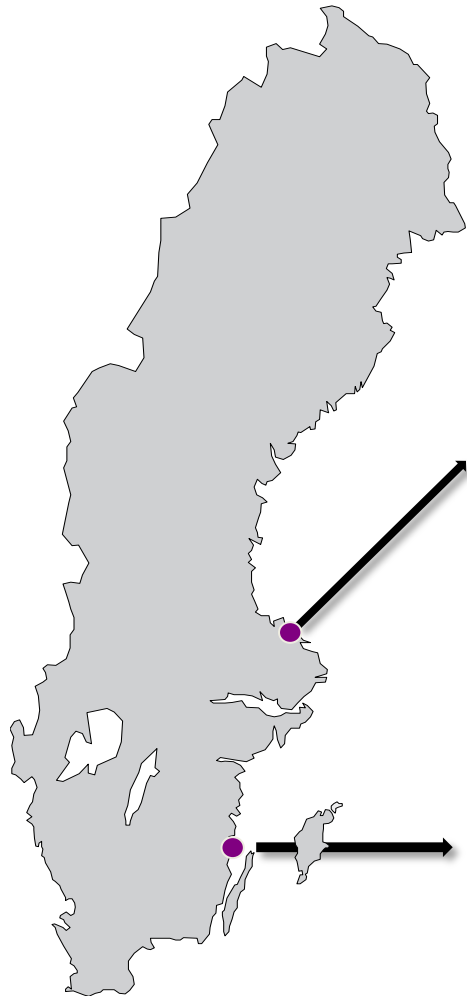
SKB's method for spent nuclear fuel



Finding a site



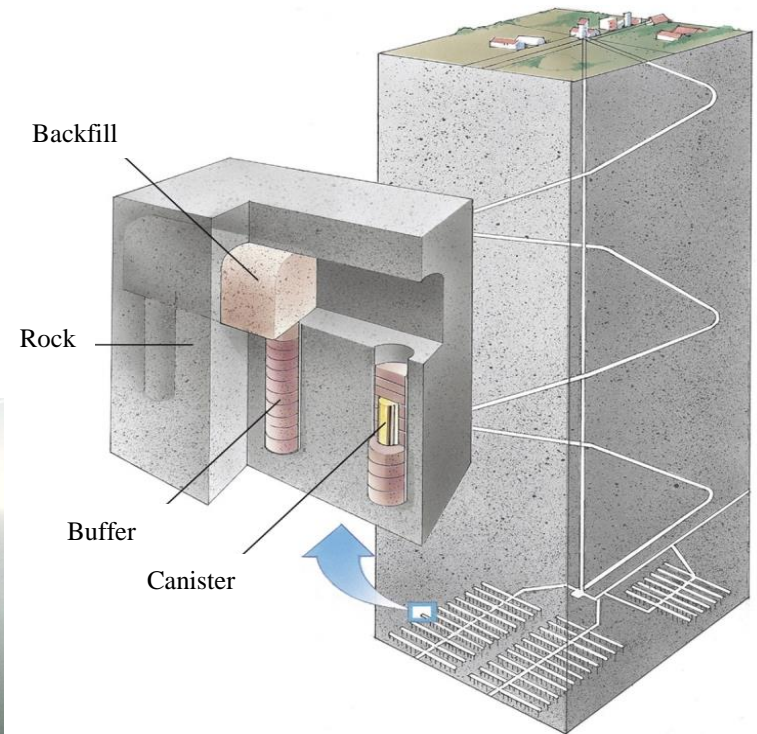
License application submitted March 2011 for



Spent Fuel Repository at Forsmark



Encapsulation plant in Oskarshamn



The reviewing of the post-closure safety report SR-Site

- An international peer review by OECD/NEA of SR-Site was commissioned by the Swedish Government
- The results were reported in 2012 with the following conclusion
 - “From an international perspective, SKB’s post-closure radiological safety analysis report, SR-Site, is sufficient and credible for the licensing decision at hand. SKB’s spent fuel disposal programme is a mature programme - at the same time innovative and implementing best practice - capable in principle to fulfil the industrial and safety-related requirements that will be relevant for the next licensing steps.”
 - “Another challenge for the future will be to both enhance and broaden the basis for the scientific evidence supporting long-term safety. To that effect, additional research and more detailed calculations will be needed for the safety cases supporting the next licensing steps.”

Michael Sailer,
Chairman of the
NEA review team



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
 - Close to nuclear power plants
 - Inland site – regional groundwater flow
- Long term safety issues
 - Canister integrity
 - Detailed technical issues – mainly from SSM
- “Conventional” environmental consequences
 - Discharges to water
 - Consequences for endangered species and nature values
 - Consequences from traffic, noise from operations
 - Management of rock from excavation



Next steps towards implementation

- Main items of work
 - Construction of the facilities
 - Build-up of organization in Forsmark
 - Continued technology development
 - Detailed design
 - Industrialized production and control system
 - Further strengthening the scientific basis on processes of importance for long term safety
 - To keep and develop public confidence



Clink and Spent fuel repository

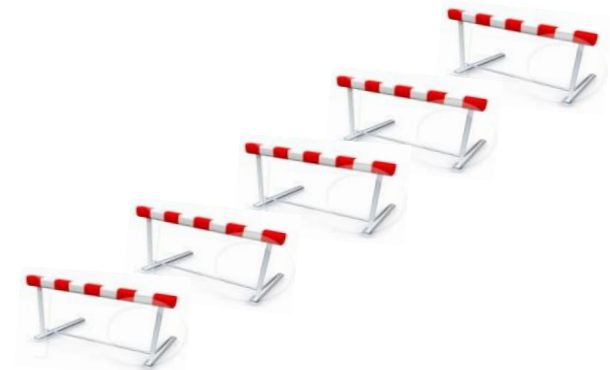
Licencing process

- SKB's applications scrutinized for four years.
- Authorities and NGO's have asked for additional data, reports etc.
- SKB has submitted extensive additional materials.
- Next formal step:
 - Public notification – applications deemed complete by SSM and the environmental court.
- Examination in substance starts.



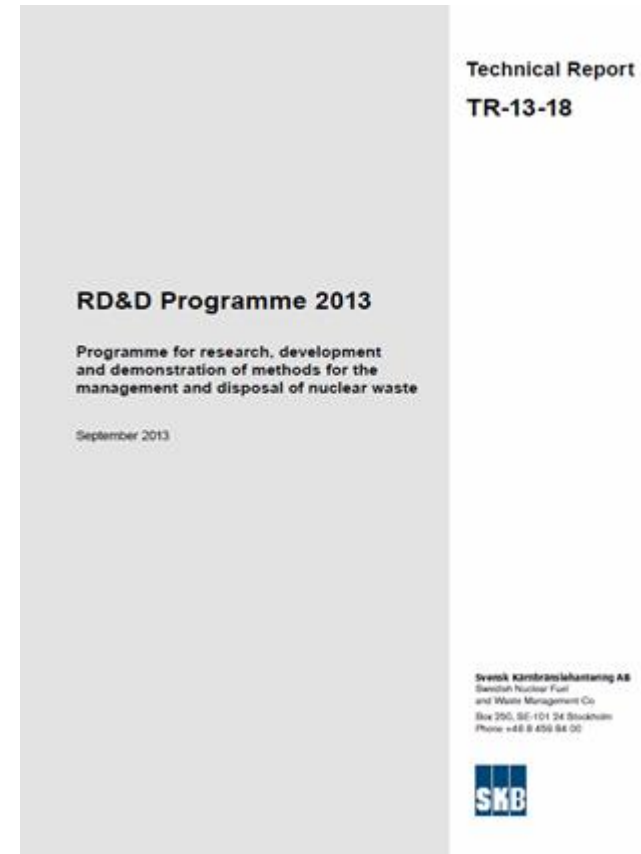
Remaining challenges

- Licensing and acceptance of a First of a Kind facility
- Going from theory to practice – Industrialization
- Keeping public confidence



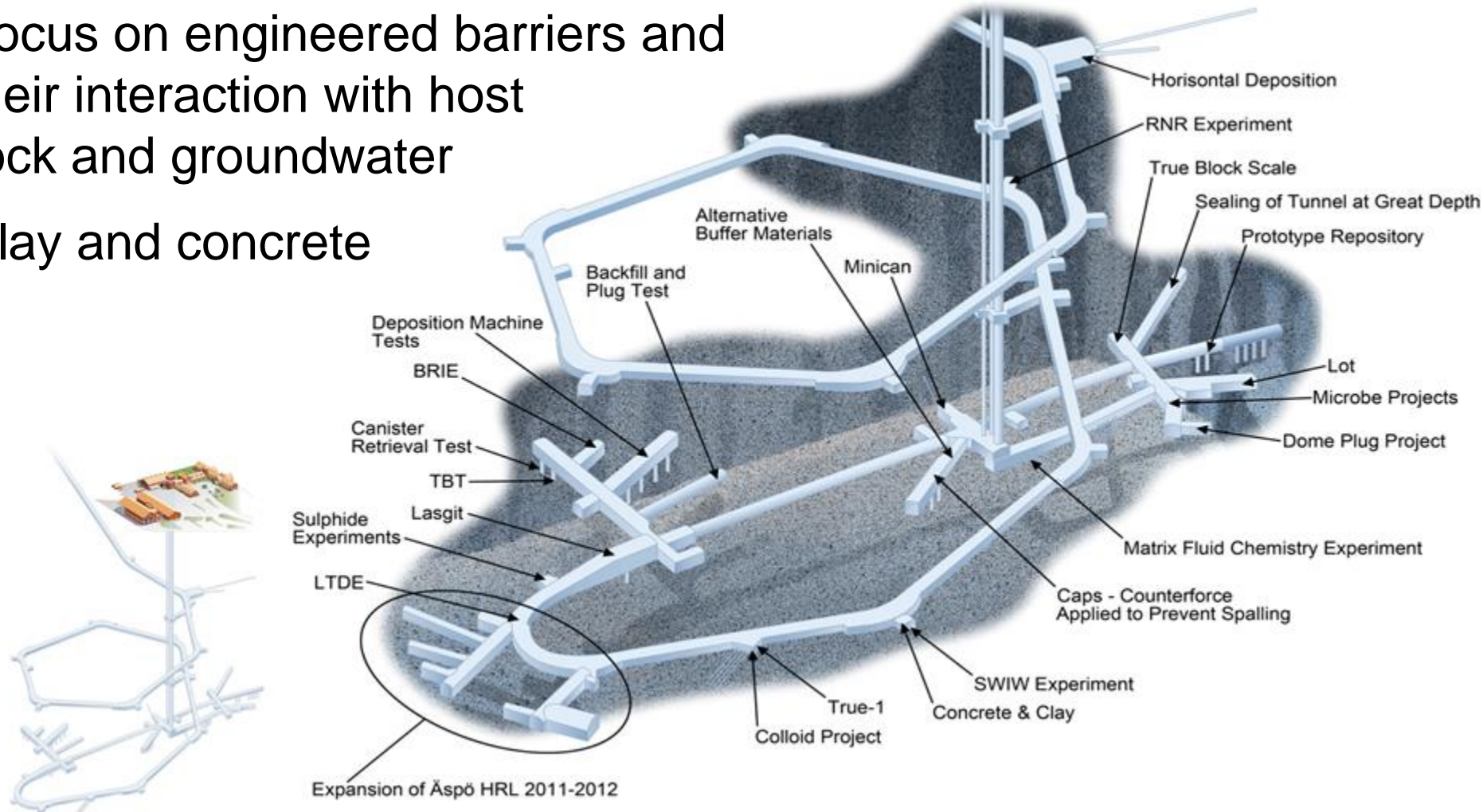
Research, Development and Demonstration Programme 2013

- Requirements according to the Nuclear Act
 - License holders for nuclear reactors should every 3rd year submit a programme for research and development and other measures necessary for decommissioning of nuclear facilities and final disposal of nuclear waste.
 - The programme should provide an overview of all measures that might may be necessary and specify in more detail the measures that are intended to be implemented within at least six years.
 - The programme shall be submitted to SSM by the end of September every third year.
- Has been in effect since 1986.



Äspö HRL Today

- Focus on engineered barriers and their interaction with host rock and groundwater
- Clay and concrete

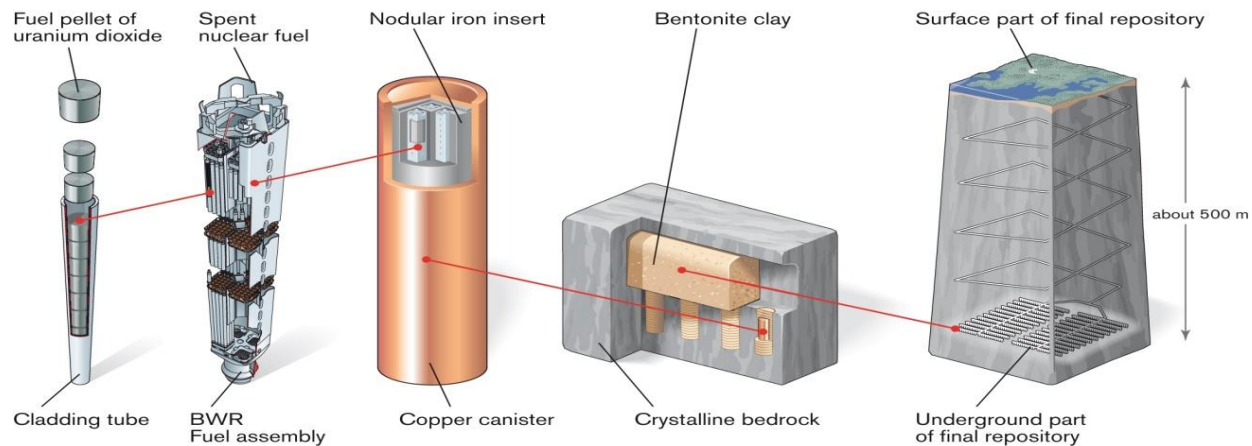


The Canister Laboratory



Extended cooperation with Posiva

- Programs for final disposal of spent nuclear fuel similar in Sweden and Finland
- Extensive cooperation countries over the years
 - KBS-3 concept in common
- Swedish Nuclear Fuel and Waste Management Co. (SKB)
 - License applications submitted in 2011 for a final repository at Forsmark, Sweden.
- Posiva, Finland
 - construction license application in 2012
- Soon a stage of final design and implementation
 - cooperation is deepened, aiming for the same technical design.



Swedish presentation at the 5th Joint Convention Review Meeting, 13 May 2015

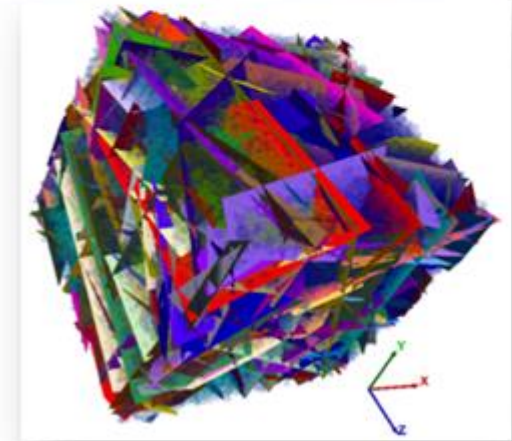
Full scale underground testing

- 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).



Research for assessment of long-term safety

- Main objectives in the current phase (for KBS-3)
 - find solutions to identified problems that affect safety or that reduce uncertainty in the assessment of long-term safety,
 - Focus on factors that contribute to risk, further clarify assumptions in the assessment
 - follow scientific progress, and
 - maintain and develop the competence necessary to carry out assessment of long-term safety.



Concluding remarks

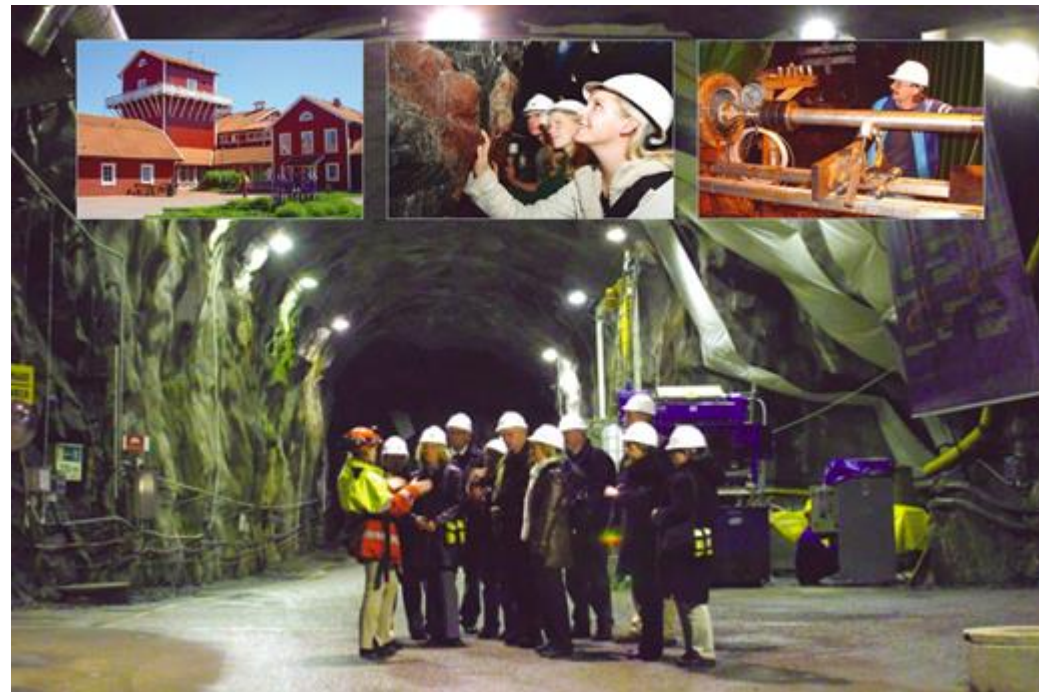
- Main conceptual issues resolved
- Substantial technology development and demonstration efforts required before the KBS-3-system can be operated as an industrial enterprise
- The KBS-3-system has been shown to provide safe final disposal for spent fuel at Forsmark and Olkiluoto
- Still some open issues remain to further strengthen the scientific basis on processes that contribute to risk
 - Reduce uncertainties
 - Additional data needs (host rock, engineered barrier properties)
- Maintain competence for future assessments



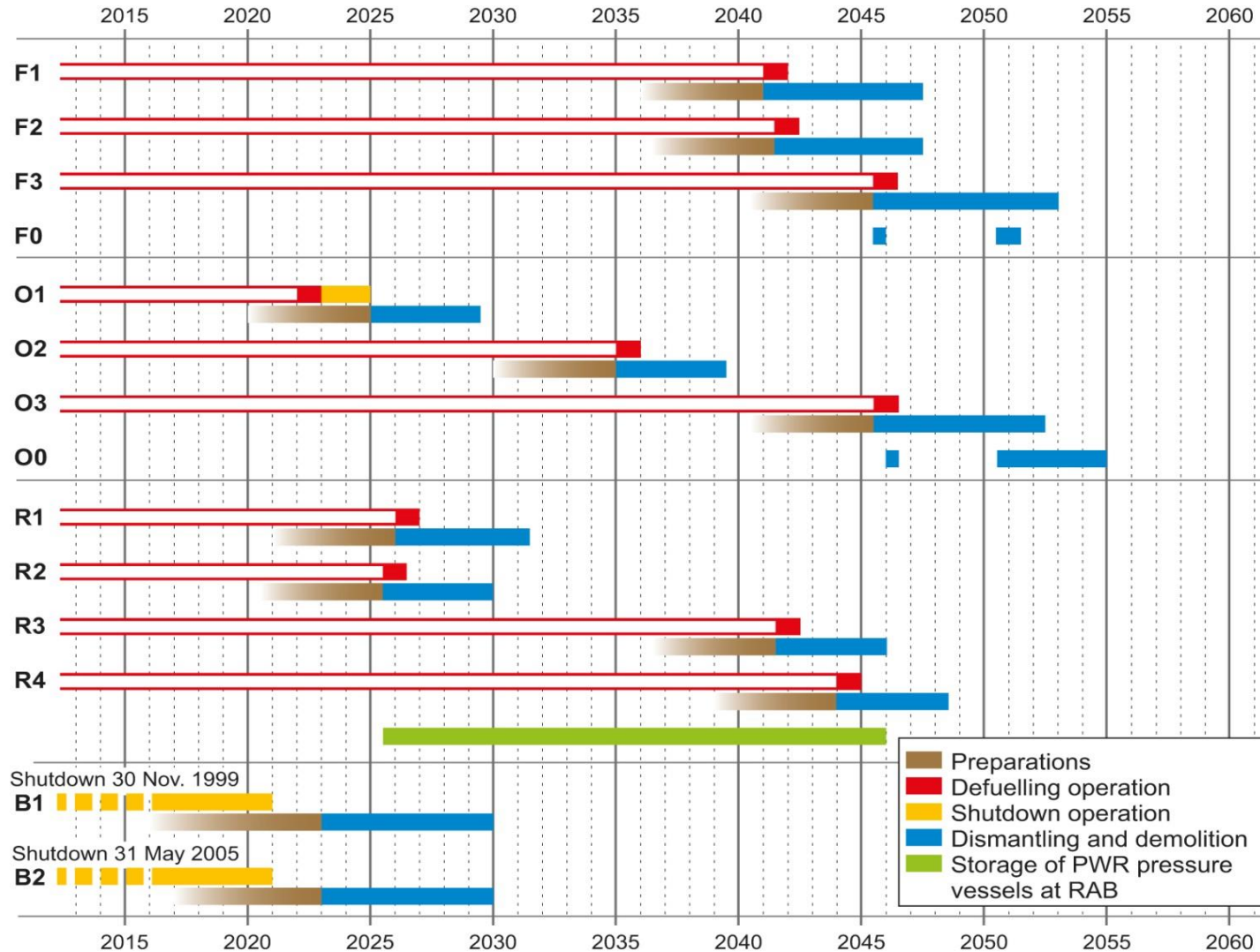
International cooperation started in the Stripa mine and continues at Äspö HRL



- Stripa project started in 1980 , 9 countries participated
- Construction of Äspö HRL started in 1990



Decommissioning





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General efforts to improve safety

Measures on suggestions and challenges from previous review

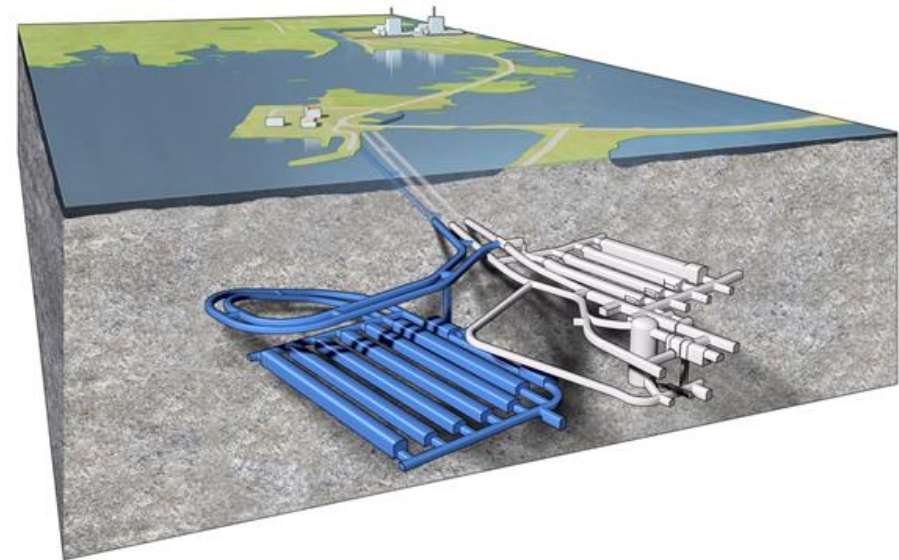
- Licensing of an encapsulation plant and a disposal facility for encapsulated spent fuel
- Licensing of an extension to the existing disposal facility for short-lived low and intermediate level waste (SFR) to also accommodate decommissioning waste
- Development of waste acceptance criteria for long-lived waste
- Safety reassessments as a consequence of the Fukushima Daichii accident



General efforts to improve safety

Licence application for a disposal facility for short-lived decommissioning waste

- ➔ SKB licence application Dec 2014
- ➔ Parallell review by SSM and Land & Environment Court
- ➔ First review assessment initiated
- ➔ Public consultation initiated
- ➔ Technical consultants in place
- ➔ SSM review project fully operational in 2016
- ➔ Statement in 2017 / 2018

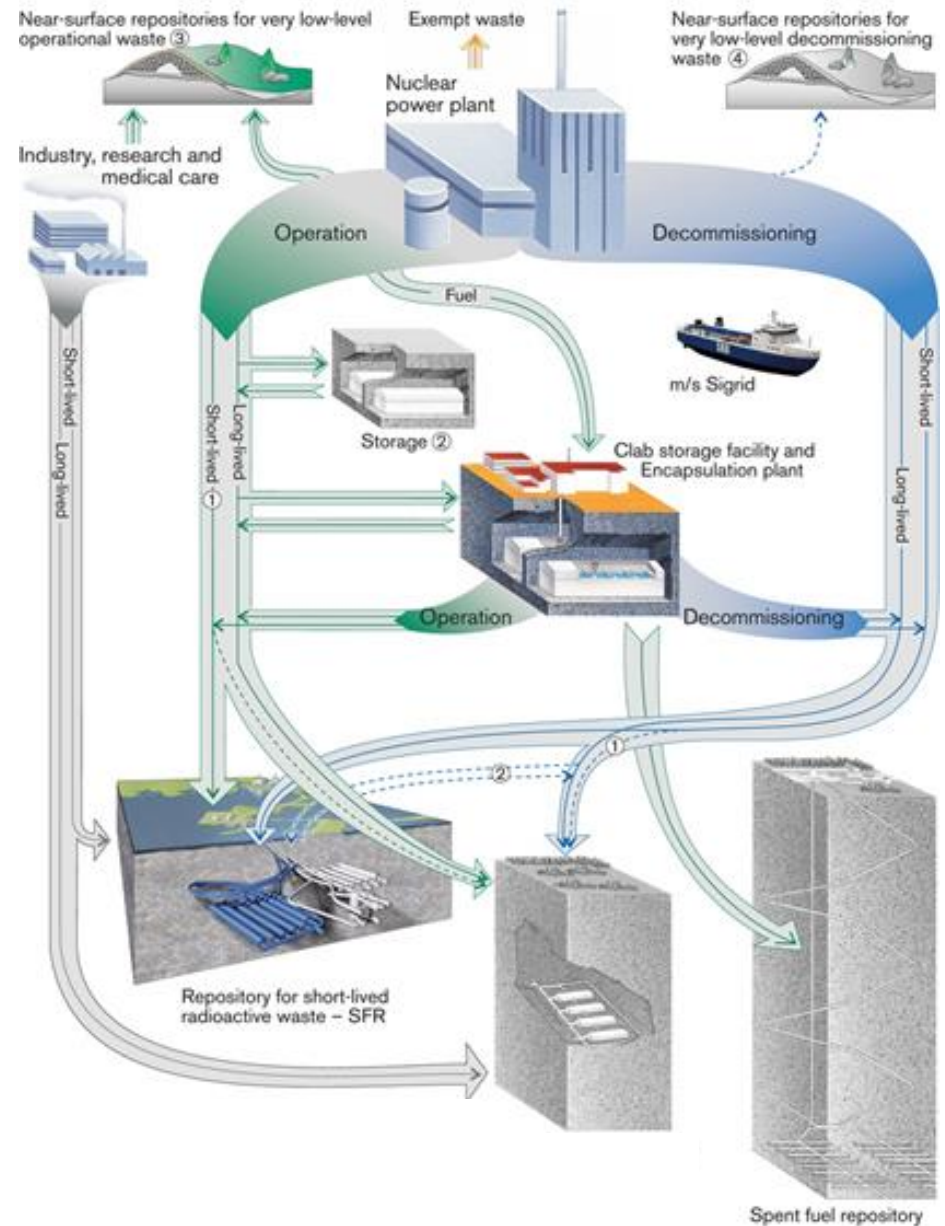




General efforts to improve safety

Development of waste acceptance criteria

- ➔ Long-lived waste (future SFL facility)
- ➔ Short-lived LIL waste (SFR)
- ➔ Short-lived VLL waste (shallow land burials)





General efforts to improve safety

Effects of the Fukushima accident

- ➔ Clab stress tests
- ➔ Spent fuel pools at NPP's
- ➔ Emergency preparedness





General efforts to improve safety

Other on-going measures since previous review

- ➔ Implementation of Directive 2011/70/Euratom (Waste directive)
- ➔ National plan for the management of spent nuclear fuel and radioactive waste
- ➔ Implementation of Directive 2013/59/Euratom (BSS)
- ➔ Review and updating of regulations
- ➔ Policy and plans for international peer review missions
- ➔ Periodic safety reviews (PSR)
- ➔ Actions to enhance openness and transparency



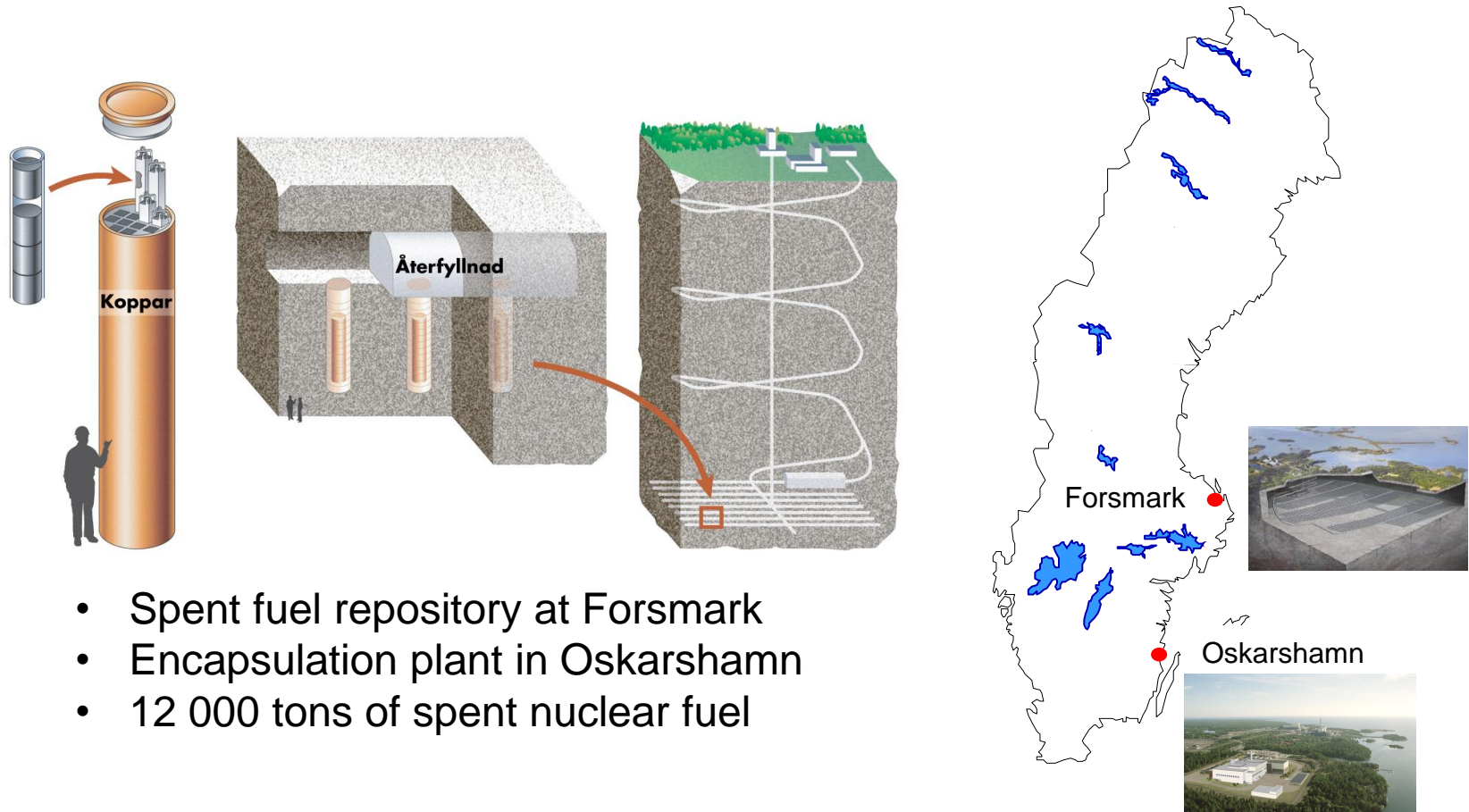
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Licensing review for spent fuel repository

SKB's license applications submitted 16 March 2011

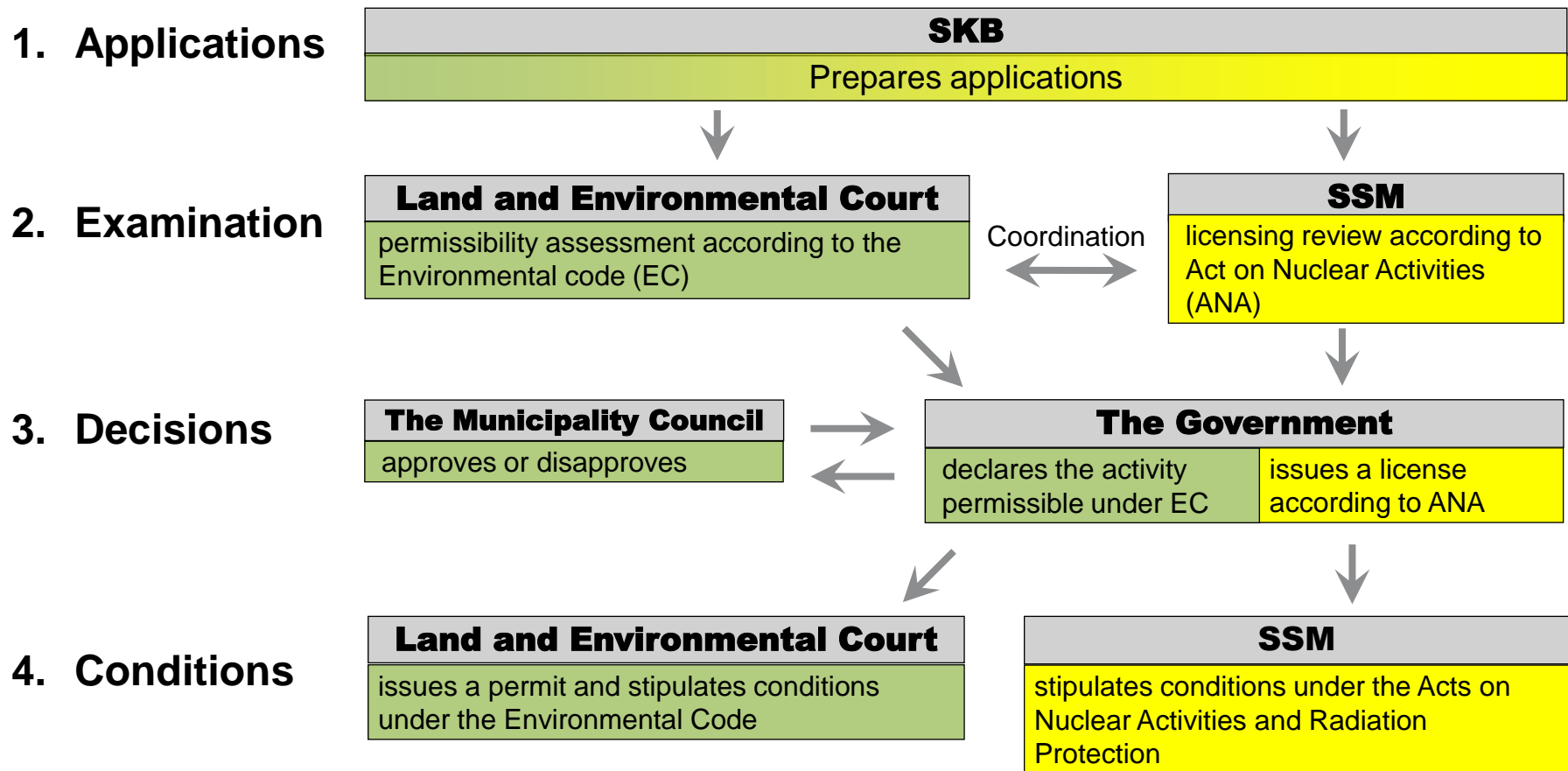


- Spent fuel repository at Forsmark
- Encapsulation plant in Oskarshamn
- 12 000 tons of spent nuclear fuel



Licensing review

The review process





Licensing review

SSM's review organisation

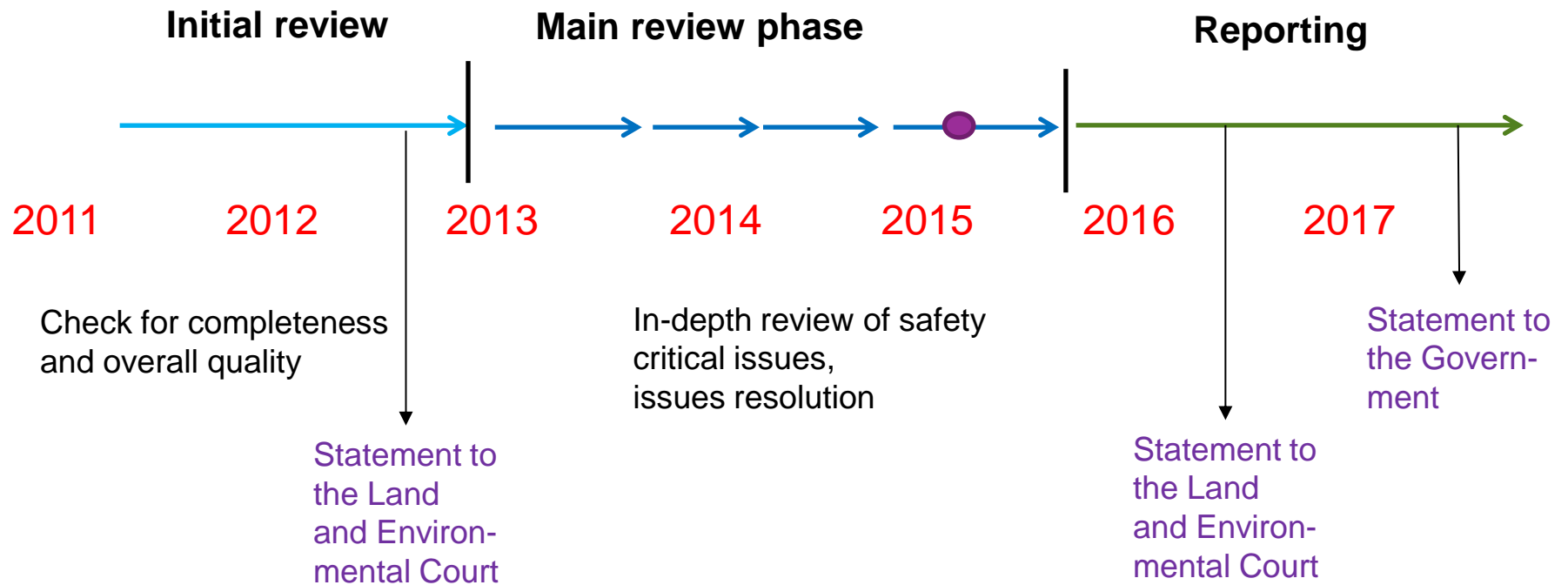
- ➔ SSM project
 - about 50 SSM staff (12 person yrs/yr)
- ➔ More than 40 external experts
- ➔ Funded by the Nuclear Waste Fund





Licensing review

SSM's review plan





Licensing review

Results so far

- ➔ Review of all primary documents
- ➔ Independent modeling
- ➔ 70 external experts' Technical Notes
- ➔ About 80 requests for complementary information
- ➔ International peer review



Licensing review

Support for stakeholder involvement

- ➔ Two national consultations of SKB's applications
 - municipalities, environmental org, NGOs, universities, authorities
- ➔ Public meetings after review milestones
- ➔ SSM's website
 - all correspondence with SKB
 - all external expert's review reports
- ➔ Publication of preliminary review findings (2015)
- ➔ Public Court hearings



Presentation outline

1. Introduction and context
2. Summary results from the 4th review meeting
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8. *Strong features, major challenges and areas for improvement*
9. Main questions raised to Sweden in the 5th review
10. Conclusions



Strong features

- ➔ Clear division of roles and responsibilities
- ➔ Continuity in waste management programme
- ➔ Provisions for stakeholder involvement
- ➔ Regulatory involvement in pre-licensing phase
- ➔ Clearly defined step-wise licensing process
- ➔ Openness and transparency
- ➔ Competent regulatory authority
- ➔ Independence of regulator



The Kynnefjäll site - guarded by locals 24/7 for 20 years (1980 – 2000)





Almunge 1985:
Dyersorp - Sweden
SKB stops test drillings

© Bengt Backström, Upsala Nya Tidning

June 2009: SKB reveals which site they selected for the repository (from the left) :

- one (initially) not so happy mayor
- one happy mayor and
- a happy SKB president



With permission
from SKB



Challenges

- ➔ Development of regulations
- ➔ Managing stakeholder interactions
- ➔ Moving from R&D phase to licensing phase
- ➔ Resources for regulatory reviews
- ➔ Managing a step-wise licensing process



Areas for improvement

- ➔ Regulatory framework
- ➔ Regulatory supervision practices
- ➔ Knowledge management and maintaining staff experience
- ➔ Plan for disposal of waste arising from nuclear accidents

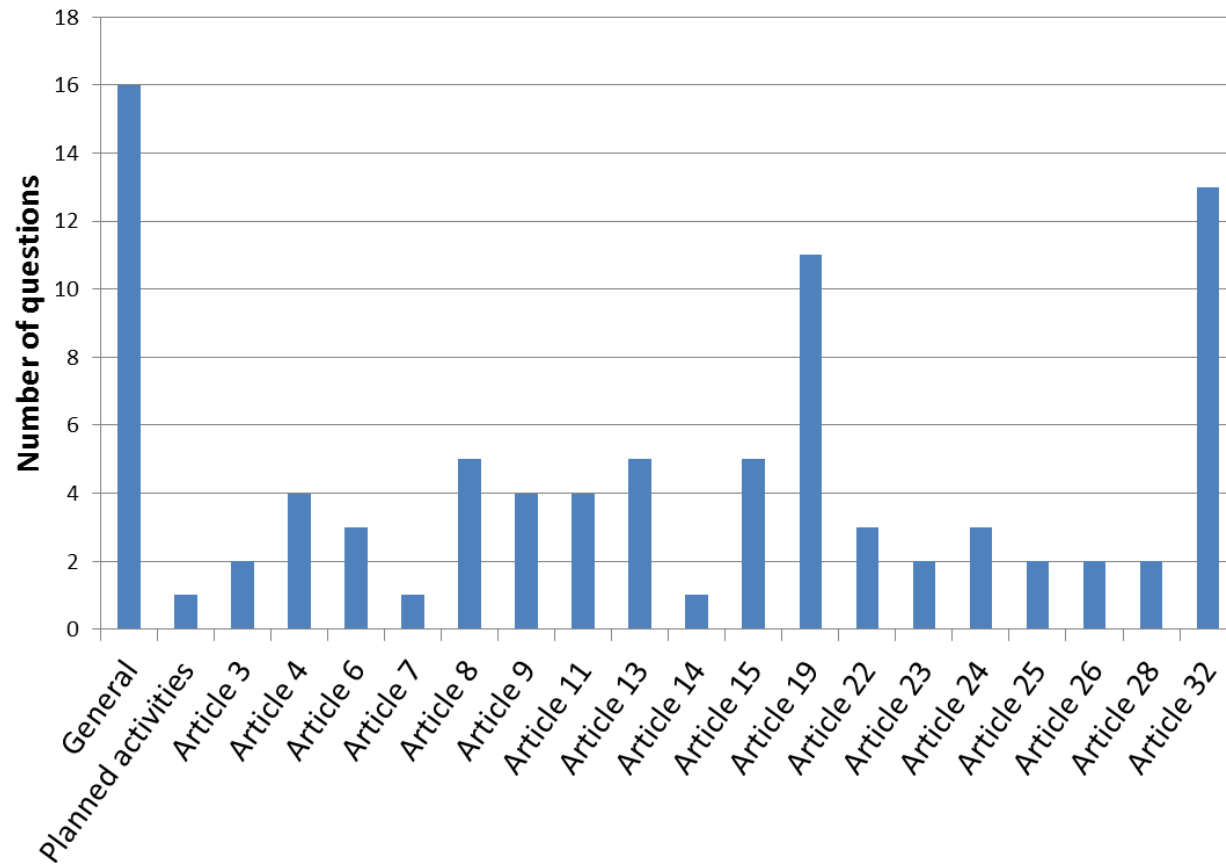


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Questions posted to Sweden



Contracting Party	Number of questions
Belgium	3
Canada	6
China	5
Czech Republic	5
Finland	7
France	5
Germany	5
Hungary	2
Japan	4
Korea, Republic	12
Netherlands	4
Poland	2
Russian Federation	3
Ukraine	15
United Kingdom	5
United States	6
Total	89



Questions to Sweden

Main areas - I

- ➔ SKB's repository programme
 - application for extension of SFR and licensing review
 - need for additional storage capacity in CLAB due to delayed repository
 - time table for late construction (2045) of SFL-repository
 - Consequences of delays in expansion of SFR and construction of SFL

- ➔ Äspö HRL international research cooperation



Questions to Sweden

Main areas - II

- ➔ Licensing of a spent fuel repository
 - the review process and progress of the review
 - consideration of alternatives
 - why 6 year long review period
- ➔ Openness and stakeholder involvement
 - laws and policies promoting stakeholder involvement
 - public participation in the licensing review
 - SSM's independence in relation to SKB
 - national consultation of SKB's RD&D programmes
 - the role of local safety boards
 - openness about incident reporting



Comparison of the Swedish and Finish licensing reviews

	Sweden (SSM's review)	Finland (STUK's review)
Disposal system	KBS-3 type repository + encapsulation plant	KBS-3 type repository + encapsulation plant
Selection of site & disposal method	Included	Not included (decision-in-principle 2001)
Review of Environmental Impact Statement	Included	Not included
Stakeholder dialogue and national consultation	Included	Not included
"Test" licensing review	No	Yes
Time schedule for review	No specific requirement	Specified by government
Other differences	SSM coordinates its review with the Land & Env. Court SKB has added application for extended storage capacity in CLAB	



Questions to Sweden

Main areas - III

- ➔ Operation of nuclear waste facilities
 - post-Fukushima stress tests of CLAB
 - lessons learned from the WIPP accidents
 - management of damaged fuel
- ➔ Non-nuclear waste
 - management procedures, storage and plans for disposal of orphan sources
- ➔ Waste characterisation and classification
 - system for waste acceptance criteria for all waste streams
 - supervision of pre-disposal management



Questions to Sweden

Main areas - IIII

➔ Decommissioning

- plans for decommissioning of Ågesta
- objectives of SKB's NPP decommissioning studies
- requirements on updating of decommissioning plans
- plans for disposal of long-lived decommissioning waste
- decommissioning process for research reactors R1 and R2

➔ Financing

- process for periodic review of decommissioning cost estimates
- reason for SSM's reconsideration of fees on nuclear energy



Questions to Sweden

Main areas - V

- ➔ **Emergency preparedness**
 - plans for management of waste after nuclear accident
 - roles and responsibilities of national actors
 - recent improvements in emergency preparedness and response system due to exercises?

- ➔ **Legal and regulatory framework**
 - ultimate responsibility of the state & institutional control
 - regulations for disposal facility construction
 - role of WENRA reference levels in Swedish regulations



Questions to Sweden

Main areas - VI

- ➔ Regulatory competence and resource issues
 - access to expertise when there is no TSO?
 - development of resources and competence for parallel activities: disposal facility & CLINK construction, SFR extension, possible SFL licensing, Barsebäck decommissioning etc?



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Conclusions

Swedish spent fuel and waste management system status (1)

- Comprehensive regulatory framework in place
- Licencee responsibilities clear in legislation
- Independent competent regulatory authority established
- Active participation in international technical and regulatory developments
- Research and development program established and ongoing for three decades
- Financing system for nuclear liabilities established and operative for three decades
- Management system for legacy waste and orphan sources established



Conclusions

Swedish spent fuel and waste management system status (2)

- Central interim storage facility for spent nuclear fuel (Clab) established since 1985
- Central disposal facility for operational LIL nuclear and non-nuclear waste (SFR) established since 1988
- Application for a spent nuclear fuel repository submitted in 2011, licensing review ongoing and planned statement to the Government in 2017
- Application for an extension of the SFR disposal facility to also accommodate decommissioning waste submitted in 2014
- Advanced plans for the decommissioning of nuclear reactors



Conclusions

Good practices?

- A long-term strategy is in place for the final disposal of spent fuel and nuclear waste with
 - defined milestones,
 - continuous research, development and demonstration and
 - financing provisions.

- Provisions for transparency and public consultation in the decision making process



Sweden's implementation of the JC

- Sweden complies with the obligations and terms of the Joint Convention
 - National report submitted as required
 - Questions asked to other Contracting Parties
 - Answers provided on questions to Sweden
- Sweden reaffirms its commitment to the Joint Convention

Thank you for your attention