The background of the slide is a scenic landscape photograph. It shows a wide, calm lake or river winding through a dense forest. The trees are in various shades of green and yellow, suggesting an autumn setting. The sky is filled with soft, white clouds. In the foreground, there is a large, blue, rounded hexagonal shape that serves as a text box.

Overall planning for decommissioning in Sweden

NKS Radworkshop 2018

Fredrik De la Gardie
Principal Investigator
Low and Intermediate Level Waste

Overall planning for decommissioning in Sweden



Content of presentation

- Introduction
- Requirements/Phases/Guidance
- Overall decommissioning planning
- Decommissioning activities in Sweden
- Interaction between decommissioning and waste management
- Challenges
- Competences (today and future)
- Summary

Introduction



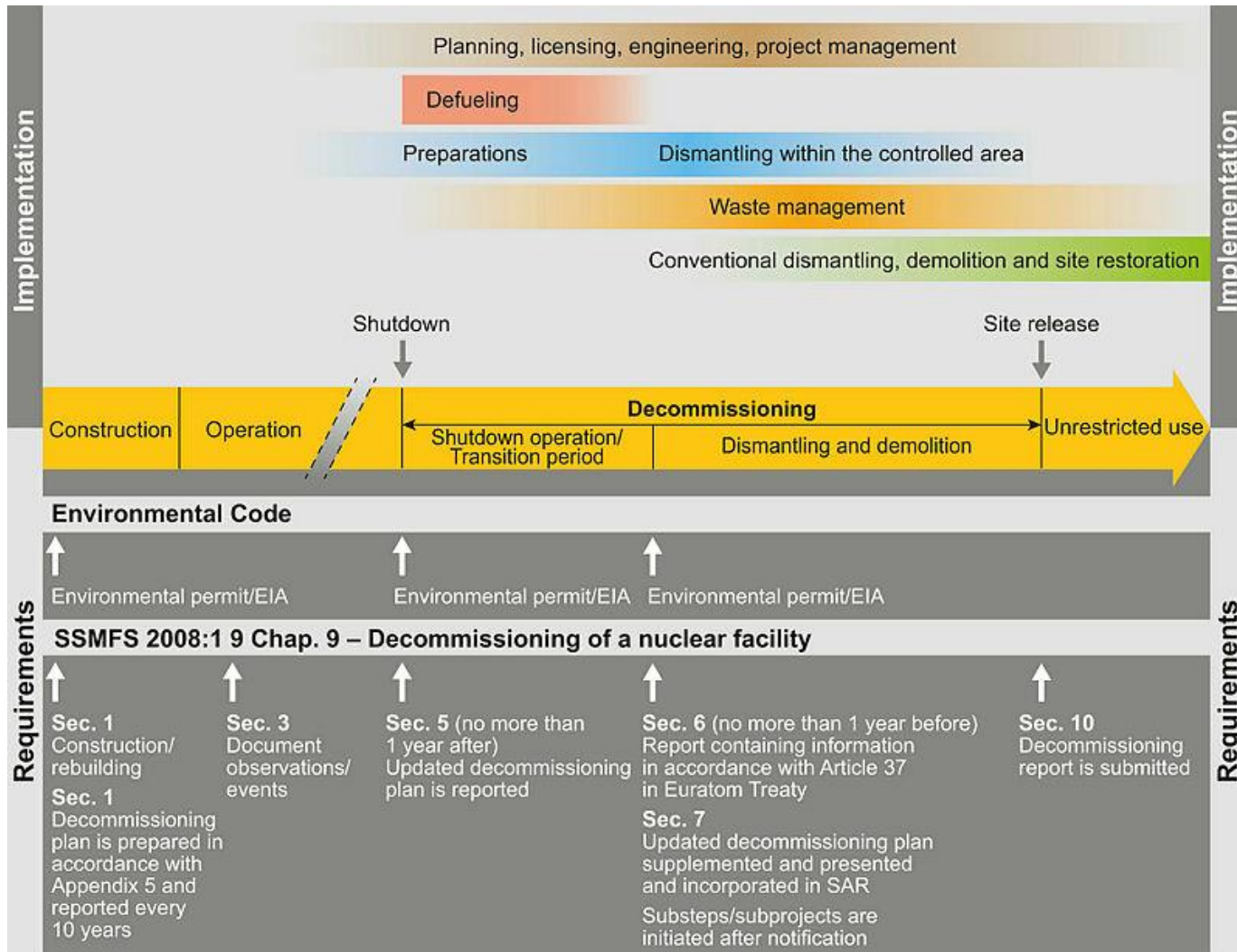
- SKB is owned by the nuclear power companies
- SKB manage the radioactive waste from NPP in Sweden
- SKB operates in three places:
 - Stockholm – head office
 - Forsmark/Östhammar – SFR, repository for short lived LILW
 - Oskarhamn – Clab interim storage facility, research laboratories
- Finance
 - Fees to the nuclear waste fund by the nuclear power companies
 - Waste management and decommissioning of NPP
 - Based on SKB (and NPP) calculations/estimates and reviewed by SSM
 - Decision by the government
 - About 0,05 SEK/kWh for NPP in operation
 - Barsebäck NPP, about one billion SEK per year



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Phases/requirements/guidance



Overview of the different phases for execution of a power reactor's decommissioning as well as SSM's and the Environmental Code's requirements for decommissioning during the life of a nuclear facility.

Phases/requirements/guidance (cont.)

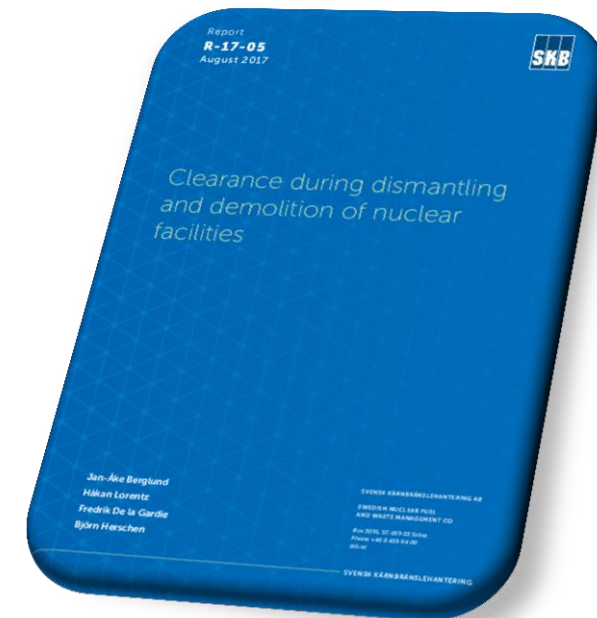


- Developed requirements from the authority
 - SAR for D&D
 - Decommissioning plan and decommissioning strategy
 - Waste management plan
 - Work packages for the execution of D&D
 - Preparatory work (during transition period)
- Guidelines within the industry
 - Clearance handbooks (operational and decommissioning aspects)
 - Position papers within the group of KSKG (Safety assessment D&D, Exemption, Work Packages D&D)
 - International cooperation, e.g. OECD/NEA reports



Strålsäkerhets
myndigheten

Swedish Radiation Safety Authority



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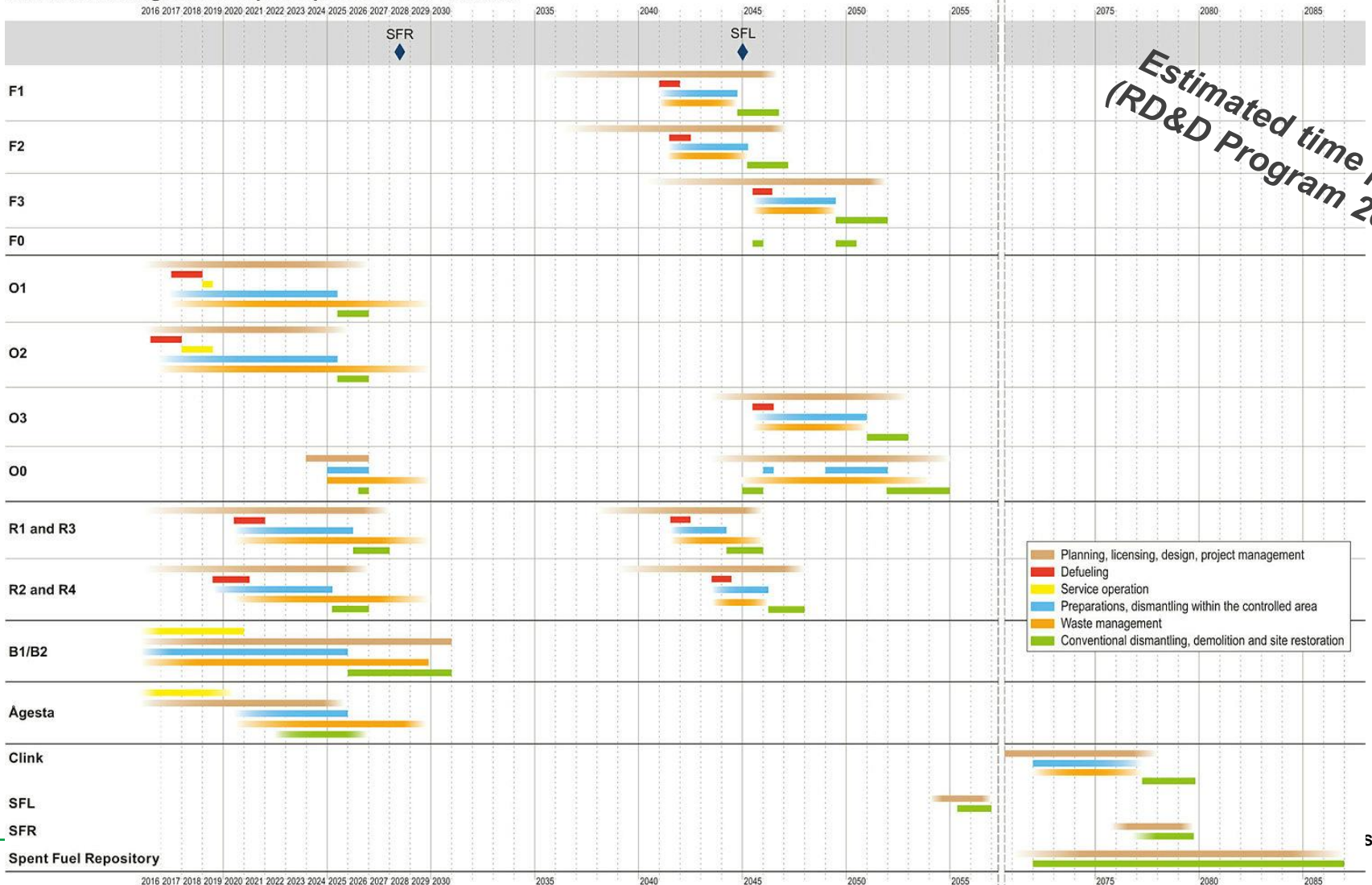
Basis for decommissioning planning in Sweden

- Decommissioning is executed as efficient projects
- Planning and engineering to be finalised before final shut down
- Direct dismantling (as fast as possible after defueling)
- Fuel to be transported to Clab as soon as possible (defueling about one year)
- Primary circuit decontamination
- Activated components to be dismantled first (risk based approach)
- Proven techniques to be used
- The national waste management system/program to be used
- Interim storage (or final disposal) to be able to receive waste
- End state – cleared facility/site to be used for other industrial purposes

Overall decommissioning planning



Decommissioning of nuclear power plants and SKB facilities



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Decommissioning activities in Sweden



- **Barsebäck NPP**
 - Preparations of large scale D&D, public hearing (Environmental Impact Assessment) 2018-02-14
 - Project HINT; on site interim storage in operation, segmentation of RPV internal (B2 finished, B1 ongoing)
 - Project FOCT; new facility for sorting/characterisation/conditioning of intermediate level waste
- **OKG NPP**
 - Unit 2 is defueled (fuel transported to the SKB-Clab facility)
 - Segmentation of RPV internals unit 2 started 14 May 2018 (Unit 1 spring 2019)
 - Preparing specifications for segmentation of RPVs (unit 1 and 2) is ongoing
- **Ringhals NPP**
 - Preparations for Ringhals unit 1 and 2 final shutdown (end of 2020/2019)
 - Defueling, separation of unit 1/2 from unit 3/4, organisational aspects
 - Program R12 Decommissioning started within Vattenfall (Business Unit Nuclear Decommissioning)
 - Started projects (planning); primary circuit decontamination, segmentation of internals/RPV
 - Hearing environmental court, license for shut down operation (EIA), 2018-05-22
- **Ågesta NPP**
 - Program Ågesta decommissioning is started within Vattenfall (BUND responsible)
 - Public hearing D&D license (Environmental Impact Assessment), 2018-02-20

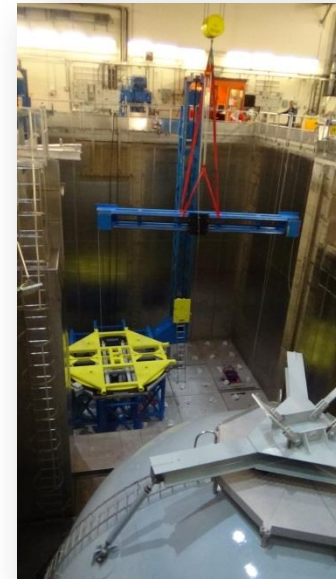


Photo: OKG. Equipment for segmentation of RPV internals at unit 2.



Photo: BKAB. On site transportation of RPV internals to interim storage.

Decommissioning activities in Sweden (cont.)



- Decommissioning of research reactor in Studsvik
 - Dismantling of reactors has been finalised
 - Dismantling/demolition of biological shield is ongoing
 - Facility ready to be cleared in 2019
- Decommissioning of the Ranstad uranium facility
 - To be finalised (cleared site) during 2018
 - Uranium mining and milling facilities (outside the city of Skövde) 1965-1969
 - Dose calculations according to specific waste routes (scenarios) fulfils the safety case
 - Limits for specific clearance (exemption) have been decided for Ranstad
- Development of waste containers and waste type descriptions (acceptance criteria) for decommissioning
- Optimising segmentation of BWR pressure vessels (“from cradle to grave”)
- Management of very low level radioactive waste from decommissioning
 - Local landfills at the NPP, conditional clearance, incineration, etc

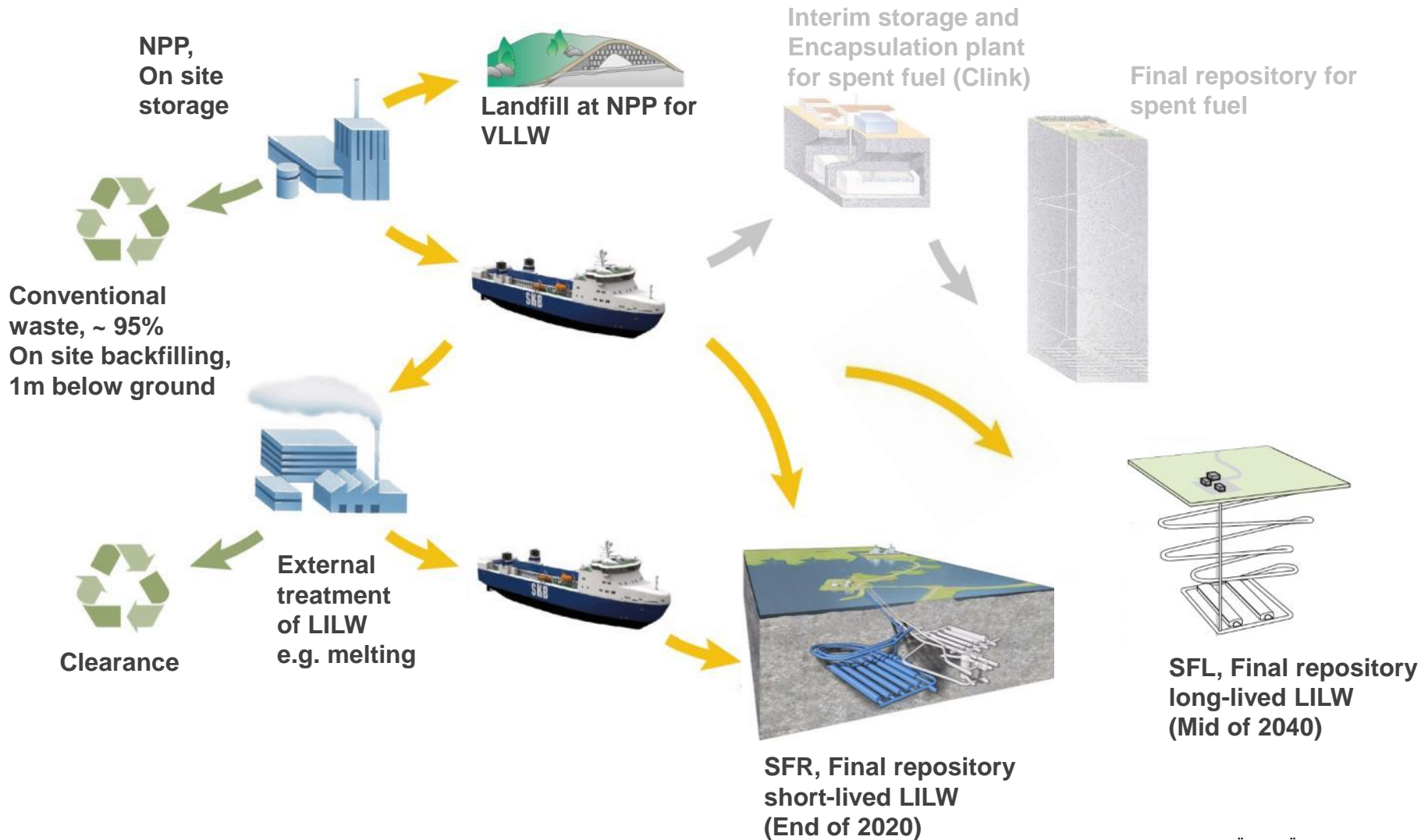


Photo: AB SVAFO. Demolition of biological shield, research reactor in Studsvik.

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Interaction between decommissioning and waste management

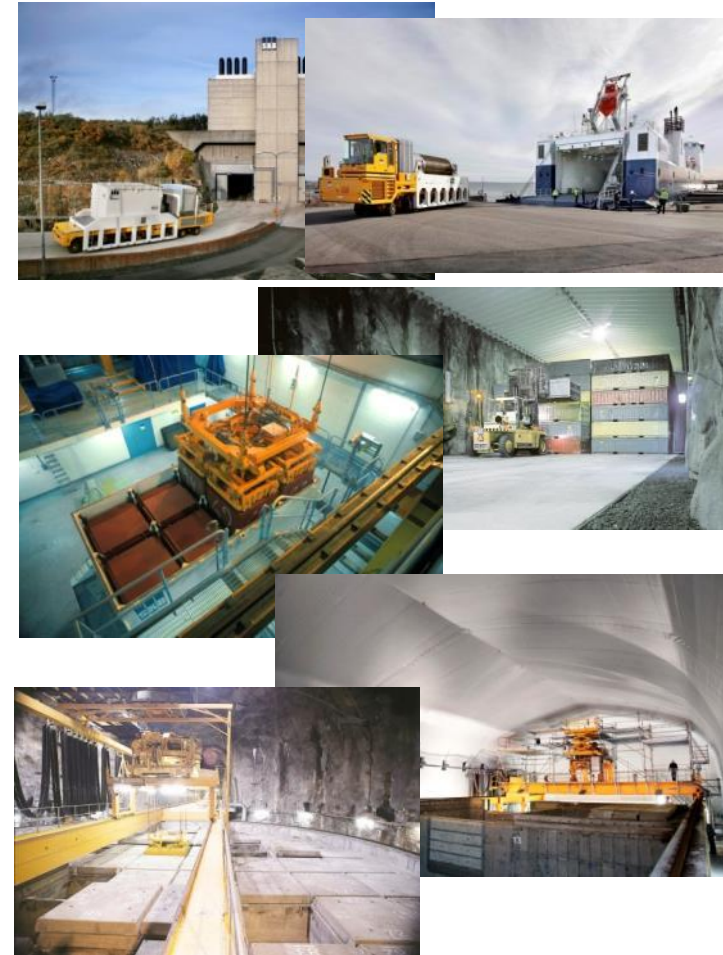
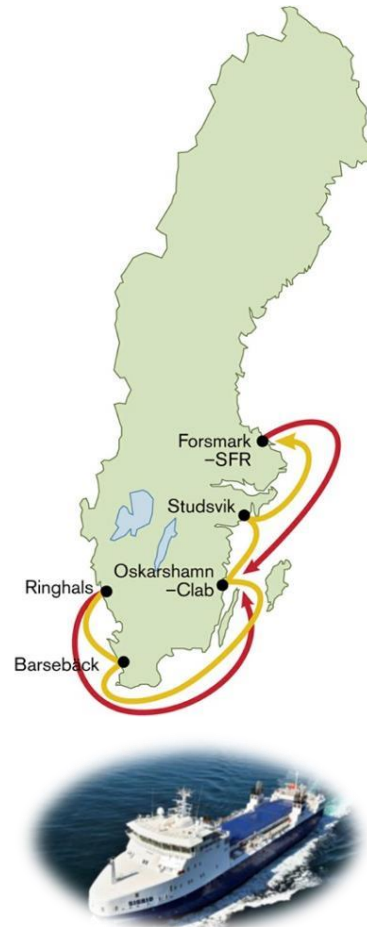


Interaction between decommissioning and waste management



NPP - Waste generators

SKB - Waste transport/disposal



Interaction between decommissioning and waste management

- Implemented routines/processes/packages for the *operational waste* will also be used for the decommissioning waste
- In order to optimise decommissioning:
 - Develop packages/waste types descriptions
 - Manage large components (optimise segmentation)



ILW

Segmented RPV



LLW

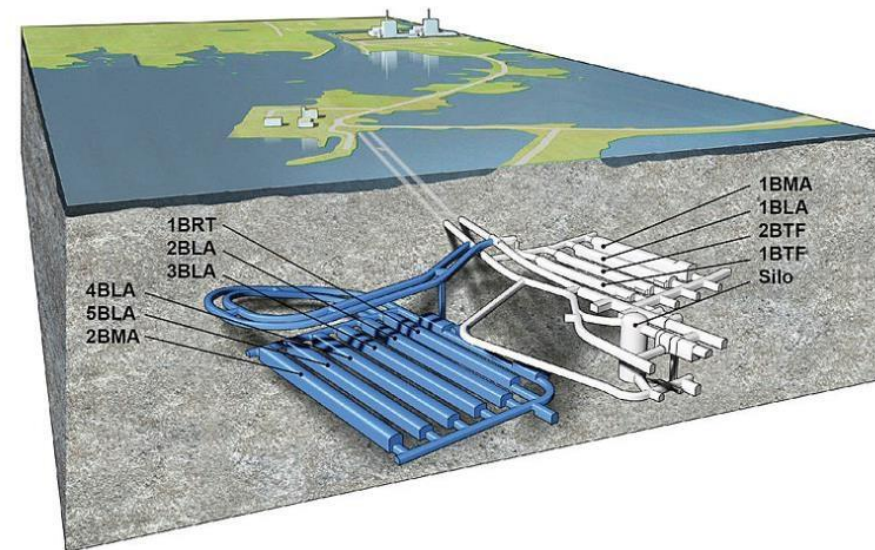
Long-lived

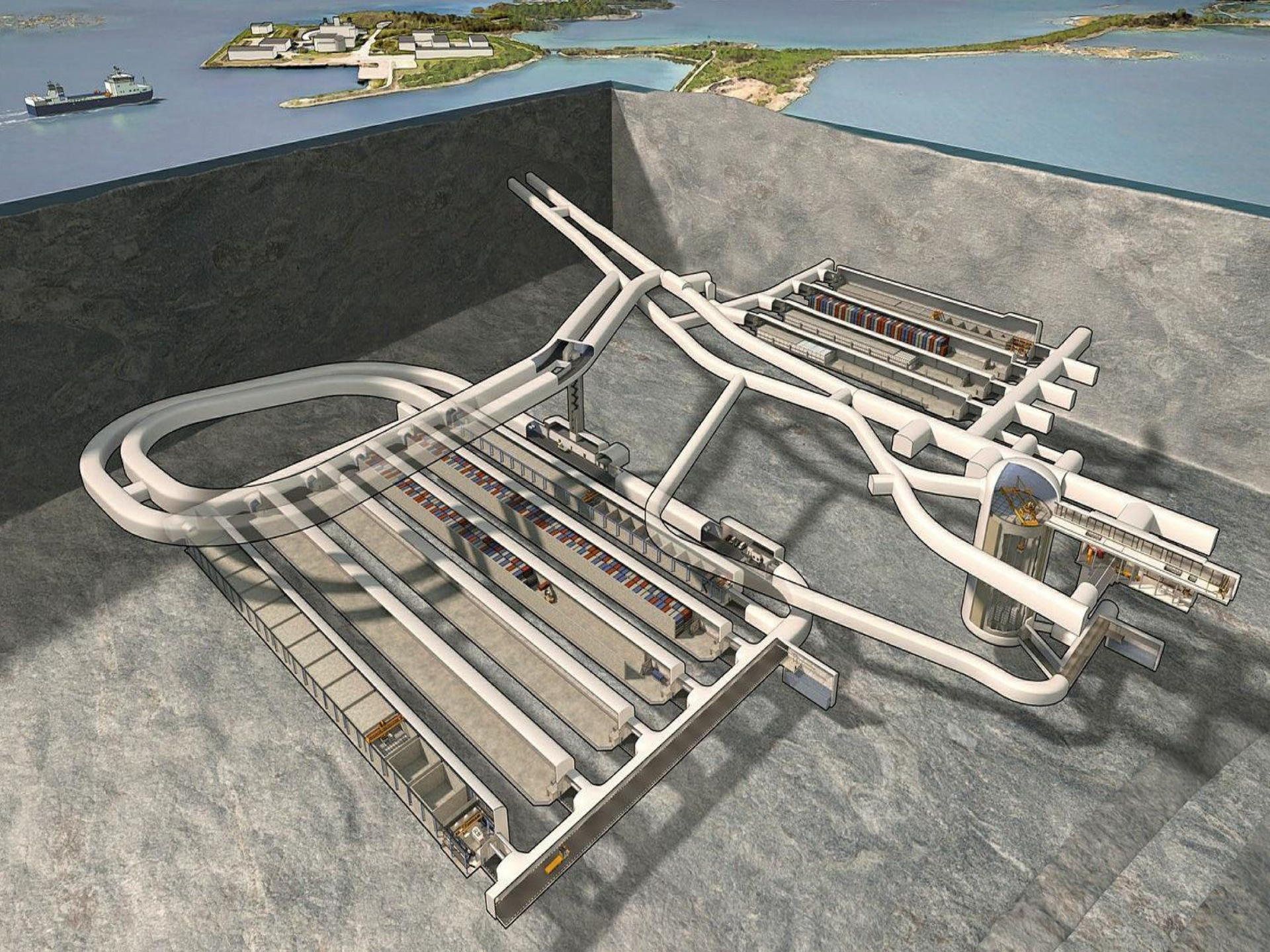


Interaction between decommissioning and waste management

Extension of the SFR facility

- Application handed in Dec 2014
- Final disposal for *decommissioning* (and operational) waste
- Vaults for disposing about 120 000 m³ LILW
- Vault/tunnel for 9 RPVs (BWR, segmented)
- Repository depth 117-137 m
- Disposing rock at the bay next to SFR



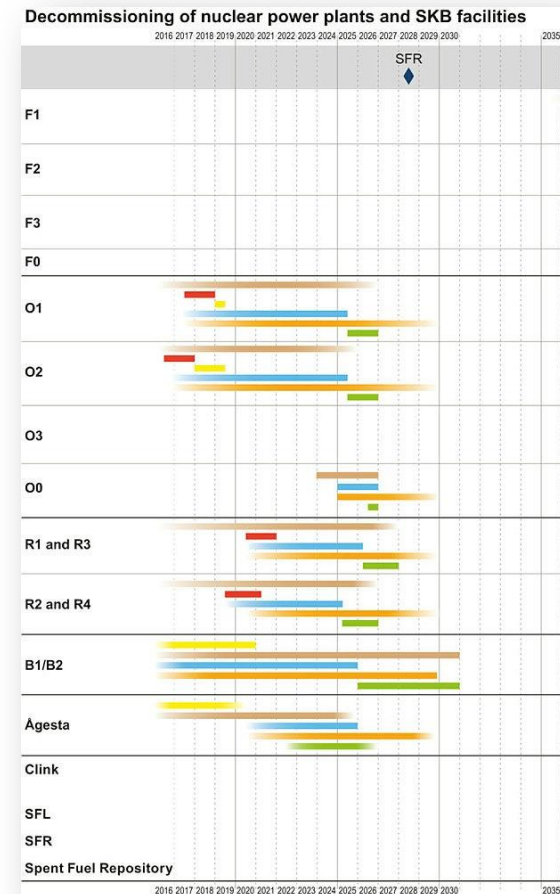


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Decommissioning of 7 nuclear power reactors

- Turning planning into execution
- Choosing the “right” strategy – flexibility
- Optimising from “cradle to grave”
- Logistics
- Decision making
- Competences/resources
 - (NPP:s, SKB, SSM, etc)
- Etc...



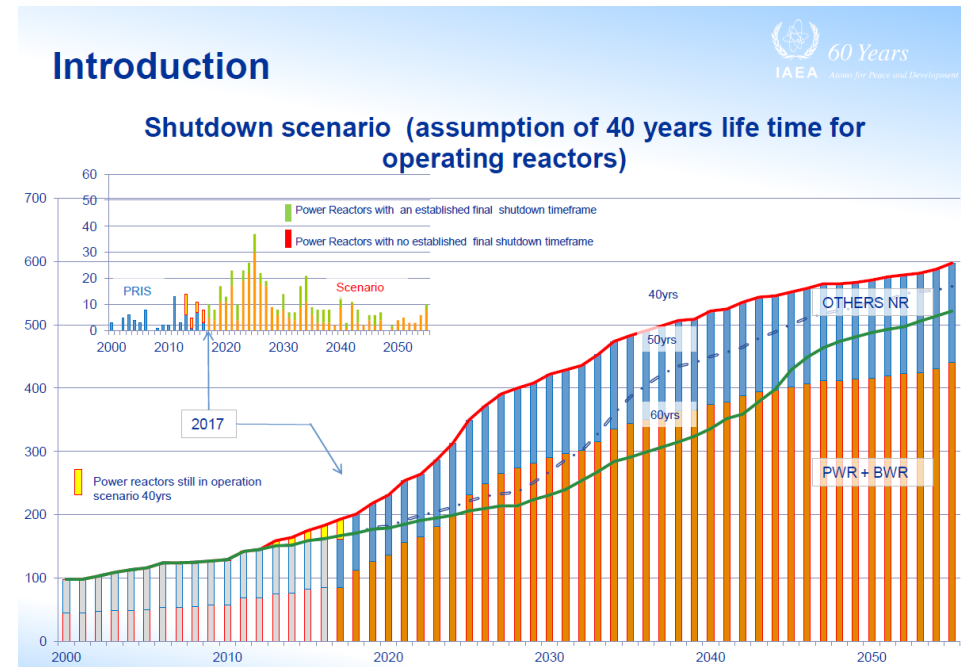
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Competences (today and future)



- Decommissioning is a wide topic
 - Planning and strategy
 - Cost estimates
 - Licensing
 - Waste management
 - Construction
 - Development of methods/techniques
 - Waste inventory (calculations, etc)
 - Clearance and statistical approaches
 - Conventional environmental aspects
 - Q/A, managing data
 - Etc.
- Need of resources/competences have increased
 - Implementers (NPP:s, SKB, SVAFO, etc)
 - Consultants/contractors (Westinghouse, Studsvik, Cyclife, etc)
 - Authorities (SSM, etc)
- Internationally highlighted to make decommissioning more attractive for the next generation



Source: IAEA, Symposium, Berlin, Germany, November 2017

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Summary



- Challenge to decommissioning 7 nuclear reactors in Sweden
- Planning decommissioning from an end state perspective
- Importance of international collaboration
- The field of decommissioning and waste management needs to be highlighted and be attractive for students (“future colleagues”)
- Funding of decommissioning and waste management is fundamental (having the “money”)

Thank you!

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