Strål
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Swedish Radiation Safety Authority

Lessons learned from application of the Swedish regulations for decommissioning of nuclear facilities - The regulator´s perspective

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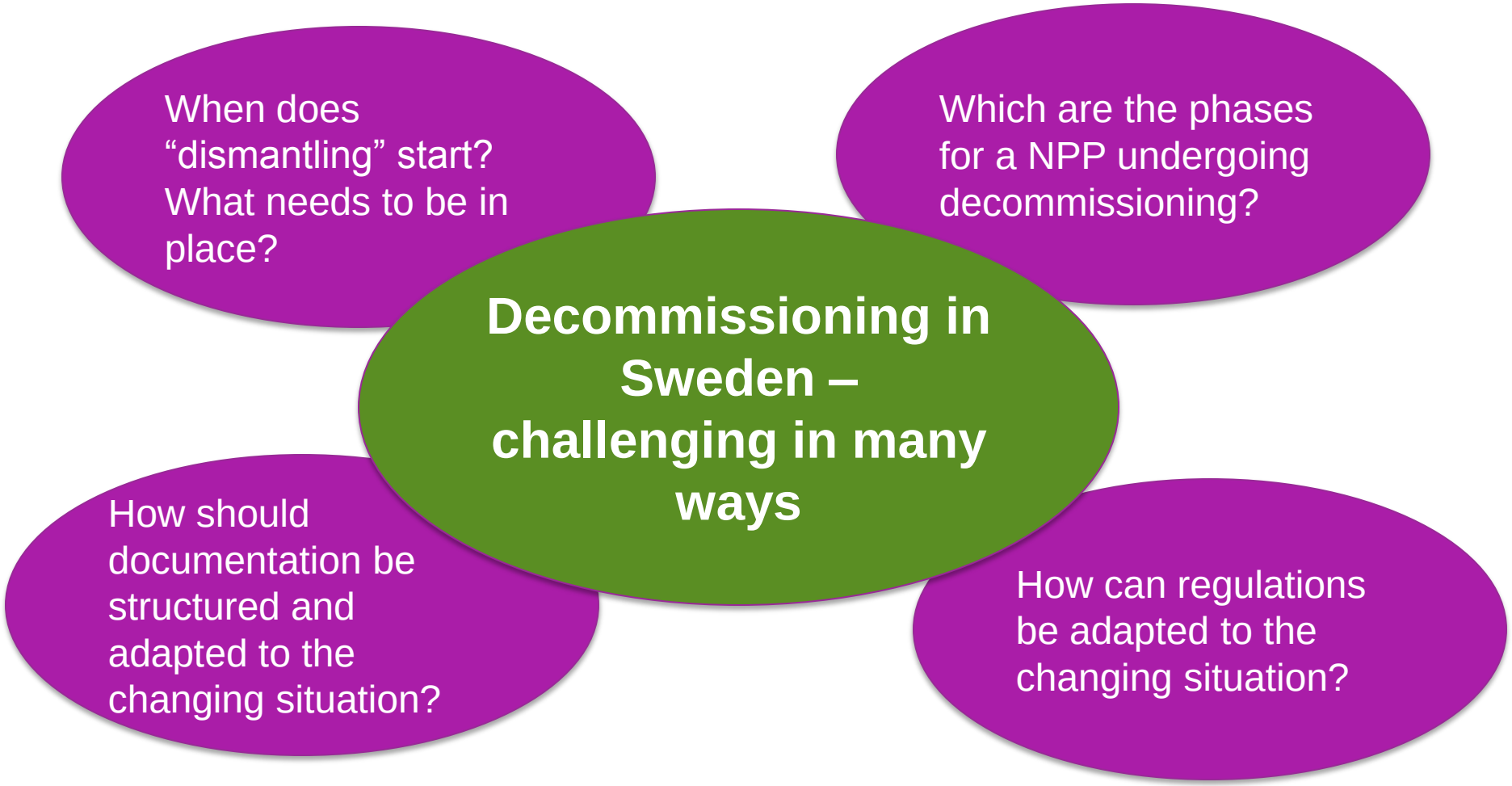
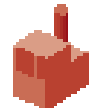
Content – main issues



Nuclear Facilities in Sweden



Boiling Water Reactor

Pressurized Water Reactor

Other facilities

Forsmark NPP
Forsmarks Kraftgrupp AB

	Capacity MW(th)	In operation since
Forsmark 1	2 982	1980
Forsmark 2	3 253	1981
Forsmark 3	3 300	1985

SFR
Swedish Nuclear Fuel and Waste Management Co (SKB)

Final repository for radioactive operational waste

Westinghouse Electric Sweden AB

Fuel fabrication plant (facility)

Ranstad
Ranstad Industricentrum AB

Former Uranium mining and milling facility

Ågesta PHWR
Vattenfall AB

Capacity MW(th)	In operation
80	1964–1974

Studsvik
Studsvik Nuclear AB, AB SVAFO

Facilities for fuel and materials testing, waste management and storage including two shut-down material test reaktors

Ringhals NPP
Ringhals AB

	Capacity MW(th)	In operation since
Ringhals 1	2 540	1976
Ringhals 2	2 660	1975
Ringhals 3	3 144	1981
Ringhals 4	2 783	1983

Oskarshamn NPP
OKG AB

	Capacity MW(th)	In operation since
Oskarshamn 1	1 375	1972
Oskarshamn 2	1 800	1975
Oskarshamn 3	3 900	1985

Barsebäck NPP
Barsebäck Kraft AB

	Capacity MW(th)	In operation
Barsebäck 1	1 800	1975–1999
Barsebäck 2	1 800	1977–2005

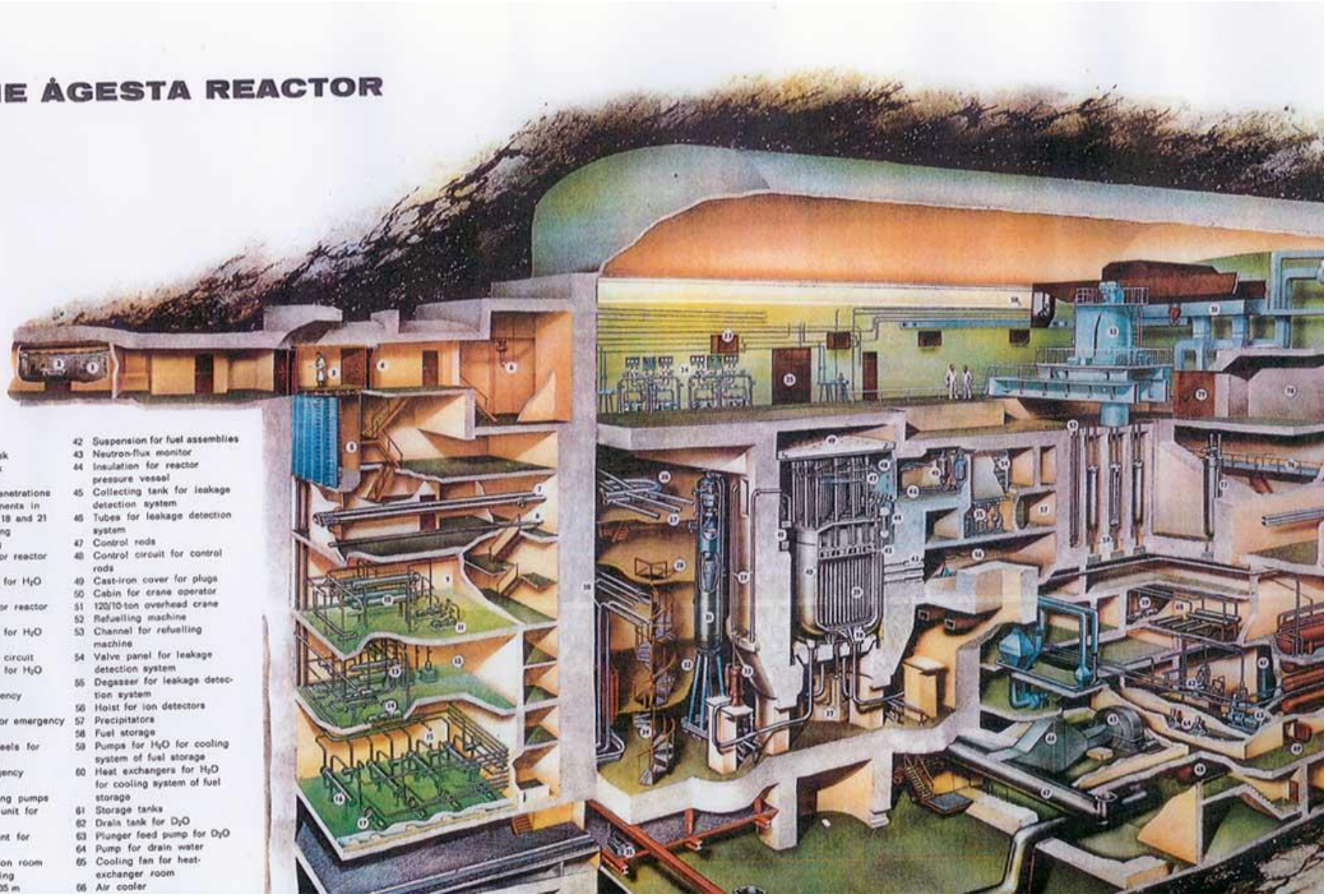
CLAB
Swedish Nuclear Fuel and Waste Management Co (SKB)

Central interim storage facility for spent nuclear fuel

Ranstad uranium mining and milling facility

Studsvik material test reactors (R2 and R2-0)

THE ÅGESTA REACTOR



1 Control room
2 Main control desk
3 Personnel airlock
4 Airlock door
5 Electric cable penetrations
6 Hoist for components in rooms 9, 12, 15, 18 and 21
7 Main steam piping
8 Feedwater piping
9 Coolant circuit for reactor top shield
10 Heat exchangers for H_2O
11 Pumps for H_2O
12 Coolant circuit for reactor top shield
13 Heat exchangers for H_2O
14 Pumps for H_2O
15 Start-up heating circuit
16 Heat exchangers for H_2O
17 Pumps for H_2O
18 Room for emergency cooling pumps
19 Electric motors for emergency cooling pumps
20 Manoeuvring wheels for sprinkler valves
21 Room for emergency cooling pumps
22 Emergency cooling pumps
23 Air-conditioning unit for reactor hall
24 Control equipment for feedwater
25 Door to expansion room
26 Main steam piping
27 Floor level +21.35 m
42 Suspension for fuel assemblies
43 Neutron-flux monitor
44 Insulation for reactor pressure vessel
45 Collecting tank for leakage detection system
46 Tubes for leakage detection system
47 Control rods
48 Control circuit for control rods
49 Cast-iron cover for plugs
50 Cabin for crane operator
51 120/10-ton overhead crane
52 Refuelling machine
53 Channel for refuelling machine
54 Valve panel for leakage detection system
55 Degasser for leakage detection system
56 Hoist for ion detectors
57 Precipitators
58 Fuel storage
59 Pumps for H_2O for cooling system of fuel storage
60 Heat exchangers for H_2O for cooling system of fuel storage
61 Storage tanks
62 Drain tank for D_2O
63 Plunger feed pump for D_2O
64 Pump for drain water
65 Cooling fan for heat-exchanger room
66 Air cooler

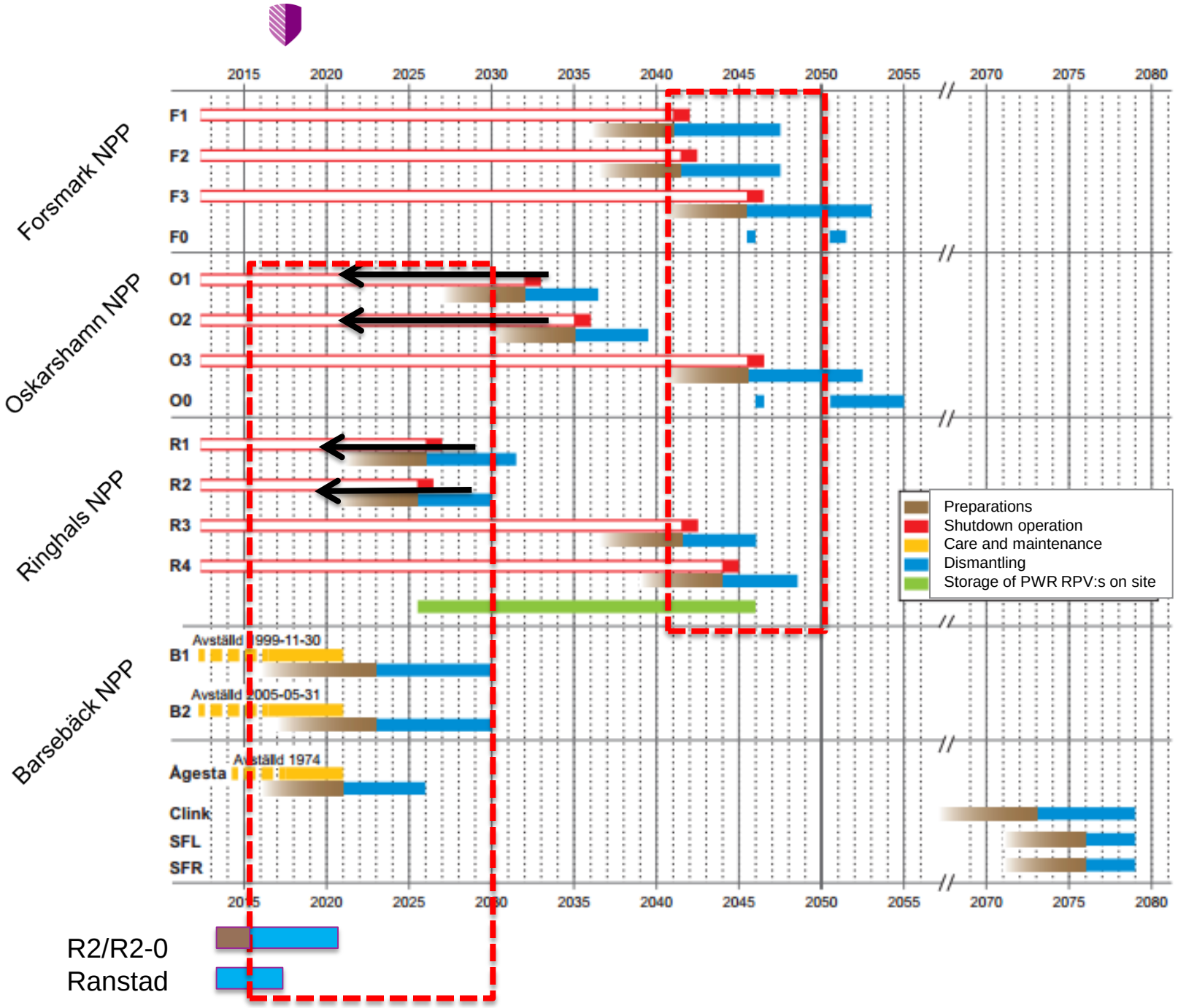
Barsebäck NPP

Ringhals NPP

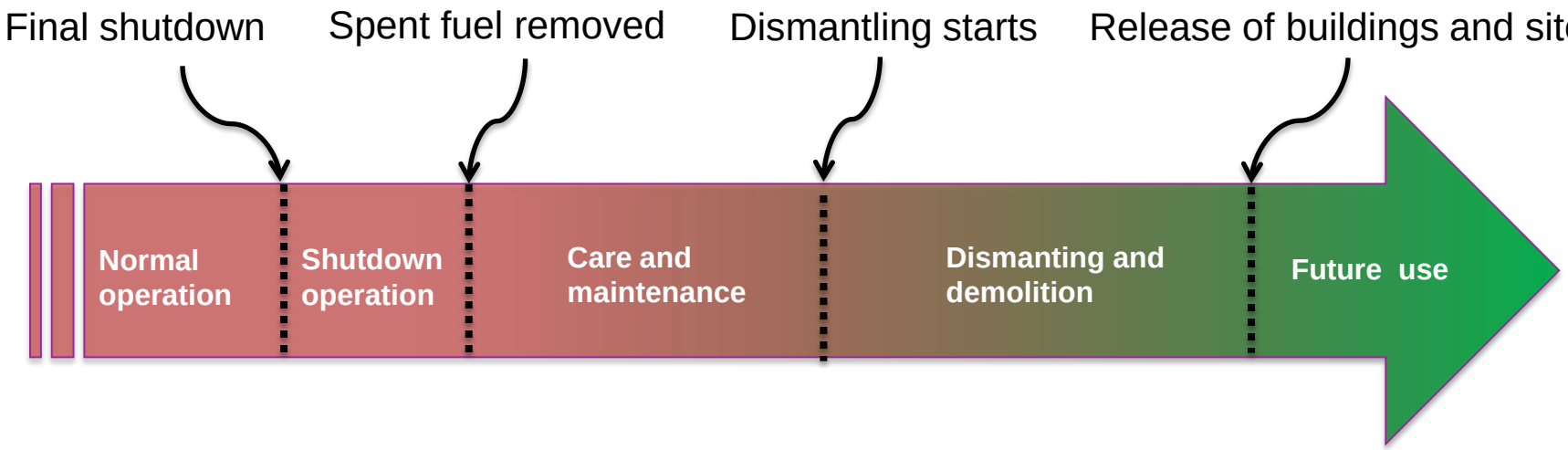
Oskarshamn NPP

In 2015 it was announced that 4 reactors are to shut down until 2020 due to low profits

- Ringhals units 1 (2020) and 2 (2019)
- Oskarshamn units 1 (2017-19) and 2 (2016)
- Decommissioning is planned to be carried out with very short transition and care and maintenance periods


2015
2020
2025
2030
2035
2040
2045
2050
2055
2070
2075
2080
Forsmark NPP
F1
F2
F3
F0
Oskarshamn NPP
O1
O2
O3
O0
Ringhals NPP
R1
R2
R3
R4
Barsebäck NPP
Avställd 1999-11-30
B1
Avställd 2005-05-31
B2
Avställd 1974
Ågesta
Clink
SFL
SFR
Preparations
Shutdown operation
Care and maintenance
Dismantling
Storage of PWR RPV:s on site
R2/R2-0
Ranstad

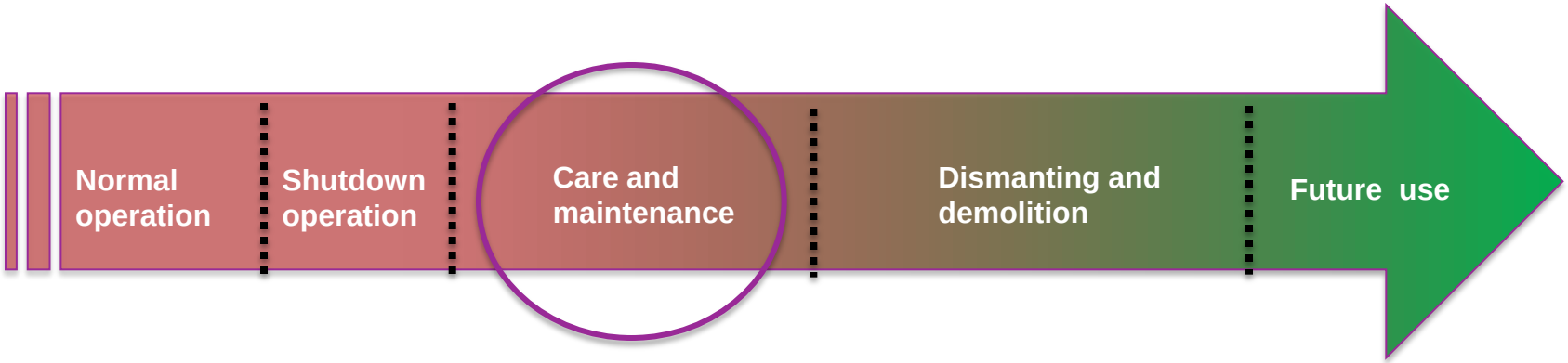
Phases of a nuclear power reactor according to Swedish regulations



- Most regulations issued by the SSM on different aspects of nuclear facilities are applicable also during decommissioning
- Regulatory system based on self-assessment by the operator

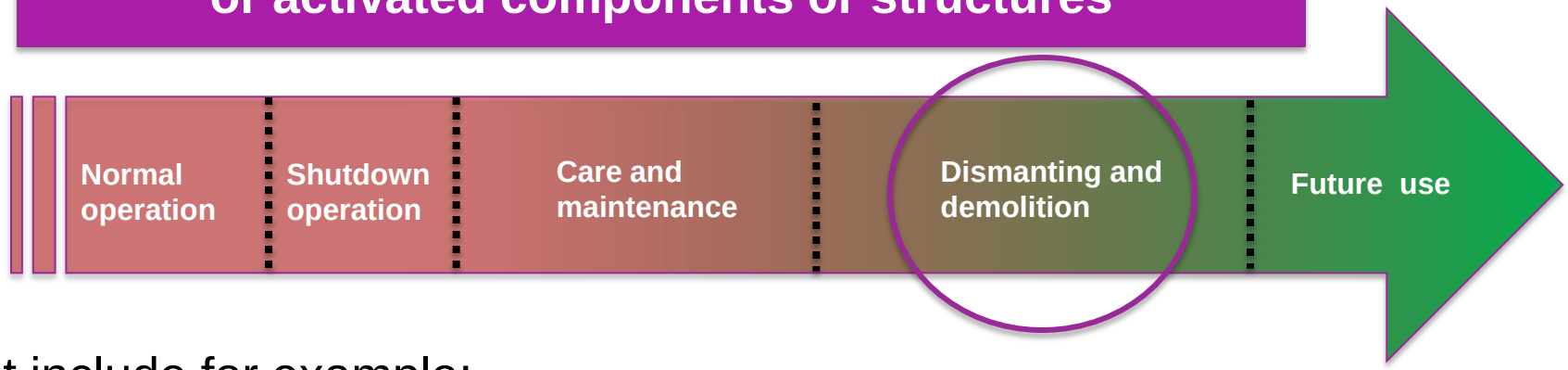
Adaptation of the safety analysis report for care and maintenance after removal of nuclear fuel from the site

- The Safety Analysis Report (SAR) and the Operational Limits and Conditions should be adapted to the new situation.
- Exemptions can be given from several requirements concerning the no longer present nuclear fuel.
- The SSM has issued guidelines to facilitate the process of granting exemptions and reviewing the adapted SAR:s in 2015.
- The care and maintenance phase is not mandatory.



What is “dismantling”?

Disassembly or segmentation of major contaminated or activated components or structures

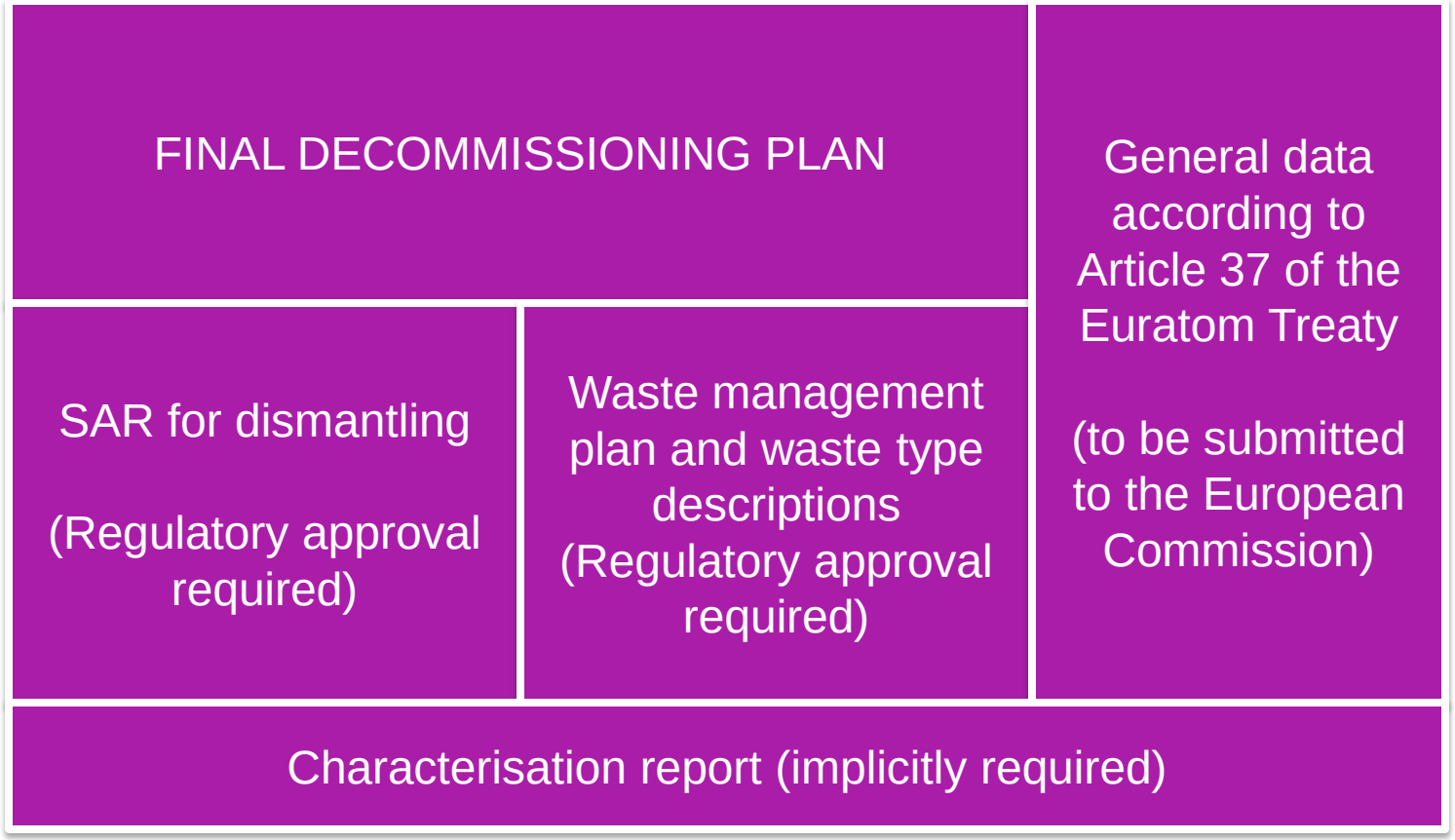


Does not include for example:

- removal of spent nuclear fuel
- management of operational waste and removal of loose objects,
- removal of contaminated, non-safety related components for reuse in other nuclear facilities,
- removal of non-contaminated, non-safety related components and structures,
- system decontamination with subsequent waste treatment.

Not clearly defined, interpretation by praxis

Required documents and approvals before dismantling



Final decommissioning plan

Purpose: Describe and justify the planned decommissioning activities

Main issues:

What are the boundary conditions?

Basis for other documents:

Detailed measures and procedures for

- Characterisation
- Dismantling
- Waste management
- Radiation protection
- Safety
- Security
- Etc.

Importance of Decom Plan once other documents in place??

Safety analysis report for dismantling

- Description of the facility and its functions (those relevant during dismantling), radioactive inventory, hazards, organisation and planned safety and protection measures.
- Content not well specified in regulations.
- More details on safety can be analyzed and described by the licensee in advance of each work package or subproject within the decommissioning project (no formal approval needed).
- Alternatively, the licensee may adopt the SAR for a specific dismantling stage or period of time only.

The SSM plans to prepare guideline on this issue before new regulations are in place.

Waste management plan

Purpose:

Describe and justify the planned waste management activities

Depends heavily on

- Characterisation of the facility
- Identification of all applicable requirements
- Waste acceptance criteria
- The decommissioning plan

Waste type descriptions (WTD)

- Documents that define typical waste packages and describe the methods for ensuring that they fulfill the waste acceptance criteria of the repository.
- For waste without existing repository, preliminary waste acceptance criteria have to be established.
- New procedure for elaboration of WTD was recently established. Implementation ongoing.

Depends heavily on waste acceptance criteria,
thus difficult for waste without existing repository

General data according to Article 37 of the Euratom Treaty

- Report to the European Commission needed for the dismantling of nuclear reactors, mixed-oxide fuel fabrication plants and reprocessing plants
- To be submitted to the Commission not less than six months before “any authorisation for the discharge of radioactive waste is granted by competent authorities”
- The SSM awaits any review comments from the Commission before approving the SAR for dismantling or partial demolition projects

The SSM is currently streamlining its internal processes in anticipation of the increased number of decommissioning projects

Main experiences

- Difficult to foresee the full impact of regulations before they have been put in practice (a “journey” for both regulators and licensees).
- Important to characterize the facility carefully and prepare for waste routes in correspondence with the existing or planned waste management system.
- Flexibility and preparedness for changes needed, to manage new information and change in plans
  (licensee and SSM).
- The decommissioning plan becomes more or less obsolete once the SAR and waste management plan has been approved.
- Industry intention:
  Immediate partial dismantling projects, with spent fuel in the facility.

Summary

- During 2015 NPP owners decided to shut down four of Sweden’s ten remaining nuclear reactors by 2020, Oskarshamn units 1&2, Ringhals units 1&2.
- Intense period of decommissioning in Sweden over the next 10-15 years.
- Parallel development of guidelines and new regulations to tackle the increasing workload as well as streamlining internal processes.
- Our own lessons learnt are very valuable, but more international collaboration and exchange of experience would be beneficial for SSM.

Thank you for your attention!

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