



Federal Office
for the Safety of
Nuclear Waste Management

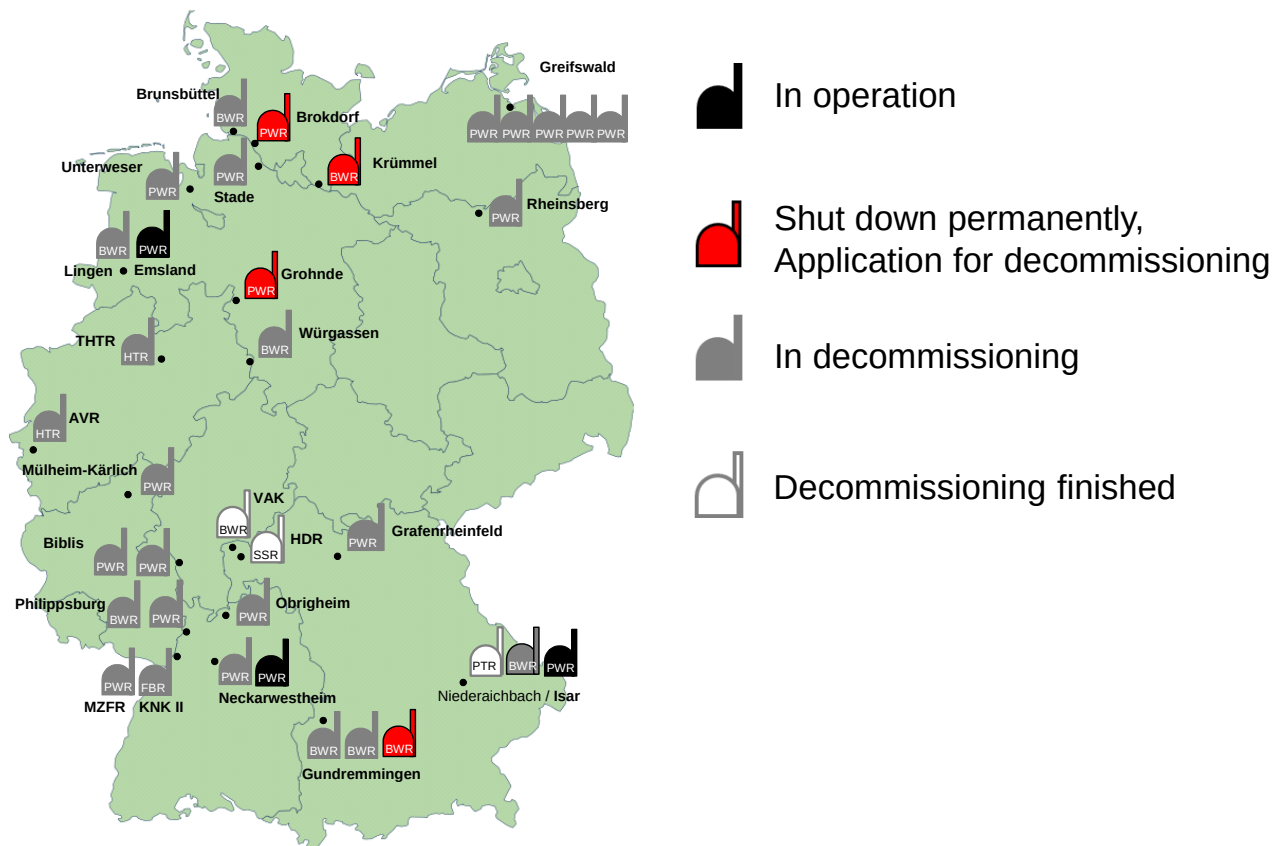
Approaches for decommissioning strategies and lessons learned so far

Experience from Germany

Initial Position in 2011 Regarding Nuclear Power Phase Out

- In 2011 the German legislator decided to accelerate **phase out** the use of nuclear power for the commercial generation of electricity in a **stepwise process** by the end of 2022 at the latest
- Germany gained technical and organizational **experience** in nuclear decommissioning since the seventies
- Experience with decommissioning strategies immediate dismantling (often) as well as safe enclosure (rarely) are available

Overview: Status of NPPs in Germany



Status: April 2022

Overview: Nuclear Facilities in Germany

	Nuclear Power Plants	Research Reactors	Nuclear Fuel Cycle Facilities
In operation	3	6	3
Shut down permanently	4	3	-
In decommissioning	26	6	2
Decommissioning finished	3	31	9

Status: April 2022

Nuclear Power Plants with period of safe enclosure

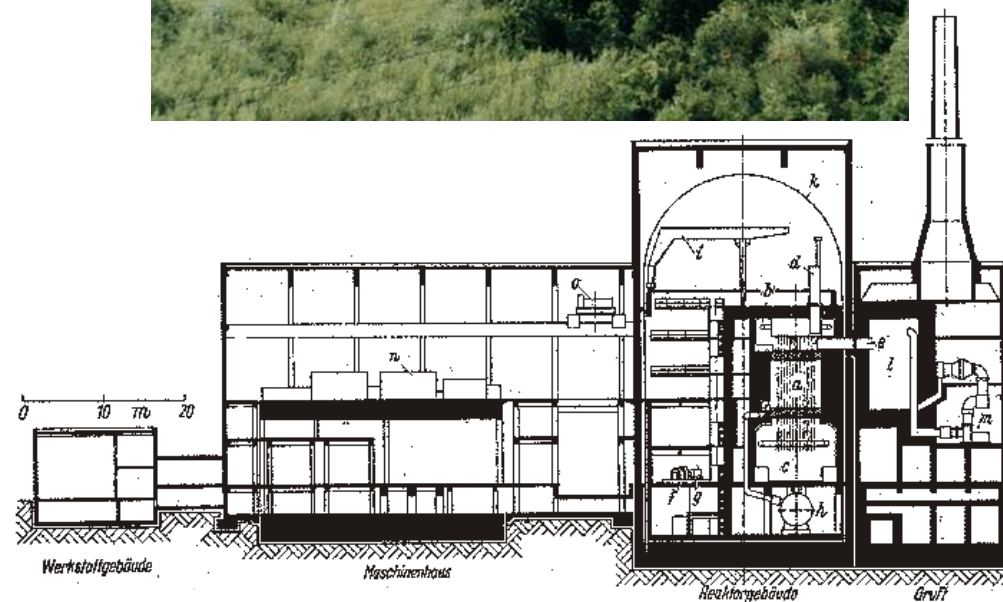
NPP / Actual status	Reactor type	Power MWe	Operational	Period of safe enclosure
Niederaichbach / decommissioning finished in 1995	Pressure Tube Reactor	106	1972 - 1974	1981 - 1986
Lingen / dismantling	BWR	252	1968 - 1977	1988 - 2015
THTR 300 / safe enclosure	HTR	308	1983 - 1988	since 1997

Research Reactors with period of safe enclosure

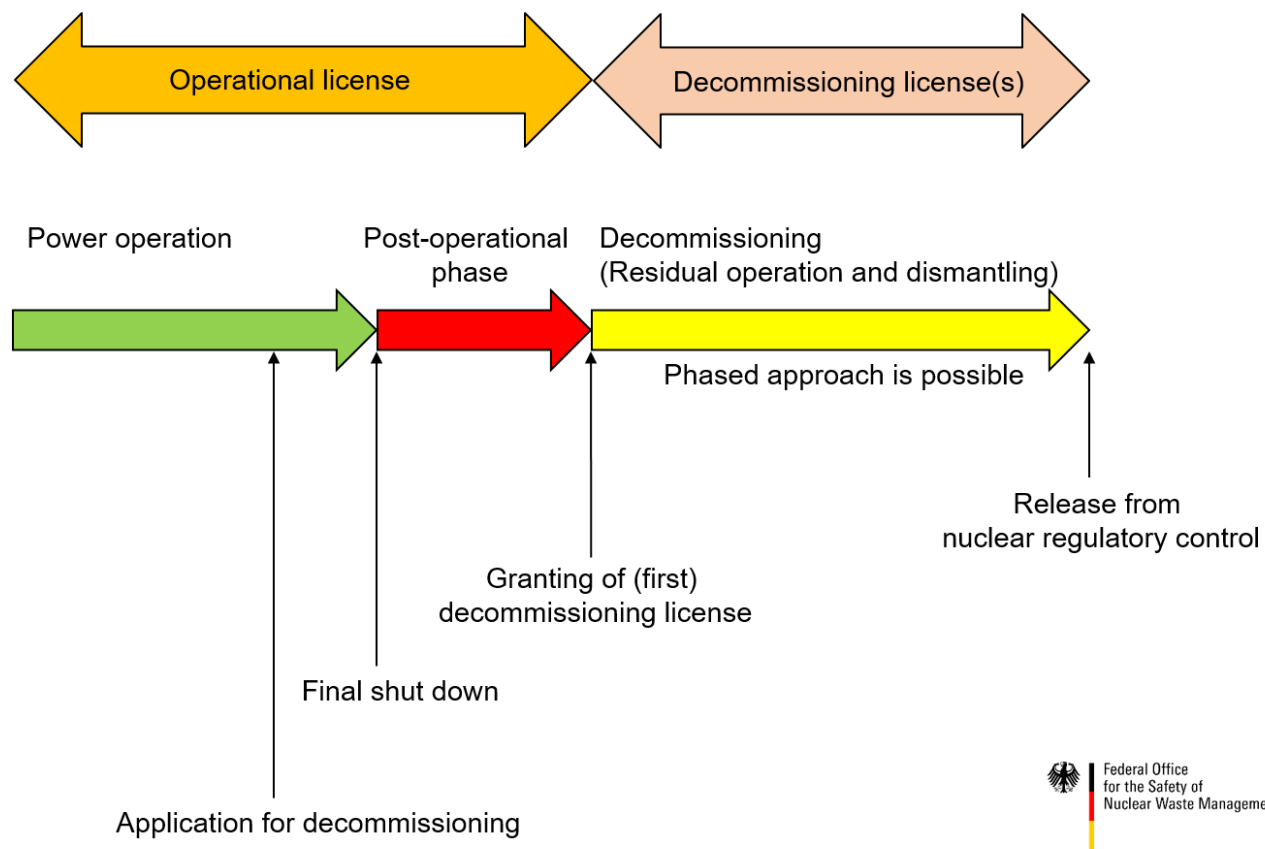
Research Reactor / Actual status	Reactor type	Power MWth	Operational	Period of safe enclosure
TRIGA Heidelberg I / decommissioning finished in 2009	Pool-type / TRIGA MARK-I	0,25	1966 - 1977	1980 - 2006
Forschungsreaktor Neuherberg / safe enclosure	Pool-type / TRIGA MARK-III	1	1972 - 1982	since 1984
Forschungsreaktor 2 / safe enclosure	Tank-type	44	1961 - 1981	since 1996

Example: Pressure Tube Reactor Niederaichbach (KKN)

- Operation: 1972 – 1974
- Decommissioning finalized: 1995
buildings demolished



Licensing Scheme for Decommissioning



Applications and licenses for decommissioning of NPPs due to nuclear phase out (since 2011)

NPP		Permanent shutdown	First application for decommissioning	First licence granted for decommissioning
Unterweser	KKU	06.08.2011	04.05.2012	05.02.2018
Brunsbüttel	KKB	06.08.2011	01.11.2012	21.12.2018
Isar 1	KKI 1	06.08.2011	04.05.2012	17.01.2017
Philippsburg 1	KKP 1	06.08.2011	24.04.2013	07.04.2017
Neckarwestheim I	GKN 1	06.08.2011	24.04.2013	03.02.2017
Biblis A	KWB A	06.08.2011	06.08.2012	30.03.2017
Biblis B	KWB B	06.08.2011	06.08.2012	30.03.2017
Krümmel	KKK	06.08.2011	24.08.2015	–
Grafenrheinfeld	KKG	27.06.2015	28.03.2014	11.04.2018
Gundremmingen B	KRB B	31.12.2017	11.12.2014	19.03.2019
Philippsburg 2	KKP 2	31.12.2019	18.07.2016	17.12.2019
Grohnde	KWG	31.12.2021	26.10.2017	–
Brokdorf	KBR	31.12.2021	01.12.2017	–
Gundremmingen C	KRB C	31.12.2021	31.07.2019	26.05.2021
Isar 2	KKI 2	In operation, exp. end 2022	01.07.2019	–
Neckarwestheim II	GKN 2	In operation, exp. end 2022	18.07.2016	–
Emsland	KKE	In operation, exp. end 2022	22.12.2016	–

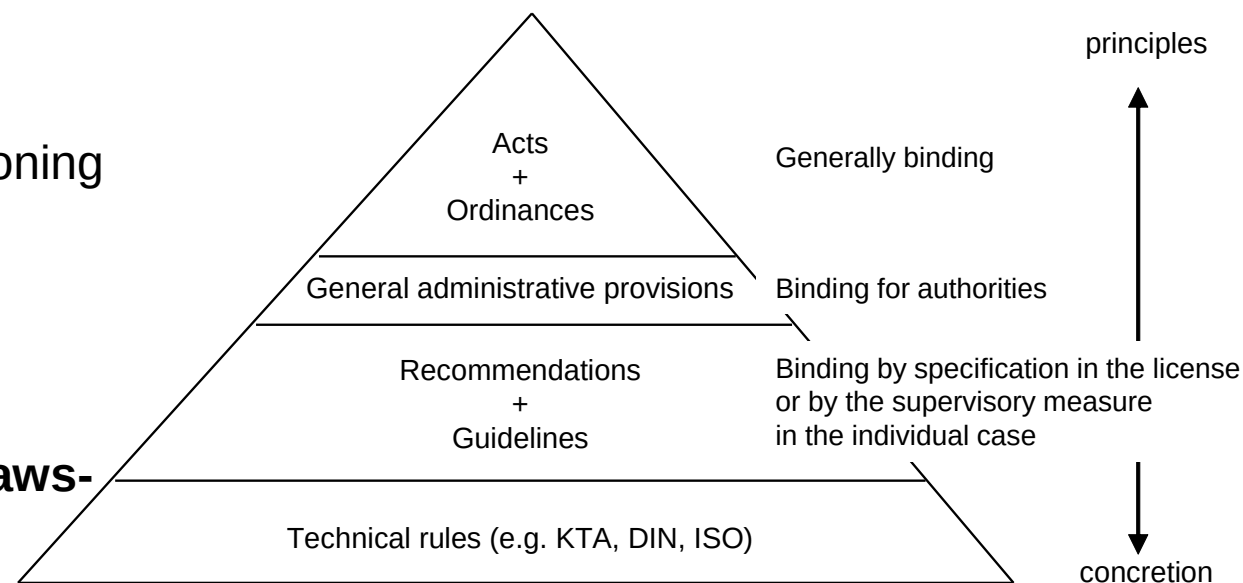
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Competent Regulatory Bodies

- **Federal government** has the exclusive legislative power by German constitution regarding nuclear energy and radiation protection
- **Länder** are competent licensing and/or supervising authorities by order of the state fixed in German constitution and Atomic Energy Act
- **Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)** supervises legality and expediency of the administrative action of the Länder (federal oversight)

Regulatory Framework

- Applicable to all types of nuclear facilities / activities including decommissioning (generic approach)
- Provisions applicable for decommissioning are „scattered“ in various documents
- **Handbook on Nuclear Safety and Radiation Protection:**
https://www.base.bund.de/EN/bfe/laws-regulations/hns/mrs_node.html



Guiding documents help to achieve a common understanding

- **“Guide to the Decommissioning, the Safe Enclosure and the Dismantling of Facilities [...]”** (Decommissioning Guide), developed by representatives of the Federal Government and of the Länder authorities, updated and republished 23 November 2021
- Recommendation of the Nuclear Waste Management Commission (ESK): **“Guidelines for the Decommissioning of Nuclear Facilities”**, updated and published 5 November 2020

Decommissioning Strategies in Germany

Atomic Energy Act provides two basic decommissioning strategies:

- Immediate Dismantling
- Safe Enclosure (with subsequent dismantling)

Based on the German experience so far, immediate dismantling is the preferred decommissioning strategy the operators applied for

Decay storage of unsegmented large components with delayed segmentation can be seen as hybrid strategy



Binding by specification in the licence or by the supervisory measure in the individual case

New Allocation of Responsibilities since 2017

In 2017, the responsibilities for waste management were rearranged by law (Act on the Reorganization of Responsibility in Nuclear Waste Management):

- Utilities remain responsible for
 - Decommissioning and dismantling
 - Waste treatment and packaging
- Publically-owned companies become responsible for
 - Storage
 - Transport
 - Disposal

In this context, the obligation for immediate dismantling of NPPs was supplemented in § 7 (3) Atomic Energy Act. On a case-to-case basis, the competent authority may grant exceptions for plant components insofar and as long this is necessary for radiation protection reasons

Advantages of Immediate Dismantling Compared to Safe Enclosure

- Easier transfer and keeping of knowledge regarding facility and its operational history
- Parts of operational staff can be employed for planning and implementation of decommissioning
- Job protection
- Less ageing of systems and components (e.g. cranes) that are required for dismantling works

Accordance With IAEA Rules

German procedure regarding decommissioning strategies is in accordance with basic IAEA General Safety Requirements Part 6 „Decommissioning of Facilities“, which stipulates:

- Strategies for decommissioning that have been adopted or are being considered by States include immediate dismantling and deferred dismantling (1.9)
- A combination of these two strategies may be considered practicable (1.10)
- Entombment is not an option in the case of planned permanent shutdown (1.10)
- Selecting a decommissioning strategy is the responsibility of the licensee (3.4)
- The preferred decommissioning strategy shall be immediate dismantling (5.1)
- The selection of a decommissioning strategy shall be justified by the licensee (5.2)

Lessons learned

- Technological and organizational know-how for decommissioning is available
- Large number of licensing procedures shortly is a challenge, but due to federal structure the workload is distributed to several Länder authorities
- Regulatory framework is in place and updated as needed
- Update of guiding documents on sub-legal level improves flexibility and exchange of experiences
- Immediate dismantling is advantageous for keeping of knowledge and it facilitates planning



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