Nuclear Safety Department

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Bundesamt
für die Sicherheit
der nuklearen Entsorgung

Status report Nuclear Energy in the Federal Republic of Germany 2024 – Usage, Storage and Disposal

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Preface

The Federal Office for the Safety of Nuclear Waste Management (BASE) is the central federal authority responsible for the safe handling of radioactive waste from the use of nuclear energy. It performs regulatory, licensing, and supervisory tasks in the areas of final storage, interim storage, and the handling and transport of high-level radioactive waste. In particular, it regulates the site selection process for a final repository for high-level radioactive waste and implements public participation. As an independent higher federal authority, BASE is part of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection (BMUV) and advises it with its technical expertise on issues of nuclear waste management and nuclear safety. It conducts and coordinates research in its areas of expertise. Its tasks are based on the following legal foundations:

- Act on the Peaceful Use of Nuclear Energy and Protection against its Hazards (Atomic Energy Act - AtG)
- Act on the Search and Selection of a Site for a Disposal Facility for High-Level Radioactive Waste (Site Selection Act - StandAG)
- Act on the Establishment of a Federal Office for the Safety of Nuclear Waste Management (BfnEErrG)
- Act on the Establishment of a Fund for Financing Nuclear Waste Management (Waste Management Fund Act - EntsorgungsfondsG)
- Act regulating the transition of financing and action obligations for the disposal of radioactive waste oft he operators of nuclear power plants (Waste Management Transfer Act)
- Act on Transparency regarding the Costs of Decommissioning and Dismantling Nuclear Power Plants and the Packaging Radioactive Waste (Transparency Act)
- Act on Subsequent Liability for Decommissioning and Disposal Costs in the Nuclear Energy Sector (Subsequent Liability Act)
- Act on Protection against the Harmful Effects of Ionising Radiation (Radiation Protection Act - StrlSchG)

In the scope of its statutory tasks, the Federal Office for the Safety of Nuclear Waste Management – or the Federal Office for Radiation Protection (BfS) as it was called until 2016 - has published an annual status report on the use of nuclear energy in the Federal Republic of Germany since 1993. Over the course of time, a report that was initially intended solely for internal use or for the then Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) developed into an important document providing an overview for experts and interested members of the public. For the international community, the report is regularly made available in an English translation. The report is available on the BASE website at https://www.base.bund.de/en/nuclear-safety/nuclear-technology/reports/reports.html

This report, which was correct on 31 December 2024, is a further development of the previous report, "Status Report on the Use of Nuclear Energy“ provides an overview of the use and decommissioning of nuclear facilities as well as the storage and disposal of nuclear fuels, radioactive waste, and residual materials in the Federal Republic of Germany. The report lists the key data for all nuclear power plants, research reactors, and nuclear supply and disposal facilities.

List of abbreviations

ADIBKA	Burnup measurement of differential fuel elements with critical arrangement
AGEB	AG Energy balances
AKR-2	Training reactor at Dresden University of Technology
ANEX	Facility for zero-power experiments
ANF	Advanced Nuclear Fuels GmbH, French industrial group, Framatome subsidiary, main business area: nuclear technology
APR	Advanced Pressurized water Reactor
AtG	Atomic Energy Act
AVR	Jülich Experimental Nuclear Power Plant
AZA	Ahaus Storage Facility for low-level and intermediate level waste
AZB	Biblis Storage Facility for low-level and intermediate level waste
AZG	Gorleben Storage Facility for low-level and intermediate level waste
AZN	Neckarwestheim Storage Facility for low-level and intermediate level waste
AZO	Obrigheim Storage Facility for low-level and intermediate level waste
AZP	Philippsburg Storage Facility for low-level and intermediate level waste
AZR	Grafenrheinfeld Storage Facility for low-level and intermediate level waste
AZS	Stade Storage Facility for low-level and intermediate level waste
AZU	Unterweser Storage Facility for low-level and intermediate level waste
AZW	Würgassen Storage Facility for low-level and intermediate level waste
BASE	Federal Office for the Safety of Nuclear Waste Management
BB	Brandenburg
BDEW	German Association of the Energy and Water Industry
BE	Berlin
BER II	Berlin Experimental Reactor II
BfnEErrG	Act to Establishment of a Federal Office for the Safety of Nuclear Waste Management
BfS	Federal Office for Radiation Protection
BGE	The Federal Company for Radioactive Waste Disposal
BGZ	BGZ Company for Interim Storage mbH
BLG	Gorleben Fuel Element Storage Facility GmbH
BMBF	Federal Ministry of Education and Research
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (until December 2021)
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection
BNFL	British Nuclear Fuels Ltd.
Bq	Becquerel
BUND	Bund für Umwelt und Naturschutz Deutschland e.V.
BVerwG	Federal Administration Court
BW	Baden-Württemberg
BWR	Boiling water reactor
BY	Bavaria
BZA	Ahaus Storage Facility for Fuel Elements
BZB	Biblis Storage Facility for Fuel Elements
BZD	Grohnde Storage Facility for Fuel Elements
BZF	Brokdorf Storage Facility for Fuel Elements
BZG	Gorleben Storage Facility for Fuel Elements
BZI	Isar Storage Facility for Fuel Elements
BZK	Krümmel Storage Facility for Fuel Elements
BZL	Lingen Storage Facility for Fuel Elements
BZM	Gundremmingen Storage Facility for Fuel Elements
BZN	Neckarwestheim Storage Facility for Fuel Elements
BZP	Philippsburg Storage Facility for Fuel Elements
BZR	Grafenrheinfeld Storage Facility for Fuel Elements
BZU	Unterweser Storage Facility for Fuel Elements

CASTOR®	Cask for Storage and Transport of Radioactive Material
CEA	French Commission for Atomic Energy and Alternative Energies
CSD	Standard Package for Compacted Waste (Colis Standard de Déchets Compactés)
DIDO	Heavy water moderated and cooled research reactor at the Jülich Research Centre
DKFZ	German Cancer Research Centre
DWK	German Nuclear Fuel Reprocessing Company
EIA	Environmental impact assessment
ELK	Storage chamber
ELMA	Extended storage facility for intermediate-level radioactive waste
EnBW	Energiewerke Baden-Württemberg AG
EnKK	EnBW Kernkraft GmbH
EntsorgÜG	Waste Management Transition Act
E.ON	E.ON Kernkraft GmbH, now PreussenElektra
ERAM	Morsleben Disposal Site for radioactive waste
ERU	Enriched uranium
ESTRAL	Transport Cask Storage Facility
EUC	End-used casks
EVU	Energy power utility
EWN	Energiewerke Nord GmbH, EWN Entsorgungswerk für Nuklearanlagen GmbH since February 2, 2017
FMRB	Braunschweig Research and Measurement Reactor
FR 2	Karlsruhe 2 Research Reactor
FRF 1	Frankfurt 1 Research Reactor
FRF 2	Frankfurt 2 Research Reactor
FRG-1	Geesthacht 1 Research Reactor
FRG-2	Geesthacht 2 Research Reactor
FRH	Research Reactor of the Hanover Medical School
FRJ-1	Jülich 1 Research Reactor
FRJ-2	Jülich 2 Research Reactor
FRM	Munich Research Reactor
FRM-II	Munich II Research Reactor, high-flux neutron source
FRMZ	TRIGA Mark II research reactor at the University of Mainz
FRN	Neuherberg Research Reactor
FSR	Fast Sodium-cooled Reactor
FZJ	Jülich Research Centre GmbH
FZK	Karlsruhe Research Centre GmbH
GB	Great Britain
GDR	German Democratic Republic
GKN 1	Neckarwestheim Unit 1 Nuclear Power Plant
GKN 2	Neckarwestheim Unit 2 Nuclear Power Plant
GKSS	Gesellschaft für Kernenergieverwertung in Schiffbau und Schifffahrt mbH, now: Helmholtz Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH (Centre for Materials and Coastal Research GmbH)
GNS	Gesellschaft für Nuklear Service mbH
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit gGmbH
GWh	Gigawatt hour
HAW	High Active Waste
HAWC	High Active Waste Concentrate
HB	Hanseatic City of Bremen
HDR	Großwelzheim superheated steam reactor
HE	Hesse
HEU	Highly-enriched uranium

HH	Hanseatic City of Hamburg
HKG	High Temperature Nuclear Power Plant GmbH
HM	Heavy metal
HMGU	Helmholtz Zentrum München, German Research Centre for Health and Environment GmbH
HOBEG	Hochtemperatur-Brennelement Gesellschaft
HTR	High-Temperature Reactor
HWCR	Heavy Water Compression Reactor
HWL	High-active waste storage facility
JEN	Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH
K	Kelvin
KAHTER	Critical facility for high-temperature reactors
KBR	Brokdorf nuclear power plant
KEITER	Critical experiment on the in-core thermionics reactor
KGR	Greifswald Nuclear Power Plant
KIT	Karlsruhe Institute of Technology
KKB	Brunsbüttel Nuclear Power Plant
KKE	Emsland Nuclear Power Plant
KKG	Grafenrheinfeld Nuclear Power Plant
KKI 1	Isar Unit 1 Nuclear Power Plant
KKI 2	Isar Unit 2 Nuclear Power Plant
KKK	Krümmel Nuclear Power Plant
KKN	Niederaichbach Nuclear Power Plant
KKP 1	Philippsburg Unit 1 Nuclear Power Plant
KKP 2	Philippsburg Unit 2 Nuclear Power Plant
KKR	Rheinsberg Nuclear Power Plant
KKS	Stade Nuclear Power Plant
KKU	Unterweser Nuclear Power Plant
KKW	Nuclear power plant
KMK	Mülheim-Kärlich Nuclear Power Plant
KNK II	Compact Sodium-cooled Core Reactor, Karlsruhe
KRB A	Gundremmingen Unit A Nuclear Power Plant
KRB-II-B	Gundremmingen Unit B Nuclear Power Plant
KRB-II-C	Gundremmingen Unit C Nuclear Power Plant
KWB A	Biblis Unit A Nuclear Power Plant
KWB B	Biblis Nuclear Unit B Power Plant
KWG	Grohnde Nuclear Power Plant
KWL	Lingen Nuclear Power Plant
KWO	Obrigheim Nuclear Power Plant
KWU	Siemens AG, Power Plant Section
KWW	Würgassen Nuclear Power Plant
LasmA	Storage facility for radioactive waste and residual materials
LasmAaZ	Storage facility for low- and intermediate-level radioactive waste at the storage facility of the Krümmel Nuclear Power Plant
LAVA	Facility for storing and evaporating of highly radioactive liquid waste
LAW	Low active waste
LEU	Low -enriched uranium
LUnA	Unterweser Storage Facility for low and intermediate radioactive waste; now: AZU
LWR	Light water reactor
MERLIN	Medium Energy Research Light Water Moderated Industrial Nuclear Reactor at the Jülich Research Centre
MEU	Medium-enriched uranium
MOX	Mixed oxide (fuel)
MTR	Materials Testing Reactor

MWU	Ministry of Science, Energy, Climate Protection, and Environment of the Federal State of Saxony-Anhalt
MV	Mecklenburg-Western Pomerania
MW_e	Megawatt of electrical power
MWh	Megawatt hour
MW_{th}	Megawatt thermal power
MU	Lower Saxony Ministry for the Environment, Energy, and Climate Protection
mvK	with modified basket
MZFR	Multi-purpose Research Reactor, Karlsruhe
NBauO	Building Code of Lower Saxony
NI	Lower Saxony
NUKEM	NUKEM GmbH Alzenau
NW	North Rhine-Westphalia
OH	Otto Hahn
oHG	General partnership
OVG	Higher Administrative Court
PFB	Planning approval decision
PG	Process building
PKA	Pilot conditioning plant
PSF	Public sector financing
PTB	Physikalisch-Technische Bundesanstalt
PuO_2	Plutonium dioxide
PWR	Pressurized water reactor
RAKE	Rossendorf Arrangement for Critical Experiments
RBZ-N	Residual Material Processing Centre at the Neckarwestheim site
RBZ-P	Residual Material Processing Centre at the Philippsburg site
RFR	Rossendorf Research Reactor
RP	Rhineland-Palatinate
RPV	Reactor pressure vessel
RRR	Rossendorf Ring Zone Reactor
RSK	Reactor Safety Commission
RWE	Rheinisch-Westfälische Elektrizitätsgesellschaft
SAAS	State Office for Nuclear Safety and Radiation Protection (of the former GDR)
SAR	Siemens Argonaut Reactor
SE	Safe enclosure
SEWD	Disruptive actions or other third-party interventions
SG	Decommissioning licence
SH	Schleswig-Holstein
SL	Saarland
SMUL	Saxon State Ministry for the Environment and Agriculture
SN	Saxony
SNEAK	Research Reactor at the Research Centre Karlsruhe; Fast zero-energy arrangement
ST	Saxony-Anhalt
StandAG	Site Selection Act
STARK	Research Reactor at the Research Centre Karlsruhe; Fast Thermal Argonaut Reactor
StMUV	Bavarian State Ministry of the Environment and Consumer Protection
StrlSchG	Radiation Protection Act
StrlSchV	Radiation Protection Ordinance
SUA	Siemens subcritical arrangement
SUR	Siemens Training Reactor
SZL	On-site storage facility

TBG	Partial operating licence
TBL	Transport cask storage facility
TEG	Partial construction licence
TG	Partial licence
TH	Thuringia
THTR-300	Thorium High-temperature Reactor, Hamm-Uentrop
TRIGA	Training Research and Isotope Production Facility of General Atomics
TRIGA HD I	TRIGA HD I Research Reactor, Heidelberg
TRIGA HD II	TRIGA HD II Research Reactor Heidelberg
TSG	Partial decommissioning licence
TUM	Technical University of Munich
TVEL	Russian fuel company, owned by Rosatom
TWh	Terawatt hour
U-235	Uranium isotope 235
U_3O_8	Triuranium octoxide
UAG	Gronau uranium enrichment facility
UF_6	Uranium hexafluoride
UNS	Independent auxiliary emergency system
UO_2	Uranium dioxide
UTA	Uranium separation plant
UVPG	Environmental Impact Assessment
VAK	Kahl Experimental Nuclear Power Plant
VDEW	Verband der Elektrizitätswirtschaft (e.V.)
VEK	Karlsruhe Vitrification Plant
VKTA	Strahlenschutz, Analytik und Entsorgung Rossendorf (registered association)
WAK	Dismantling Project for the Karlsruhe WAK reprocessing plant
WAW	Wackersdorf reprocessing plant
WWER	Water-cooled, water-moderated energy reactor (Soviet-type PWR)
WWR-S (M)	Water-cooled, water-moderated reactor of Soviet-type; S stands for series production and M for modification (in the case of the RFR: changes to the core and fuel)
ZLN	Storage Facility North

1 Nuclear energy in Germany

1.1 Introduction

The phase-out of commercial electricity generation from nuclear energy in Germany has been completed. On April 15, 2023, the last three nuclear power plants (see Chapter 2) Emsland, Isar Unit 2, and Neckarwestheim Unit 2 were shut down. Their authorization for commercial operation has thus expired. Nuclear decommissioning licences were issued and utilized for all shut-down plants. The nuclear power plants are being gradually dismantled. The aim is to release the plants from nuclear regulatory supervision.
In addition to nuclear power plants, other nuclear facilities are operated in Germany. These include research reactors (see Chapter 3). They are used in research centres and universities for scientific experiments, among other things. In the 2024 reporting year, six research reactors were in operation.
Other nuclear facilities in operation are the Gronau Uranium Enrichment Plant and the Lingen Fuel Element Factory. These facilities are classified as nuclear supply facilities (see Chapter 4).
In addition, interim storage facilities are operated at nuclear power plant sites in Germany. Highly radioactive materials are stored there safely until a final repository is ready to accept them. Other interim storage facilities are used to store low-level radioactive waste and residual materials. Interim and final storage facilities are classified as nuclear waste disposal facilities (see Chapter 5).

1.2 Phasing out nuclear power generation

The German Bundestag's decision on June 30, 2011, to phase out nuclear power paved the way for an orderly end to the commercial use of nuclear energy for electricity generation in Germany. This Bundestag decision was based on a broad, cross-party majority.
The trigger for the vote in the German Bundestag was the nuclear disaster in Fukushima on March 11, 2011. The seven oldest German nuclear power plants, which were still in operation at that time, and the Krümmel plant lost their operating licences after the events in Japan. A step-by-step plan was established for the shutdown of the remaining nuclear power plants.
This decision was enshrined in law with the 13th amendment to the Atomic Energy Act of July 31, 2011.
According to this, the last three nuclear power plants, Isar Unit 2, Emsland, and Neckarwestheim Unit 2, were to be shut down permanently on December 31, 2022. Due to the energy policy situation in 2022, the Bundestag decided to allow these three power plants to continue operating on a temporary basis until April 15, 2023. This date marked the end of the legally stipulated phase-out of nuclear energy for commercial electricity generation.
Figure 1 provides a graphical representation of the development of nuclear energy use in Germany over time.

1957	**First research reactors in Germany** In 1957, the two research reactors in West and East go into operation: the Munich research reactor, the so-called Garching Atomic Egg, and the Rossendorf research reactor. These two facilities are used for research purposes and not for generating electricity.
1960	**Atomic Energy Act in the Federal Republic of Germany** The Atomic Energy Act comes into force in the Federal Republic of Germany. Its purpose ist he peaceful utilization of nuclear energy and protection against its dangers. The issue of waste disposal is not addressed.
1960	**Kahl Experimental Nuclear Power Plant** The Kahl Experimental Nuclear Power Plant is commissioned in 1960 with an electrical output of 16 MW. It is the first commercial nuclear power plant in the Federal Republic of Germany. A total of 36 nuclear power plants will go into operation in the FRG.
1962	**Atomic Energy Act in the GDR** The law on the use of nuclear energy in the GDR (Atomic Energy Act) is passed by the Peoples`s Chamber of the GDR.
1966	**Rheinsberg Nuclear Power Plant** The GDR`s first commercial nuclear power plant in Rheinsberg is commissioned in 1966 with an electrical output of 70 MW.
1973	**Greifswald Nuclear Power Plant** The first unit of the Greifswald nuclear power plant goes into operation in the GDR. A total of 8 units oft he Russian WWER-440 type were planned, each with an electrical output of 440 MW. Units 2-4 were commissioned in 1974, 1977 and 1979.
1975	**Biblis Nuclear Power Plant** In 1975, the first oft wo units oft he twin-unit Biblis nuclear power plant, Biblis Unit A, goes into operation. With an electrical output of around 1200 MW, Biblis A is considered the largest reactor Unit in the world at the time. Biblis Unit B also goes into operation in 1977.
1982	**Stendal Nuclear Power Plant** A construction licence for two units of a pressurised water reactor oft he Russian type WWER-1000, each with an electrical output of 1000 MW, is granted for the Stendal site. Construction work is stopped during the reunification period 1990.
1985	**Fast Breeder Reactor Kalkar** The fast breeder reactor in Kalkar ist completed in 1985, but does not go into operation. The project is cancelled in 1991. The site is used as an amusement parc from 1996.
1988	**Isar 2, Emsland und Neckarwestheim 2 Nuclear Power Plants** The Isar Unit 2, Emsland and Neckarwestheim Unit 2 nuclear power plants, the three newest plants in Germany to date, go into operation. They are pressurised water reactors with electrical outputs of around 1400 MW and more.
1989/ 1990	**Greifswald und Rheinsberg Nuclear Power Plants** In the GDR, unit 5 at the Greifswald nuclear power plant reaches first criticality in 1989, but does not go into operation. Units 1-4 are taken out of operation. Construction work on units 6 to 8 is stopped in 1990. The Rheinsberg nuclear power plant ist also finally shut down in 1990.
1990	**Atomic Energy Act in reunified Germany** With the entry into force of the Treaty on the Creation on the Monetary, Economic and Social Union between the Federal Republic of Germany and the GDR, the Atomic Energy Act also becomes applicable in the new federal states from July 1990.
2002	**First Nuclear Phase-out** The Bundestag introduces the Nuclear Phase-out Act („Act on the Orderly Termination of Nuclear Energy Utilisation for the Commercial Generation of Electricity"). Once the remaining electricity volumes have been produced, the licences to operate nuclear power plants will expire.
2010	**Lifetime Extension** With the lifetime extension, the federal legislator introduces additional residual electricity volumes for the individual nuclear power plants.
2011	**Second Nuclear phase-out** An earthquake followed by a tsunami leads to a nuclear disaster at the Fukushima Daiichi nuclear power plant on 11 March 2011. As a result the Bundestag passes a cross-party solution to finally phase out the use of nuclear energy. The nuclear power plants Biblis Unit A and B, Neckarwestheim Unit 1, Brunsbüttel, Isar Unit 1, Unterweser, Philippsburg Unit 1 and Krümmel lose their operating licences.
2015	**Grafenrheinfeld Nuclear Power Plant** The operator finally shuts down Grafenrheinfeld nuclear power plant on 27 June 2015, six months before its operating licence expires at the end of the year.
2017	**Gundremmingen Nuclear Power Plant Unit B** The Gundremmingen nuclear power plant unit B loses its licence for power operation on 31.12.2017.
2019	**Philippsburg Nuclear Power Plant Unit 2** The Philippsburg nuclear power plant unit 2 loses its licence for power operation on 31.12.2019.
2021	**Grohnde, Gundremmingen Unit C und Brokdorf Nuclear Power Plants** Grohnde, Gundremmingen Unit C and Brokdorf nuclear power plants lose their licence for power operation on 31.12.2021.
2022	**Isar Unit 2, Emsland und Neckarwestheim Unit 2 Nuclear Power Plants** According to the 19th amendment to the Atomic Energy Act of 4 December 2022, the final shutdown of the last three nuclear power plants operated in Germany, Isar Unit 2, Emsland and Neckarwestheim Unit 2, will be postponed from 31 December 2022 to 15 April 2023.
2023	**Completion of the phase-out of the use of nuclear energy for the commercial generation of electricity** The final shutdown of the three last operating nuclear power plants in Germany, Isar Unit 2, Emsland and Neckarwestheim Unit 2, on 15 April 2023 marked the completion of the legally use of nuclear energy for commercial generation of electricity.

Fig. 1: Chronological development of the commercial use of nuclear energy in Germany

1.2.1 Nuclear legislation in Germany

The Atomic Energy Act (AtG) was promulgated on December 23, 1959, following the Federal Republic of Germany's declaration that it would renounce nuclear weapons, and has been amended several times since then. The purpose of the Atomic Energy Act is to protect life, health, and property from the dangers of nuclear energy and the harmful effects of ionizing radiation, to compensate for any damage caused, to bring about the orderly phase-out of the use of nuclear energy for commercial electricity generation, and to ensure orderly operation until the phase-out is complete. Accordingly, the Bundestag passed the 19th Act Amending the Atomic Energy Act of December 9, 2022, which finally ended the era of commercial electricity generation from nuclear energy in Germany on April 15, 2023. Furthermore, the use of nuclear energy should not be allowed to jeopardize the internal or external security of the Federal Republic of Germany. The Act is also intended to ensure that Germany fulfils its international obligations in the field of nuclear energy and radiation protection.

1.3 Reportable events

According to the Nuclear Safety Officers and Reporting Ordinance (AtSMV), accidents, incidents, or other events significant to nuclear safety must be reported. These reportable events must be reported by the licence holder (operator of the facility) to the relevant nuclear regulatory authority. The competent nuclear regulatory authorities then forward the reportable events to the Incident Reporting Office of the Federal Office for the Safety of Nuclear Waste Management.

The Incident Reporting Office is responsible for centrally recording reportable events in nuclear facilities, conducting an initial assessment for nuclear power plants and research reactors, and publishing monthly and annual reports. In this way, it supports the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection (BMUV) in regularly informing the public about reportable events.

In 2024, 29 reportable events were recorded for nuclear power plants, 17 reportable events for nuclear fuel supply and disposal facilities, and 32 reportable events for radioactive waste disposal facilities. There were no reportable events at research reactors.

Details and further information on reportable events are available on the BASE website at https://www.base.bund.de/en/nuclear-safety/incident-reporting-centre/reportable-events/reportable-events_content.html.

2 Nuclear power plants

The Federal Republic of Germany does not have any nuclear power plants (NPPs) in commercial operation. The last three nuclear power plants were permanently shut down on April 15, 2023.
As of December 31, 2024, the status was as follows:

- 33 nuclear power plants in decommissioning,
- 3 nuclear power plants decommissioning completed and released from the Atomic Energy Act, and
- 6 nuclear power plant projects discontinued.

The Russian Federation's attack on Ukraine on February 24, 2022, represents a turning point for the safe use of nuclear energy in Europe and Germany's strategy for energy security and energy production. The ensuing political process in Germany and worldwide led to dramatic changes in national and international economic and energy policy. In Germany, for example, in order to ensure the reliability of the electricity supply system for the winter of 2022/2023, the final shutdown of the last three nuclear power plants in operation, Isar 2, Emsland, and Neckarwestheim 2, originally set for December 31, 2022, to April 15, 2023. Continuing operation in this so-called extended operation beyond the date would have required a change in the law and was not pursued for economic, legal, and safety reasons.

The life cycle of a nuclear power plant consists of several phases. After the construction phase and commissioning (first criticality), the plant enters power operation, which serves to generate energy. During this operating phase, regular (annual) inspections take place, during which the plant is (temporarily) shut down in order to carry out maintenance and testing work and to replace fuel elements. Power operation ends with permanent shutdown. This is followed by the post-operating phase, during which the irradiated fuel elements are removed from the reactor core and transferred to the cooling ponds. Since all of the nuclear power plant's safety systems are still required at this point, this operating phase is still covered by the operating licence for power operation. A decommissioning and dismantling licence is required for the decommissioning and dismantling of a nuclear power plant. Once this licence is used, power operation ends and the nuclear power plant enters the decommissioning or residual operating phase.

The individual nuclear power plants are described according to their status in chapters 2.1 to 2.3 and in the corresponding tables in Annex I.

Table2.1: Nuclear power plants in Germany in 2024, as of December 31, 2024

Status	Pressurized water reactor (PWR)		Boiling water reactor (BWR)		Other		Total	
	Number	MWe (gross)	Number	MWe (gross)	Number	MWe (gross)	Number	MWe (gross)
Decommissioned	21	19,447	9	7,906	3	344	33	27,697
Completely dismantled	–	–	1	16	2	131	3	147
Project discontinued	5	3,320	–	–	1	327	6	3,647

2.1 Nuclear power plants in decommissioning

As of December 31, 2024, there were 33 nuclear power plant units in decommissioning in the Federal Republic of Germany (see Table I.2 in Annex I). The Hamm-Uentrop Thorium High-temperature Reactor is the last German nuclear power plant in *safe enclosure*. The other nuclear power plants are being decommissioned with the aim of being released from nuclear regulatory supervision.

Emsland Nuclear Power Plant (KKE)
The Emsland Nuclear Power Plant was a pressurized water reactor (PWR) and one of three convoy plants in the Federal Republic of Germany. The plant was commissioned in 1988 with a capacity of 1,316 MWe. The last valid reactor capacity of 1,406 MWe was achieved through a thermal and several electrical capacity increases. The last power increase of 6 MW took place in May 2014 through the replacement of the high-pressure turbine. On the basis of section 7 (1e) Atomic Energy Act, the KKE lost its authorization for power operation on April 15, 2023, and was permanently shut down.

On December 22, 2016, Kernkraftwerke Lippe-Ems GmbH submitted an application pursuant to Section 7 (3) according to Atomic Energy Act for the decommissioning and dismantling of the plant. Due to the pandemic situation, the discussion meeting took place as a three-phase online consultation, which also included the handling licence pursuant to Section 12 of the StrlSchG for the Emsland Technology and Logistics Building (TLE), see below. The licence for the decommissioning and dismantling of the Emsland Nuclear Power Plant was granted on September 26, 2024, and immediately put into effect. The power plant has been in decommissioning since then.

The on-site storage facility for irradiated fuel elements was transferred to BGZ on January 1, 2019, and is being continued to be operated by BGZ as the Lingen Storage Facility for Fuel Elements (BZL).

On August 29, 2019, Kernkraftwerke Lippe-Ems GmbH submitted an application for the handling of radioactive substances in accordance with Section 12 of the StrlSchG in a new technology and logistics building in Emsland (TLE). The application was revised on July 8, 2020, and is currently being processed. Due to the pandemic, online consultations took place instead of a discussion meeting. The TLE is also intended to accept radioactive materials from the Lingen Nuclear Power Plant. The building licence for the TLE was granted in 2023. The building is currently under construction.

Grohnde Nuclear Power Plant (KWG)
The Grohnde Nuclear Power Plant was a PWR (pre-Convoy) and went into operation in 1984 with a capacity of 1,365 MWe. One thermal and two electrical power increases resulted in a reactor output of 1,430 MWe. The authorization to operate the nuclear power plant expired on December 31, 2021, in accordance with Section 7 (1a) of the Atomic Energy Act. The Grohnde Nuclear Power Plant was permanently shut down on that date.

On October 26, 2017, an application was submitted in accordance with Section 7 (3) of the Atomic Energy Act for the decommissioning and dismantling of the plant in the first dismantling phase. In connection with this application, an application was submitted on November 30, 2017, for the construction of a transport preparation building in accordance with Section 7 of the Radiation Protection Ordinance. The documents are currently being reviewed by the Lower Saxony Radiation Protection Authority. As part of the environmental impact assessment, a scoping meeting for both procedures took place on April 4, 2019. The procedure was announced on April 28, 2021, and the documents were available for inspection from May 6 to July 5, 2021. The objections were discussed in an online consultation from October 1, 2021, to December 31, 2021. The decommissioning and dismantling licence was granted on December 6, 2023. This has been in use since January 18, 2024. On January 16, 2024, an application was submitted for approval of the second dismantling phase (dismantling of the reactor pressure vessel and *biological shield)*.

The building licence for the transport preparation building was granted. Construction began during the reporting period.

The on-site storage facility for irradiated fuel elements was transferred to BGZ on January 1, 2019, and is operated by BGZ as the Grohnde Storage Facility for Fuel Elements (BZD).

Krümmel Nuclear Power Plant (KKK)
The Krümmel Nuclear Power Plant is the most powerful boiling water reactor (BWR) in the 69 series. The plant was commissioned in 1983 with a capacity of 1,316 MW_e. At the end of its operational life, the reactor capacity was 1,402 MW_e.

The plant was shut down after a transformer fire in June 2007. In June 2009, after a brief start-up, another short circuit occurred in a machine transformer. The KKK was then placed in shutdown mode.

Following the amendment of the Atomic Energy Act in 2011, the plant finally ceased power operation and has been in post-operation since June 18, 2018. The reactor was unloaded. Since December 11, 2019, the Krümmel Nuclear Power Plant has been free of fuel elements and fuel rods. Unirradiated fuel elements contaminated only by storage pool water have already been transported to Sweden for storage. At a later date, they are to be transported to the USA for further processing. During the reporting year, the decommissioning of a number of systems was continued. The disposal of old *core scrap* (old components of the reactor pressure vessel (RPV)) is ongoing.

On August 24, 2015, the operator submitted an application for the decommissioning and dismantling of the Krümmel Nuclear Power Plant. As part of the environmental impact assessment, a scoping meeting was held on June 27, 2016. On September 29, 2017, the application for decommissioning of the plant was clarified. The decommissioning and dismantling licence was granted on June 20, 2024, and has been in effect since October 9, 2024. The KKK is therefore in residual operation.

An application for a licence in accordance with Section 7 of the Radiation Protection Ordinance for the handling of radioactive substances in a new storage facility for radioactive waste and residual materials (LasmAaZ) was submitted on December 13, 2016. The building application was submitted on March 31, 2017. The building licence for the LasmAaZ was granted on April 29, 2020. The building is currently under construction.

The Krümmel Storage Facility, which has been approved since 2003, underwent structural upgrades and was handed over to BGZ on January 1, 2019. Since then, it has been operated under the new name Krümmel Storage Facility for Fuel Elements (BZK).

Brokdorf Nuclear Power Plant (KBR)
The Brokdorf Nuclear Power Plant is a PWR (pre-convoy). The plant was commissioned in 1986 with a capacity of 1,380 MW_e. The reactor capacity was most recently 1,480 MW_e. This was the result of two thermal and several electrical capacity increases. The licence to operate the nuclear power plant expired on December 31, 2021, in accordance with Section 7 (1a) of the Atomic Energy Act. The Brokdorf Nuclear Power Plant was permanently shut down on that date.

On December 1, 2017, the operator applied to the licensing authority for the decommissioning and dismantling of the plant in the first dismantling phase in accordance with Section 7 (3) of the Atomic Energy Act. The application was supplemented on March 24, 2020. Two dismantling phases are planned. The start of dismantling phase one is planned with fuel elements at the plant.

On December 8, 2017, an application for approval was submitted in accordance with Section 7 of the Radiation Protection Ordinance (StrlSchV) for the handling of radioactive substances and residual materials in a new transport preparation building to be constructed. A scoping meeting for both projects took place on January 29, 2019, as part of the environmental impact assessment. The documents were available for public inspection from June 15 to August 17, 2020. The discussion meeting was held as an online consultation between February 15 and May 15, 2021. The decommissioning licence was granted on October 23, 2024, and has been in use since December 13, 2024.

The Brokdorf Storage Facility, which had been approved since 2003, was handed over to BGZ on January 1, 2019, and operated under the new name Brennelemente-Zwischenlager Brokdorf (BZF) (Brokdorf Storage Facility for Fuel Elements). On July 7, 2022, BASE granted approval for the expansion of the structural protection of the BZF.

Neckarwestheim Nuclear Power Plant Unit 1 (GKN 1)
The Neckarwestheim Nuclear Power Plant Unit 1 was a pressurized water reactor (PWR) and went into operation in 1976 with a capacity of 855 MW_e. The reactor's electrical output was most recently 840 MW_e. The plant was shut down on March 16, 2011, by order of the German federal government. The authorization for power operation expired with the amendment of the Atomic Energy Act on August 6, 2011. The fuel elements were transported to Unit 2. The last transport took place in April 2018. Since then, the plant has been free of fuel elements and fuel rods.

The first decommissioning and dismantling licence was applied for on April 24, 2013, and granted on February 3, 2017. Since then, the internal components of the reactor pressure vessel have been dismantled and disassembled. Decommissioning work in the turbine hall has begun. The second dismantling licence was applied for in a letter dated December 21, 2017, and granted on December 12, 2019. It includes, among other things, the dismantling of the lower part of the reactor pressure vessel, the *biological shield*, the fuel element storage pool, and parts of the reactor containment. The dismantling of the reactor pressure vessel began in August 2021. This was completed at the beginning of 2022, followed by the dismantling of the ring support in 2023 and the inner shield in 2024.

For additional information on the site, see the following section: Neckarwestheim Nuclear Power Plant Unit 2.

Neckarwestheim Nuclear Power Plant Unit 2 (GKN 2)
The Neckarwestheim Nuclear Power Plant Unit 2 was a pressurized water reactor (PWR), a convoy plant that went into operation in 1988 with a capacity of 1,316 MWe. The last valid electrical reactor output of 1,400 MWe was the result of several thermal and electrical output changes.
On the basis of AtG § 7 (1e), GKN 2 lost its authorization for power operation on April 15, 2023, and was permanently shut down.
On July 18, 2016, EnBW Kernkraft GmbH (EnKK) submitted an application for the decommissioning and dismantling of GKN 2 in accordance with Section 7 (3) AtG. The application was updated by letter dated May 15, 2017. The project was announced on June 22, 2018, and the documents were made available for public inspection from July 2 to September 3, 2018. The discussion meeting took place on November 27, 2018. On April 4, 2023, the decommissioning and dismantling licence for the GKN 2 nuclear power plant was granted. This has been in effect since May 16, 2023. The first step was to decontaminate the primary circuit.

On December 7, 2020, EnBW handed over the Neckarwestheim Waste Storage Facility (AZN) for low- and intermediate-level radioactive waste, which was built on the nuclear power plant site, to BGZ Gesellschaft für Zwischenlagerung mbH (BGZ) in accordance with the Waste Management Transition Act. The Residual Material Processing Centre (RBZ-N) at the Neckarwestheim site, which was approved on December 17, 2018, in accordance with Section 7 of the Radiation Protection Ordinance, went into operation on March 2, 2021.
The on-site storage facility for irradiated fuel elements was transferred to BGZ on January 1, 2019, and has since been operated by BGZ under the new name Neckarwestheim Storage Facility for Fuel Elements (BZN).

Philippsburg Nuclear Power Plant Unit 1 (KKP 1)
Like Isar Unit 1, Brunsbüttel, and Krümmel, the Philippsburg Nuclear Power Plant Unit 1 was one of the boiling water reactors (BWR) of the 69 series and went into operation in 1979 with an output of 900 MW_e. The electrical output valid at the time of the reactor shutdown in 2011 was 926 MW_e. The authorization for power operation expired with the amendment of the Atomic Energy Act on August 6, 2011. All fuel elements and fuel rods were transferred to the Philippsburg storage facility, now known as the Philippsburg Storage Facility for Fuel Elements, by the end of 2016. KKP 1 has been free of fuel elements and fuel rods since then. On May 14, 2020, the cooling towers of the KKP 1 and KKP 2 nuclear power plants were demolished. A direct current substation (converter) is to be built on the vacated site.

On April 24, 2013, an application was submitted in accordance with Section 7 (3) of the Atomic Energy Act for the granting of a first decommissioning and dismantling licence, which was granted on April 7, 2017. Dismantling work has begun. The second dismantling licence was applied for in a letter dated December 21, 2017, and approved on July 31, 2020. The subjects of the second licence application include the dismantling of *the biological shield*, the fuel element storage pool, the reactor pool, and the flood chamber in the reactor building. The dismantling of the RPV and dismantling work in the reactor building and the turbine hall are currently underway.

For further information on the site, see following section KKP 2.

Philippsburg Nuclear Power Plant Unit 2 (KKP 2)
The Philippsburg Nuclear Power Plant Unit 2 was a pressurized water reactor (pre-convoy plant). The plant went into operation in 1984 with a capacity of 1,349 MW_e. Through several thermal and electrical capacity increases, the electrical output of the plant was gradually increased to a value of 1,468 MW_e. The licence to operate the nuclear power plant expired on December 31, 2019, in accordance with Section 7 (1a) of the Atomic Energy Act.

On July 18, 2016, EnKK applied for the decommissioning and dismantling of KKP 2 in accordance with Section 7 (3) of the Atomic Energy Act and updated the application in a letter dated May 15, 2017. The first decommissioning and dismantling licence was granted on December 17, 2019. The reactor pressure vessel was unloaded in January 2020 and the fuel elements were transferred to the fuel element storage pool. On May 14, 2020, the cooling towers of the Philippsburg Nuclear Power Plant (units 1 and 2) were demolished. Primary circuit decontamination took place between June and July 2020. The plant was in the process of being dismantled with fuel elements in the storage pool until March 2023, and has been free of fuel elements since the beginning of April 2023. Work has begun on dismantling the core components.

The Philippsburg Storage facility, which had been approved in 2003, was handed over to BGZ on January 1, 2019, and has since been operated under the new name Philippsburg Storage Facility for Fuel Elements (BZP).
The newly constructed Philippsburg Waste Storage Facility (AZP), approved on December 17, 2018, in accordance with the Radiation Protection Ordinance, was handed over to BGZ upon commissioning on April 14, 2020, in accordance with the Waste Management Transition Act. The Residual Material Processing Centre (RBZ-P) at the Philippsburg site, which was also approved on December 17, 2018, in accordance with Section 7 of the Radiation Protection Ordinance, went into operation on March 8, 2021.

Karlsruhe Multipurpose Research Reactor (MZFR)
The multi-purpose research reactor with a 57 MW_e heavy water-moderated pressure vessel reactor was operated from 1965 to 1984. In addition to generating electricity, it also supplied heat to the Karlsruhe Nuclear Research Centre through combined heat and power generation. After its final shutdown, it was decided to dismantle the plant immediately and completely. The spent fuel elements were reprocessed at the Karlsruhe Reprocessing Plant (WAK). Since then, dismantling has been carried out in separate stages, each of which has been approved under nuclear law (partial decommissioning permits).

The 8th decommissioning licence dated January 31, 2007, authorized the dismantling of the activated part of *the biological shield*, the dismantling of all systems and facilities, the decontamination, and the demolition of all building structures. The remote-controlled dismantling at the MZFR ended with the demolition of the activated concrete of *the biological shield* in 2011. Preparations for the demolition of the so-called D_2O tower, the filter house, and the auxiliary plant building began in November 2020 and included the removal of residual contamination, preliminary radiological investigations, and clearance measurements. Once these preparations were complete, demolition work began in March 2021. Decontamination work is currently being carried out on the buildings used for nuclear purposes.

Obrigheim Nuclear Power Plant (KWO)
The Obrigheim Nuclear Power Plant (KWO), a 357 MW_e pressurized water reactor, first went critical on September 22, 1968, and began commercial operation in 1969. After 36 years of operation, the KWO was permanently shut down on May 11, 2005, due to the expiry of its operating licence in accordance with Section 7 (1a) of the Atomic Energy Act (AtG).

The first decommissioning and dismantling licence (1st SAG) for the final and permanent cessation of operations was granted on August 28, 2008, and has been in effect since September 15, 2008.

On October 26, 1998, pursuant to Section 7 of the Atomic Energy Act, the operation of an additional wet storage facility, which had already been built in 1984, was approved in the earth-protected emergency building outside the

reactor building. The dismantling of this external fuel element storage pool was the subject of the 2nd SAG for the Obrigheim nuclear power plant, which was granted on October 24, 2011.

In addition, the 2nd SAG regulates the dismantling of plant components and associated auxiliary systems in the controlled area (including the reactor cooling system and steam generators) and specifies the operating regulations for the continuation of decommissioning operations.

The dismantling is to be carried out in a total of four independent approval steps. The nuclear fuel has been removed from the core. The fuel elements were transported in 15 CASTOR®casks to the Neckarwestheim Storage Facility (now: Neckarwestheim Storage Facility for Fuel Elements (BZN)) between June 27 and December 19, 2017. Since then, the plant has been free of fuel elements and fuel rods.

On April 30, 2013, the third dismantling licence was issued for the dismantling of the lower part of the reactor pressure vessel, the reactor pressure vessel internals, the *biological shield*, and individual structural components in the reactor building. The dismantling of the reactor pressure vessel internals has been completed. The lower part of the reactor vessel has been dismantled. During the reporting period, further work was carried out to dismantle the concrete structures inside the reactor building. The reactor pool and the *biological shield* have been completely dismantled and packed. The fuel element storage pool has also been dismantled.

On November 3, 2015, the fourth and final dismantling step (4th SAG) was applied for and approved on May 14, 2018. The approval covers the dismantling of the remaining structural, mechanical, and electrical plant components, the processing of the resulting residual materials, and the treatment of the resulting radioactive waste. As part of this approval, the building decontamination of the reactor building, reactor auxiliary building, and emergency building is currently underway. The focus of the dismantling activities is currently on adapting the ventilation system, dismantling the remaining plant parts, systems, and components, and decontaminating the buildings. An approval notice required for release in accordance with § 37 StrlSchV has been applied for.

On January 1, 2020, the Obrigheim On-Site Waste Storage Facility, now the Obrigheim Waste Storage Facility (AZO), was transferred to BGZ in accordance with the Waste Management Transition Act.

Compact Sodium-cooled Nuclear Reactor Plant Karlsruhe (KNK II)
The KNK II experimental power plant was used to develop breeder technology. The plant contained a 21 MW_e sodium-cooled fast breeder reactor and was commissioned in 1977. The reactor was finally shut down on August 23, 1991, after completion of the test program.

The decommissioning concept envisages dismantling the plant in ten stages. The first licence for decommissioning the plant was granted on August 26, 1993. The plant has been free of nuclear fuel since May 26, 1994; this was initially transported to Cadarache (France) and is now stored at the Storage Facility North (ZLN).

Once the removal of the primary shielding had been completed as part of the ninth decommissioning licence, preparations were made for the dismantling of *the biological shield*. The existing enclosure was dismantled and replaced by a dismantling caisson (protective enclosure). This serves to separate the ventilation systems between the reactor building and the reactor shaft. Work on dismantling the *biological shield* began in 2019.

On July 15, 2021, the 10th decommissioning licence was granted. The approved scope represents the final step towards the complete dismantling of the plant. In addition to the dismantling of the remaining facilities, the licence also covers the demolition of all buildings.

According to the operator, the decommissioning goal is to completely remove the plant from the Atomic Energy Act.

Gundremmingen Unit A Nuclear Power Plant (KRB A)
The Gundremmingen A plant went into operation in August 1966 with a capacity of 250 MW_e. A characteristic feature of this plant was an internal water-steam separation and steam drying system, which was used for the first time in a boiling water reactor (BWR). Following an incident in 1977, the operator decided in 1980 not to repair the plant for economic reasons, but to shut it down permanently. The last fuel elements were removed from the plant by 1989 and sent for reprocessing. The licence for decommissioning in accordance with Section 7 (3) of the Atomic Energy Act was granted on May 26, 1983. The plant is being completely dismantled in three phases on the basis of the existing nuclear regulatory approvals. The dismantling is well advanced. The systems and components in the

machine hall and reactor building that are no longer required have been dismantled. The reactor building has been decontaminated but has not yet been released from nuclear regulatory supervision.

The former technical building (without the reactor building) of unit A has been used as a technology centre since January 1, 2015. Decontamination and waste treatment work for units KRB II B and KRB II C is carried out there.

For additional information on the site and the operator, see the following section on the Gundremmingen B and C nuclear power plant units.

Gundremmingen Nuclear Power Plant Units B (KRB II B) and C (KRB II C)
The Gundremmingen Nuclear Power Plant (KRB II) was designed as a dual-unit plant with identical units KRB II B and KRB II C. Both units were equipped with boiling water reactors (BWR) of the 72 series, which were commissioned in 1984 and 1985 respectively with a capacity of 1,310 MW_e each.

Due to several electrical power increases, the reactor output of unit B was most recently 1,344 MW_e.
On December 11, 2014, the operator applied for the dismantling of plant components in unit B. On December 31, 2017, KRB II B was permanently shut down in accordance with the Atomic Energy Act. The reactor was unloaded. The fuel elements have been stored in the fuel element storage pool of unit C since mid-2022.

Unit C of the KRB II twin-block power plant went into operation in 1985 with an electrical output of 1,310 MWe. Gradual technical modernization ultimately resulted in an output of 1,344 MW_e. The licence to operate the nuclear power plant expired on December 31, 2021, in accordance with Section 7 (1a) of the Atomic Energy Act. The Gundremmingen Nuclear Power Plant was permanently shut down on this date. The fuel elements were transferred to the fuel element storage pool.

The fuel elements from both reactor blocks are being gradually transferred to the on-site storage facility, now known as the Gundremmingen Storage Facility for Fuel Elements (BZM).

The dismantling of KRB II is planned in three phases. All sub-projects were applied for and approved separately. Initial approval for the decommissioning and dismantling of the KRB II facility, phase 1, was granted on March 19, 2019. The first phase involves the dismantling of KRB II Unit B. The second sub-step involves the dismantling of Unit C, which was approved with the granting of the second permit for the decommissioning and dismantling of plant components of KRB II Unit C on May 26, 2021. Unit C has been undergoing dismantling since 2022. Once the site has been cleared of nuclear fuel, the remaining systems and plant components can then be gradually dismantled in the third and final stage. This third licence was applied for on July 7, 2022, and granted on May 28, 2024.

The Gundremmingen Storage Facility, which had been approved since 2003, was handed over to BGZ on January 1, 2019, and has since been operated under the new name Gundremmingen Storage Facility for Fuel Elements (BZM).

On November 13, 2020, the merger of Kernkraftwerk Gundremmingen GmbH with RWE Nuclear GmbH took effect. RWE Nuclear GmbH is thus the sole holder of the nuclear licences for the Gundremmingen Nuclear Power Plant.

Isar Nuclear Power Plant Unit 1 (KKI 1)
The Isar Nuclear Power Plant Unit 1 belonged to the BWR series 69 and was commissioned in 1977 with an electrical output of 907 MW_e. The last valid electrical reactor output was 912 MW_e. KKI 1 has been permanently shut down since March 17, 2011. The authorization for power operation expired with the amendment of the Atomic Energy Act on August 6, 2011. In April 2020, the last CASTOR® container loaded with fuel elements was transferred to the Isar On-site Storage Facility, now known as the Isar Storage Facility for Fuel Elements. The last defective fuel rod was transferred to the fuel element storage pool at the Isar Nuclear Power Plant Unit 2. This means that the Isar Nuclear Power Plant Unit 1 has been free of fuel elements and fuel rods since October 2020.

On May 4, 2012, an application was submitted in accordance with Section 7 (3) of the Atomic Energy Act for the decommissioning and dismantling of the KKI 1 plant. On January 17, 2017, the first decommissioning and dismantling licence was granted for the Isar Nuclear Power Plant Unit 1 (Phase 1). The licence was appealed. The lawsuit filed by BUND Naturschutz in Bayern e.V. on February 8, 2017, against the decommissioning and dismantling licence was dismissed by the 22nd Senate of the Bavarian Administrative Court in its ruling of December 20, 2018. On January 21, 2021, the Federal Administrative Court also rejected the appeal. This means that the first decommissioning and dismantling licence is now final.

On January 31, 2020, an application was submitted in accordance with Section 7 (3) of the Atomic Energy Act for the further dismantling of the plant, phase 2 (2nd decommissioning permit). The application concerns the dismantling of the reactor pressure vessel and the *biological shield*, as well as the handling of other radioactive materials from the Isar 2 Nuclear Power Plant in the waste processing facilities and buffer storage areas. This licence was granted on September 4, 2023. The dismantling activities for phases 1 and 2 are to be carried out in parallel. The reactor pressure vessel is currently being dismantled.

An application has been submitted for an extension of the handling of other radioactive materials from KKI 2 and the handling of radioactive materials from KKG.

For further information on the site, see Isar 2 Nuclear Power Plant.

Isar Nuclear Power Plant Unit 2 (KKI 2)
The Isar Nuclear Power Plant Unit 2 was a convoy plant with PWR. It was the first of the three convoy plants (Isar 2, Neckarwestheim 2, Emsland) to go into operation in 1988 with a capacity of 1,370 MWe. The last valid reactor output of 1,485 MWe was achieved as a result of two thermal and several electrical output increases. This made KKI 2 the most powerful nuclear power plant unit in Germany. On the basis of AtG § 7 (1e), KKI 2 lost its authorization for commercial operation on April 15, 2023, and was permanently shut down.
On July 1, 2019, an application was submitted for the decommissioning and dismantling of KKI 2. As part of the environmental impact assessment process, a scoping meeting was held on March 5, 2020. The project was announced on July 29, 2021, and the documents were made available for public inspection from September 3 to November 2, 2021. At its own request, Austria received notification in accordance with Article 3 of the UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and Article 7 of the EIA Directive. The documents were made available for public inspection in Austria from September 20 to November 19, 2021.
On March 21, 2024, the first decommissioning and dismantling licence was issued, which has been in effect since April 2, 2024.

The On-site Storage Facility for Spent Fuel Elements was transferred to BGZ on January 1, 2019, and is operated by BGZ as the Isar Storage Facility for Fuel Elements (BZI).

An application for a licence in accordance with Section 7 of the German Radiation Protection Ordinance (StrlSchV) for the handling of radioactive materials in a transport preparation building and an application for the construction of transport preparation building were submitted and granted for the Isar site. Commissioning was approved on July 29, 2022.

Grafenrheinfeld Nuclear Power Plant (KKG)
The Grafenrheinfeld Nuclear Power Plant was a PWR (pre-convoy plant) and went into operation in 1981 with a capacity of 1,299 MW_e. The reactor capacity was most recently 1,345 MW_e and was achieved through two electrical capacity increases. On December 15, 2020, the last loaded CASTOR® container was transferred to the site's storage facility, now known as the spent fuel storage facility. The plant has been free of fuel elements and fuel rods since December 2020 and will also be free of water since August 2023.

On March 28, 2014, an application was submitted for the decommissioning and dismantling of the plant. The plant was taken off the grid by the operator on June 27, 2015. The first decommissioning licence pursuant to Section 7 (3) of the Atomic Energy Act was granted on April 11, 2018. The lawsuit filed by BUND Naturschutz in Bayern e. V. on June 4, 2018, against this licence was withdrawn in 2021 and the proceedings were subsequently discontinued. This means that the first decommissioning licence is now final.

The Grafenrheinfeld Nuclear Power Plant is in the first of two dismantling phases. On December 17, 2019, PreussenElektra GmbH submitted an application pursuant to Section 7 (3) AtG for the further dismantling of the KKG, phase 2 (2nd dismantling licence). The application covers the dismantling of the reactor pressure vessel and the dismantling of *the biological shield.* The dismantling activities are to be carried out in parallel dismantling phases. The second dismantling licence was granted on December 20, 2022, and its use as of March 1, 2023, was approved by the authorities. During the reporting period, dismantling and disassembly work on the reactor pressure vessel began. On August 16, 2024, the cooling towers were demolished by explosion.

The Grafenrheinfeld On-site Storage Facility, which had been approved since 2003, was handed over to BGZ on January 1, 2019, and has since been operated under the new name Storage Facility for Fuel Elements (BZR).

The storage hall for low- to intermediate-level radioactive waste built by PreussenElektra GmbH was handed over to BGZ on May 3, 2021, ready for operation, and has been operated by BGZ as a waste storage facility (AZR) since mid-2021.

Rheinsberg Nuclear Power Plant (KKR)
The Rheinsberg Nuclear Power Plant, with a capacity of 70 MW_e (reactor type WWER), went into operation in 1966. It was used for the GDR's independent reactor development. The electrical energy generated was fed into the national grid. The plant was finally shut down in 1990 after 24 years of operation. The site has been free of nuclear fuel since May 9, 2001; the fuel elements were transferred to the Storage Facility North (ZLN). The plant is scheduled for complete dismantling. The first decommissioning licence was issued on April 28, 1995. The decommissioning work is being carried out in successive stages with the appropriate licences.

On October 30, 2007, the reactor pressure vessel was transported to the ZLN in Lubmin near Greifswald. This has significantly reduced the activity inventory of the plant.

On July 3, 2013, the operator submitted an application for a modification licence to licence I/95 for the decommissioning and partial dismantling of the KKR in accordance with Section 7 of the Atomic Energy Act. This dealt with the concept of long-term storage. In a letter dated September 22, 2015, the operator withdrew the application. A revised concept for the further dismantling of the KKR was presented to the licensing authority on August 27, 2015. EWN submitted the *concept for the further procedure* in a letter dated January 13, 2016. In February 2022, the operator submitted an application for approval in accordance with Section 7 (3) of the Atomic Energy Act for the dismantling of buildings and building structures at the KKR. The gutting of rooms in the reactor building and the special water treatment building, as well as the connected external container facility, is currently being carried out.

The decommissioning of the Rheinsberg Nuclear Power Plant also includes the Active Storage Facility for Solid and Liquid Radioactive Waste (ALfR). Demolition work is being carried out there on the remaining structures of the exposed container facility and adjacent rooms in a protective enclosure. Contaminated soil was recovered outside the protective enclosure.

Biblis Nuclear Power Plant – Units A (KWB A) and B (KWB B)
The Biblis A and B plants are among the eight nuclear power plants that had to permanently cease operations due to the amendment of the Atomic Energy Act in 2011.

The Biblis nuclear power plant was designed as a dual-unit facility. Biblis A, with a PWR, went into operation in 1974 with an output of 1,204 MW_e. The last valid electrical reactor output was 1,225 MW_e. Unit B, also a PWR, began operating in 1976 with an electrical output of 1,300 MW_e. This was also its last valid output. Unit A has been free of fuel elements and fuel rods since November 2016. Biblis B was declared free of fuel elements and fuel rods at the beginning of June 2019.

On August 6, 2012, applications were submitted under Section 7(3) of the Atomic Energy Act for the decommissioning and dismantling of Units A and B of the Biblis Nuclear Power Plant. On March 30, 2017, the first decommissioning and dismantling licences were granted for Units A and B of the plant. BUND Hessen e.V. appealed against the licence for Unit A. On April 28, 2020, the second dismantling licence was granted for Unit A and on July 15, 2020, for Unit B. The licences cover, among other things, the dismantling of the reactor pressure vessel (RPV), the *biological shield*, and the dismantling of facilities enclosing the outer safety areas.

The dismantling of the four steam generators, the pressure vessel, and the flood tanks of Unit A is well advanced. The plan is to partially dismantle the steam generators on site. These will then be further dismantled by EWN at the Lubmin site. The focus of the ongoing dismantling activities is on creating the dismantling and clearance measurement infrastructure (*dismantling factory* for units A and B). In February 2023, the two cooling towers of Unit A were demolished. In Unit B, work began in 2022 on dismantling the internals of the RPV and the spent fuel storage pool. The main coolant pumps, steam generators, and pressure vessel are currently being dismantled. At the same time, dismantling work is being carried out on various components in the containment building. The dismantled materials are to be processed in Unit A.

The Biblis On-site Storage Facility, which has been approved since 2003, was handed over to BGZ on January 1, 2019, and has since been operated under the name Biblis Storage Facility for Fuel Elements (BZB).

On April 5, 2016, approval was granted in accordance with Section 7 of the German Radiation Protection Ordinance (StrlSchV) for the storage facility for radioactive waste and residual materials from the operation and decommissioning of the KWB (LAW storage facility 2) for the temporary storage of low- and intermediate-level radioactive waste generated during dismantling at the power plant site. The two storage facilities for low- and intermediate-level waste were transferred to BGZ at the beginning of 2020 (new designation: Biblis 1 and 2 Waste Storage Facilities (AZB 1 and AZB 2)).

Greifswald Nuclear Power Plant (KGR), Units 1 to 5

The construction of the Greifswald Nuclear Power Plant was based on the decision of the government of the former GDR in 1955 to use nuclear energy for electricity generation. Of the eight PWR units at KGR, each with a capacity of 440 MW_e and of the Soviet WWER type (W-230 and W-213 reactors), Unit 1 went into operation in 1973. Units 2 to 4 were commissioned in 1974, 1977, and 1979. Units 1 to 4 were shut down in 1990 following a safety assessment by the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) and the State Office for Nuclear Safety and Radiation Protection (SAAS) of the former GDR. It was also decided to decommission Unit 5, which first reached criticality in 1989 and whose commissioning was interrupted by the then supervisory authority SAAS. Unit 5 is connected to Unit 6 by a double-block design. Units 6 to 8 were still under construction at that time (see also Chapter 2.3).

The Greifswald Nuclear Power Plant has been free of nuclear fuel since May 22, 2006.

The first decommissioning licence for the decommissioning of the entire plant and the dismantling of plant components (G01) was granted on June 30, 1995, in accordance with Section 7 (3) of the Atomic Energy Act. Since then, further licences and amendment licences for decommissioning and dismantling have been granted. Application GA 08.5 (demolition/dismantling of the structures of the North I special building, including the connecting bridge to the North I equipment building) dated November 29, 2013, is still being processed. EWN is drawing up a demolition strategy for this, as it is not possible to clear the existing structure in all areas. On July 8, 2016, EWN submitted an application in accordance with Section 7 (1) and (3) of the Atomic Energy Act to amend licence G01 and to dismantle/demolish the North II exhaust air stack, including the air duct for Special Building 2 – Stack. The licence was granted on May 9, 2018. The demolition of the stack has been completed. In a letter dated June 5, 2018, a further application was submitted for a licence to decommission and demolish/dismantle the structures of Special Building North II, including the connecting bridge to the North II equipment building and the filling station/rotary thin-film evaporator plant (GA08.7). Preparations are underway for the clearance measurement and dismantling of Special Building 1.

In a letter dated September 28, 2018, EWN applied for a permit to construct and operate a dismantling hall in accordance with Section 12 of the Radiation Protection Act. In the future dismantling hall, large components from the dismantling of the Greifswald and Rheinsberg Nuclear Power Plants are to be dismantled and packaged in a manner suitable for final storage. The building licence was granted on June 22, 2020, and the shell of the building was completed in 2022. Installation work is currently underway. Exhaust air chimneys were installed in November 2024.

In a letter dated May 29, 2019, EWN submitted an application to BASE in accordance with Section 6 of the Atomic Energy Act for the storage of casks in the new Transport Cask Storage Facility (ESTRAL), in which transport and storage containers of various designs currently stored at ZLN (see Chapter 5.1.2). The discussion meeting took place in Greifswald from November 1 to November 2, 2022. Three partial packages of the application documents have been submitted so far. On October 22, 2024, building applications for the storage building, the guard building, the ancillary building, and the outdoor facilities were submitted to the district of Vorpommern-Greifswald.

Stade Nuclear Power Plant (KKS)

The Stade Nuclear Power Plant, a PWR with a capacity of 672 MW_e, was in operation from 1972 to 2003. It was finally shut down on November 14, 2003. The former operator, E.ON, now PreussenElektra, applied for direct decommissioning of the plant in a letter dated July 23, 2001. The fuel elements were transported to France for reprocessing at the end of April 2005.

The dismantling is proceeding in five phases. Phase 4 was last approved on February 4, 2011, and involves the further dismantling of the plant and measures to release buildings and land areas. The nuclear licensing procedure for decommissioning and dismantling was completed with the approval of Phase 4. Phase 5 involves the conventional dismantling of the buildings.

During the dismantling work in January 2014, contamination was detected on the dome floor of the containment vessel. It was assumed that this contamination originated from the power operation phase. As a result of this finding, the corresponding concrete area could not be released by means of a clearance measurement on the standing building structure after rough decontamination, but had to be dismantled.

All systems and components used during power operation were removed from the controlled area. The controlled area was lifted. Demolition and disposal measures took place during the reporting year. Measures were also taken to decontaminate and release the buildings. Conventional demolition of buildings in the monitored area continued.

Lingen Nuclear Power Plant (KWL)
The Lingen Nuclear Power Plant, a BWR with an output of 252 MW_e, went into operation in 1968. After nine years of operation, the plant was shut down in January 1977 due to damage to the steam converters, which had to be replaced. Further serious damage was discovered, prompting the operator to decide in March 1979 to decommission the nuclear section and use the existing steam turbine with a newly installed, natural gas-fired high-temperature gas turbine. On the basis of the licence granted on November 21, 1985, the plant was operated in *safe enclosure* (SE) mode from 1988 onwards. The fuel elements were transported to Sellafield (UK) before the start of SE mode. The SE was monitored from the neighboring Emsland Nuclear Power Plant.

In December 2007, Kernkraftwerk Lingen GmbH announced that it was withdrawing its application to continue *safe enclosure*. On December 15, 2008, the operator submitted an application for the dismantling of the plant in accordance with Section 7 (3) of the Atomic Energy Act. The dismantling of the remaining plant is to be carried out in three sub-projects. On December 21, 2015, approval was granted for the first approval step (subproject 1) for the dismantling of the Lingen Nuclear Power Plant. This comprises the dismantling of all uncontaminated and contaminated plant components, provided that these are not required for further dismantling operations and further dismantling. The second approval step (subproject 2) includes the dismantling of the reactor pressure vessel with its internals, the *biological shield*, the remaining dismantling, decontamination, and the release of the plant from nuclear regulatory supervision. Approval for this was granted on July 22, 2021. The third subproject comprises the conventional demolition of buildings. In fall 2021, the two steam converters were removed as a whole. These were shipped to the US for recycling in the reporting year. Preparations are underway for the dismantling of the reactor pressure vessel.

Unterweser Nuclear Power Plant (KKU)
The Unterweser Nuclear Power Plant went into operation in 1978 with a capacity of 1,300 MW_e. It is a nuclear power plant with a pressurized water reactor. Most recently, the electrical reactor output was 1,410 MW_e. With the 13th amendment to the Atomic Energy Act, power operation ceased on August 6, 2011.

The fuel elements were removed from the reactor core and stored in the Unterweser On-site Storage Facility, now known as the Unterweser Storage Facility for Fuel Elements (BZU). The special fuel rods were packed in CASTOR® casks and also transferred to the storage facility. The Unterweser Nuclear Power Plant has been free of fuel elements and fuel rods since February 21, 2019.

On May 4, 2012, an application was submitted in accordance with Section 7 (3) of the Atomic Energy Act for the decommissioning and dismantling of the KKU plant, which was extended by letter dated December 20, 2013 to include the dismantling of the KKU with the fuel elements still present in the plant. On February 5, 2018, the first approval notice (Notice I/2018) was issued for the Unterweser Nuclear Power Plant for decommissioning and dismantling (1st SAG). On July 15, 2021, approval notice I/2021 was issued for subproject 2 of the dismantling (in particular, dismantling of the activated plant components). This means that all nuclear regulatory approvals required for dismantling have now been obtained.
The following work has been completed: the underwater dismantling and packaging of the reactor pressure vessel (RPV) internals, as well as the removal *of water* from the fuel storage pool and RPV. Subsequently, the RPV and *biological shield* were also completely dismantled. Dismantling and disposal work is continuing, in particular preparatory measures for the removal of the steam converters as a whole. Preparations are being made for the decontamination and release of the building. The release notice has already been issued.

The Unterweser On-site Storage Facility, which has been approved since 2003, was handed over to BGZ on January 1, 2019, and has since been operated under the new name Unterweser Storage Facility for Fuel Elements (BZU).

The Unterweser Storage Facility for Radioactive Waste (LUnA) went into operation in July 2020 and was handed over to BGZ in accordance with the Waste Management Transition Act. It is now operated under the new name Unterweser 2 Waste Storage Facility (AZU 2). AZU 1 had already been commissioned in 1981.

Arbeitsgemeinschaft Versuchsreaktor GmbH Jülich (AVR)
The AVR Experimental Nuclear Power Plant was an experimental reactor developed exclusively in Germany. With a 15 MW_e pebble bed high-temperature reactor (HTR), it went into operation in 1966 and served the development of this type of reactor in Germany with spherical fuel elements made of graphite containing uranium and *thorium-coated particles*. The AVR was finally shut down at the end of 1988 when the further development of this technology in Germany was discontinued with the decommissioning of the THTR-300 prototype reactor in Hamm-Uentrop. During its operation, the AVR fed approximately 1,500 GWh of electrical energy into the public power grid. On March 9, 1994, approval was granted for decommissioning, unloading the reactor core, dismantling plant components, and *safe enclosure*. The unloading of the spherical fuel elements into the central storage facility on the grounds of the Jülich Research Centre was completed in June 1998, with the exception of a maximum of 197 remaining elements. The remaining fuel pellets cannot be recovered at a reasonable cost in terms of radiation protection and economics until the reactor vessel has been dismantled.

After EWN took over the former Arbeitsgemeinschaft Versuchsreaktor GmbH in 2003, the operator decided to change the decommissioning concept. *Safe enclosure* was terminated and direct dismantling was applied for. Approval for the complete dismantling of the plant was granted on March 31, 2009. The reactor vessel was removed from the reactor building and transported to the reactor vessel interim storage facility erected on site on May 23, 2015. Approval for the operation of the interim storage facility was granted on March 1, 2010. This storage facility is used exclusively for the interim storage of the AVR reactor vessel and is designed for interim storage of 30 to 60 years.

The dismantling of components of the primary circuit has been completed. The decontamination work necessary to prepare for the concrete demolition work in the containment vessel has also been completed. The demolition of the containment vessel internals and the containment vessel wall continued in the reporting year and will take several years to complete. Demolition is carried out remotely using a demolition robot. In the reporting year, the demolition height of +11 m was reached. The dismantling of the floor chambers in the containment vessel continued.

On September 1, 2015, Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH (JEN) was founded as a subsidiary of EWN. It now comprises the nuclear areas of Forschungszentrum Jülich and Arbeitsgemeinschaft Versuchsreaktor GmbH.

Würgassen Nuclear Power Plant (KWW)
The Würgassen Nuclear Power Plant, a boiling water reactor with a capacity of 670 $MW_{(e)}$), was in operation from 1971 to 1994. Due to cracks found in the reactor core shroud during a scheduled inspection in 1994, the operator decided to shut down the plant permanently. The plant has been free of nuclear fuel since October 1996; the fuel elements were sent to La Hague (France) for reprocessing.

The first decommissioning licence was issued on April 14, 1997. Since then, three further decommissioning licences have been issued for the plant. Nuclear decommissioning was successfully completed in 2014. The clearance measurements in the outdoor area were completed in 2016, and the official clearance notice was issued in December 2017. Decontamination and clearance measurements of the controlled area buildings have been completed. The operator has submitted several applications for different clearance scenarios for the controlled area building and the UNS storage facility.
The low- and intermediate-level radioactive waste stored in the converted building of the independent emergency cooling system (UNS storage facility) is to be removed in the coming years, as joint demolition of all buildings can only be considered once the UNS interim storage facility has been cleared.

The operation of the Würgassen Storage Facility, which went into operation in 2007 and exclusively stores low- and intermediate-level radioactive waste from the dismantling and operation of the plant, continued. When BGZ took over the facility on January 1, 2020, it was renamed the Würgassen Waste Storage Facility (AZW).

Hamm-Uentrop High-Temperature Thorium Reactor (THTR-300)
The THTR-300, with a helium-cooled pebble bed high-temperature reactor (308 MW_e), went into operation in 1983. In September 1989, the final decommissioning of the plant was decided after it had been shut down on September 29, 1988, for its scheduled annual inspection. On November 13, 1989, the federal government, the federal state of

North Rhine-Westphalia, the operating company HKG, and its shareholders signed a framework agreement for the final completion of the THTR-300 project. The first partial licence for decommissioning, unloading the reactor core, and dismantling plant components was granted on October 22, 1993. Since then, the spherical fuel elements have been removed from the reactor core and transported in CASTOR® casks to the Ahaus Storage Facility for Fuel Elements (BZA). The reactor core has been unloaded since 1995. On May 21, 1997, approval was granted for the operation of *the safe enclosure* (maintenance operation). The plant has been in *safe enclosure* since October 1997.

Mülheim-Kärlich (KMK)
The Mülheim-Kärlich nuclear power plant, a PWR with 1,302 MW_e, went into operation in March 1986. After the Federal Administrative Court revoked the first partial licence, it had been shut down since September 9, 1988.
In a letter dated June 21, 2001, RWE Power AG withdrew its applications under Section 7 of the Atomic Energy Act for the granting of the first partial licence for the construction and operation of the KMK, insofar as they had not yet been decided, and the partial licence (continuous operation). The irradiated fuel elements were transported to La Hague (France) for reprocessing. New fuel elements intended for reloading the reactor were returned to the manufacturer in Belgium.

The dismantling of the KMK plant is taking place in three independent stages. Stage 1 covers the final decommissioning of the plant. Stage 2 includes the dismantling of the primary circuit facilities. Stage 3 envisages the release of the buildings and the site from nuclear regulatory supervision. The demolition of the released buildings will then take place in accordance with building regulations.

Based on the licence granted on July 16, 2004, for dismantling phase 1a and the amendment to licence 1a granted on February 23, 2006, the dismantling measures were continued in the reporting year.
The application for dismantling phase 2b for the dismantling of the two steam generators, the reactor pressure vessel with its core components, and the activated areas of *the biological shield* was approved on October 8, 2015. The dismantling of the steam generators began in October 2018 and was completed in January 2021. On the basis of approval 2b, the first dismantling work for the multi-stage dismantling of the reactor pressure vessel was continued with the aid of remote-controlled technology.
In addition to the dismantling of the large components and associated preliminary work, the focus remains on preparatory activities for the building clearance measurement.

The decision of January 31, 2014, pursuant to Section 7 (3) of the Atomic Energy Act regulates the release and clearance of land areas and the structures located on them (Permit 3c). On the basis of the "3a East" and "3b West" licences, which have now been completed, the plant site has been reduced to a size of 6 hectares. This area is necessary for the further dismantling of the remaining plant. A final nuclear regulatory approval 3d regulates the release of the buildings in the controlled area and the release of the site from nuclear regulatory supervision.

Brunsbüttel Nuclear Power Plant (KKB)
The Brunsbüttel Nuclear Power Plant, the oldest BWR plant in the 69 series, received its first operating licence on June 22, 1976. The reactor output of 806 MW_e has not been changed since commissioning.

Brunsbüttel is one of eight nuclear power plants in Germany that were permanently shut down due to the amendment of the German Atomic Energy Act in 2011. The plant has been free of fuel elements and fuel rods since February 18, 2018.

Approval of the application dated November 1, 2012, pursuant to Section 7 (3) of the Atomic Energy Act for the decommissioning and dismantling of the KKB plant was granted on December 21, 2018, by the Ministry of Energy Transition, Agriculture, Environment, Nature, and Digitalization of Schleswig-Holstein.
The dismantling of the reactor pressure vessel (RPV) internals was completed during the reporting period. The RPV is being dismantled. In addition, the dismantling of the first components of the containment vessel has begun. The second dismantling licence (2nd SAG) was applied for on June 8, 2020, in accordance with Section 7 (3) of the Atomic Energy Act. This provides for the further dismantling of plant components at the Brunsbüttel Nuclear Power Plant.

On May 5, 2014, an application was submitted in accordance with Section 7 of the Radiation Protection Ordinance for the handling of radioactive substances in the new storage facility for radioactive waste and residual materials (LasmA). Construction began on September 6, 2018, on the basis of a partial construction licence. The construction of the building is in its final phase. On March 8, 2023, a licence was granted in accordance with Section 12 of the Radiation Protection Act for the handling of radioactive substances.

The BfS's approval notice for the Brunsbüttel Storage Facility near the site, dated November 28, 2003, was revoked by the Schleswig Higher Administrative Court on June 19, 2013. The Brunsbüttel Storage Facility is currently operating on the basis of an order issued by the nuclear regulatory authority of the federal state of Schleswig-Holstein on January 16, 2015, in accordance with the former storage licence for nuclear fuels outside of state custody according to Section 6 of the Atomic Energy Act. This applies until a fully enforceable and usable storage licence is issued in accordance with Section 6 (1) and (3) of the Atomic Energy Act. The operator submitted a new application for approval on November 16, 2015. The scoping meeting took place on July 13, 2016, and the discussion meeting for the nuclear licensing procedure took place on June 14–15, 2017. The BGZ has joined the ongoing licensing procedure. (see Chapter 5.1.2)

2.2 Nuclear power plants released from the Atomic Energy Act

In the Federal Republic of Germany, three nuclear power plants have been completely dismantled and released from the scope of the Atomic Energy Act. Annex I, Table I.3 lists key data for these plants.

Großwelzheim hot steam reactor (HDR)
The Großwelzheim Superheated Steam Reactor with an output of 25 MW_e served as a prototype and test facility for the development of this reactor design and was commissioned in 1969. After only 1.5 years of operation, it was permanently shut down in 1971 due to deformations in the cladding tubes of the new boiling superheater fuel elements. The spent fuel elements were reprocessed at the Karsruhe Reprocessing Plant (WAK). From 1974 to 1991, the reactor building and the installed systems were used to conduct non-nuclear investigations into the behaviour of nuclear power plants in the event of severe accidents (including earthquakes). The decommissioning of the reactor was approved on February 16, 1983. The plant was completely dismantled.

In mid-May 1998, the plant was released from the scope of the Atomic Energy Act. The remaining conventional dismantling work was completed by mid-October 1998.

Niederaichbach Nuclear Power Plant (KKN)
The Niederaichbach Nuclear Power Plant, a prototype nuclear power plant with an output of 106 MW_e, was characterized by the use of natural uranium and a heavy water-moderated pressure tube reactor with CO_2-gas cooling. The pressure tube principle was intended to avoid the thick-walled pressure vessels required for LWR reactors and to allow reactors of almost any size to be used.

The licence to start operation was granted on December 11, 1972. On December 17, 1972, the reactor reached criticality for the first time. Due to technical difficulties and the fact that the light water reactor design had already become the standard at that time, the owner decided to shut down the reactor permanently. With the permanent shutdown on July 31, 1974, the development of this reactor line was discontinued. The nuclear power plant was in operation for a total of 18.3 full-load days. On October 21, 1975, thelicence was granted to transfer the plant to *safe enclosure*, and on October 20, 1981, licence was granted for *safe enclosure*. The fuel elements were transported to France to the CEA (Commissariat à l'Energie Atomique et aux Energies Alternatives). The complete dismantling of the plant was approved on June 6, 1986. On August 17, 1995, the decommissioning of the KKN was completed and the nuclear power plant was released from the Atomic Energy Act. The floor slabs of the reactor and tomb buildings remained in the soil, as complete removal would have required lowering the groundwater level. The remaining floor slabs and underground pipelines were removed. This was the first nuclear power plant in the world with significant output whose decommissioning was completed by handing over the site as *a greenfield site*. This demonstrated for the first time in Germany the feasibility of both the technical implementation of complete removal and the associated nuclear licensing procedure.

Kahl Experimental Nuclear Power Plant (VAK)
The Kahl Experimental Nuclear Power Plant, with a 16 MW_e BWR, was the first nuclear power plant for electricity generation in Germany. It went into operation in 1960. In 1985, the plant was shut down because, according to the operator, all planned scientific and operational tests had been completed. The first partial decommissioning licence was granted by decision of May 5, 1988. The fuel elements were removed from the plant by 1989 and transported to the Karlsruhe Reprocessing plant (WAK) for reprocessing. Irradiated MOX fuel elements that could not be reprocessed at WAK were transported to Sweden for storage and disposal at the Central Storage Facility for Spent Fuel Elements.
The buildings and the plant site were released from nuclear regulatory supervision on May 17, 2010. The dismantling work as part of the conventional demolition was completed on September 24, 2010.

2.3 Discontinued nuclear power plant projects

The following is a list of nuclear power plants that were planned but whose completion was discontinued after construction had begun. Table I.4 in Annex I provides an overview of these projects.

Greifswald Nuclear Power Plant (KGR), Units 6 to 8
At the Greifswald Nuclear Power Plant, construction and assembly work on Units 6 to 8 (440 MW_e Soviet-type WWER PWR, W-213 reactor) was discontinued in 1990.

Unit 6 is used for visitor tours as a technical exhibition to demonstrate reactor technology. The machine hall of Units 5 to 8 was completely cleared and is now used for industrial purposes (see also Chapter 2.1). Uncontaminated equipment from Units 7 and 8 was transported to Unit 5 and dismantled there. This was used to test tools and equipment for the remote dismantling of reactor components.

Kalkar Sodium-cooled Fast-breeding Reactor (SNR 300)
The SNR 300, a 327 MW_e Sodium-cooled Fast-breeding Reactor, was constructed between 1973 and 1991, largely completed, and prepared for commissioning. However, before the already manufactured fuel elements were loaded, it was decided in 1991 not to put the plant into operation. The systems that had been built were subsequently dismantled, scrapped, or sold. On April 1, 1996, ownership of the site was transferred to Kern-Wasser-Wunderland Freizeitpark GmbH, and it has been used commercially ever since. The fuel elements were initially stored by the Federal Office for Radiation Protection and later transported to France for reprocessing.

Stendal Nuclear Power Plant
The construction of a nuclear power plant with four units was planned near Stendal. In 1979, it was decided to build Soviet WWER-type pressurized water reactors with a capacity of 1,000 MW_e each at the site. On September 10, 1982, the former State Office for Nuclear Safety and Radiation Protection of the GDR (SAAS) granted the first construction licence for two units. The construction and assembly work that had begun on Units A and B at the Stendal Nuclear Power Plant was halted in 1990 after several years of delays. Some of the buildings and facilities were demolished or are being used for other purposes.

3 Research - Reactors

Research reactors are nuclear facilities that are not used for commercial power generation. They are used in research centres and universities for scientific experiments, among other things.

There is a total of 46 research reactors in the Federal Republic of Germany. Of these, the current status (as of December 31, 2024) is as follows:

- 6 Research reactors in operation,
- 3 Research reactors permanently shut down
- 6 Research reactors in decommissioning and for
- 31 Research reactors have completed decommissioning. They have been released from the Atomic Energy Act (AtG).

The following chapters contain information on German research reactors according to their operating and licensing status. The tables in Annex II list the most important facts about German research reactors. Figure II provides an overview of the sites where units still exist.

3.1 Research reactors in operation

As of December 31, 2024, a total of six research reactors were in operation in the Federal Republic of Germany. These include the FRM-II (P_{th} =20 MW), the FRMZ (P_{th} =100 kW), and four homogeneous zero-power teaching reactors (P_{th}≤2 W). In addition to the information below, the most important data on the research reactors in operation can be found in Annex II, Table II.1.

High-flux Neutron Source in Munich, Garching (FRM-II)
The FRM-II is the latest research reactor commissioned in the Federal Republic of Germany. It is a light water-cooled pool-type reactor with a compact core using highly-enriched uranium (HEU) as fuel and heavy water as moderator. With a thermal neutron flux of $8 \cdot 10^{14}$ 1/cm² •s, the facility is – with a comparatively low thermal output of 20 MW_{th} – the most intense German neutron source for beam tube experiments and irradiation for scientific, industrial, and medical purposes.

The nuclear commissioning and operation of the facility were regulated by the operating licence granted on May 2, 2003. The reactor went critical for the first time on March 2, 2004. Routine operation of the facility began on April 25, 2005.

Only one fuel element is used for a cycle of 60 days (1200 MWd). At the end of the cycle, the spent fuel element is stored in the spent fuel pool for at least 6.5 years before it can be transported to the Ahaus Storage Facility. The spent fuel pool has a capacity of 50 spaces. Since commissioning in 2005, a total of 47 fuel elements have been used, all of which are still in the spent fuel pool. The current storage capacity for spent fuel elements from the FRM-II in Ahaus comprises seven storage locations for 21 containers, i.e., a total capacity of 105 spent fuel elements. The required storage licence in accordance with Section 6 of the Atomic Energy Act (application submitted at the end of September 2014) and the transport licence in accordance with Section 4 of the Atomic Energy Act (application submitted in 2017) for the transport of irradiated fuel elements to the Ahaus Storage Facility are being processed by the responsible authority, BASE.

On the basis of the operating licence dated May 2, 2003, and an agreement between the federal government and the Free State of Bavaria dated May 30, 2003, it was originally stipulated to convert the reactor from HEU to a fuel with a reduced enrichment level of no more than 50% uranium-235 (MEU) by December 31, 2010 at the latest. On October 22, 2010, an amendment was made to the original federal/state agreement of May 30, 2003, which provided for conversion by December 31, 2018, at the latest. As the conversion was still not practically feasible, the

agreement was updated again in December 2020. The aim was to reach a decision on the fuel material variant by the end of 2023 and to initiate the approval process for the conversion by the end of 2025. On April 28, 2023, TUM announced that the Bavarian State Ministry of Science and the Arts had approved the conversion of the FRM-II to a fuel element with low-enriched uranium of less than 20 % uranium-235 (LEU). Monolithic uranium-molybdenum fuel material is necessary to achieve this enrichment level.

After four fresh fuel elements were delivered in December 2019, the FRM II ran its 47th cycle in regular operation from January 13 to March 16, 2020. The 47th cycle was completed as scheduled. The start of the 48th cycle was postponed until spring 2021 due to COVID prevention measures and a reportable event in May 2020 regarding an exceeding of the licensing values for the discharge of C-14. However, it was not possible to start up the FRM-II in 2021 because a defect was detected in the cold neutron source. In 2022, damage was also detected in the compensator of the central unit in the central channel. The necessary manufacturing and replacement of the cold neutron source and the central channel will take several months. The reactor is scheduled to be started up in 2025 – initially without the cold neutron source.

TRIGA Mark II Research Reactor at the University of Mainz (FRMZ)
The FRMZ is an open pool-type reactor of the TRIGA Mark II type. It is a light water-cooled and moderated reactor with homogeneous fuel moderator elements made of LEU and zirconium hydride. On August 3, 1965, the reactor reached its first criticality with the insertion of the 57th fuel element. In continuous operation, the thermal output is 100 kW_{th} and the thermal neutron flux is $4 \cdot 10^{12}$ $1/cm^2 \cdot s$. In addition, the reactor can be operated in pulse mode for 30 ms with a peak power of 250 MW_{th} and a thermal neutron flux of $8 \cdot 10^{15}$ $1/cm^2 \cdot s$. The facility is operated for basic research in nuclear physics and, due to the high neutron flux density that can be generated for short periods in pulse mode, is particularly suitable for investigating short-lived radionuclides using fast pneumatic tube systems (rabbit system).

The TRIGA Mainz has a lifetime core; almost all fuel elements are in the core since the beginning of operation in 1965. Burnup is approximately 4 g per year. The reactor core contains a total of approximately 2.5 kg of low-enriched U-235. As a rule, a new TRIGA fuel element is inserted into the core every four to five years. There is a total of 91 positions in the reactor core, of which 83 are filled with fuel moderator and dummy elements. The remaining eight are used for control rods, the central irradiation tube, the pneumatic tube, and the neutron source holder. Since 1999, Johannes Gutenberg University Mainz has rented space for up to three MTR-type CASTOR® casks in the Ahaus Transport Container Storage Facility (now: Ahaus Storage Facility for Fuel Elements), where the fuel elements are to be temporarily stored after the FRMZ is shut down until they are transferred to a national final storage facility.

On the basis of a licence dated July 28, 1992; extensive modifications were made to the reactor circuits.

Following the installation of an *ultra-cold neutron source* in 2011, peak values of 5 m/s neutron velocities and 10 n/cm^3 neutron densities have been achieved at the FRMZ.

In the 2024 reporting year, the facility was operating as intended. The multi-shift operation introduced in 2015 as part of the PRISMA university excellence initiative has been well received by international research groups and was continued in several special operating phases during the reporting year. However, there were restrictions and scheduled interruptions to operations due to adjacent construction work on the new building for the Institute of Nuclear Chemistry.

Nuclear Training Reactor at Dresden Technical University (AKR-2)
The AKR-2 is a homogeneous, solid-moderated zero-power reactor. The fuel plates consist of a homogeneous mixture of low-enriched uranium oxide (enrichment < 20% U-235) as a fuel and polyethylene as moderator material. The reactor core is surrounded on all sides by a graphite reflector. The maximum continuous thermal output of the reactor is 2 W_{th} and the thermal neutron flux is around $3 \cdot 10^7$ $1/cm^2 \cdot s$. Both, burnup and activity increase are negligible, meaning that the facility can be operated practically indefinitely with the initial core load. There are no fuel replenishment or disposal problems during operation.

The AKR-2 was commissioned on March 22, 2005, replacing the old AKR-1 facility, which was operated at the TU Dresden from July 1978 to March 2004. The AKR-2 is primarily used for training and teaching purposes, but is also an instrument for research work in national and international projects.

In the reporting year, the facility was operating as intended.

Siemens Training Reactors (SUR) 100
Three Siemens training reactors are currently still in operation in Germany (Furtwangen, Stuttgart, and Ulm). In SUR facilities, the reactor core consists of U_3O_8 with low-level U-235 enrichment (< 20%) as a fuel and polyethylene as a moderator. Both materials are compressed into cylindrical fuel plates in the form of a homogeneous mixture. The reactor core is surrounded on all sides by a graphite reflector. The SUR facilities were mainly commissioned in Germany in the 1960s and 1970s. The thermal reactor output is 100 mW_{th} and the thermal neutron flux in the central experimental channel is typically $5 \cdot 10^6$ 1/cm² •s. Both, burnup and activity increase are negligible, and the facilities can be operated practically indefinitely with the initial load. There are no fuel replenishment or disposal problems during operation.

Further details can be found in Table II.1. The SUR facilities are mainly used as practical training devices for education and teaching in the field of nuclear technology.

In the reporting year, all SUR facilities were in operation as intended.

3.2 Research reactors permanently shut down

As of December 31, 2024, three research reactors are registered under the heading "Permanently shut down." No decommissioning licence has yet been issued for these reactors. Table II.2 in Annex II of the report lists the key data for these reactors.

Berlin Experimental Reactor II (BER II)

The BER II was a pool-type reactor with MTR fuel elements. The thermal output was 10 MW_{th}, and the thermal neutron flux was approximately $2 \cdot 10^{14}$ 1/cm² •s. The reactor was commissioned on December 9, 1973, with highly-enriched uranium (HEU) fuel and was mainly used for pure and applied basic research with beamline experiments and to generate radioactive isotopes.

On June 14, 1994, in order to reduce the risk of proliferation, the operation of BER II with fuel elements made of low-enriched uranium (LEU) or mixed loads with fuel elements made of HEU and LEU was approved. After a series of mixed loads, a pure LEU core was assembled and put into operation for the first time on February 7, 2000.

On April 24, 2017, the operator submitted an application for the decommissioning and dismantling of the Berlin Experimental Reactor BER II. On December 11, 2019, the facility was permanently shut down after more than 40 years of operation. The post-operational phase began on January 1, 2020.

In the 2024 reporting year, the facility was in post-operational phase. The reactor core is fuel-free. The remaining fresh fuel elements were shipped to the manufacturer in France in June 2021. All 66 spent fuel elements are located in the storage racks of the transfer pool in the experimental hall. The plan is to load the fuel elements into two MTR3 transport and storage containers and transport them to the Ahaus Storage Facility. The aim is to have the facility free of fuel elements by May 2027.

Work on preparations for decommissioning and on transferring as many of the experimental facilities as possible to other institutes for further use is ongoing.
In June 2023, the operator submitted an application for transition to post-operational phase 3a and the associated safety downgrading of BER II systems. The application is currently under review.

Geesthacht Research Reactor 1 (FRG-1)
The FRG-1 was an open pool-type MTR reactor with a thermal output of 5 MW_{th} and a maximum thermal neutron flux of approx. $1 \cdot 10^{14}$ 1/cm²•s. It was commissioned on October 23, 1958, with HEU. The FRG-1 was originally used for research into nuclear ship propulsion. Later on, it was mainly deployed for material research with beamline experiments as well as isotope production and neutron activation analysis.

From 1963 onwards, the FRG-1 was operated together with the new reactor FRG-2 in a shared reactor hall, but in separate operating pools. Due to a subsequent joint operating licence dated September 6, 1967, both reactors are considered to be one reactor facility for licensing purposes; this continues to apply even after the licence for decommissioning and partial dismantling of the FRG-2 was granted on January 17, 1995 (see section FRG-2).

Over the course of more than 40 years of operation, the FRG-1 was continuously upgraded. In February 1991, on the basis of a modification licence dated May 4, 1988, the reactor was converted from HEU to LEU – the first converted German research reactor. In addition to reducing the risk of proliferation, by using much denser fuels it was also possible to increase the thermal neutron flux.

On June 28, 2010, the FRG-1 was permanently shut down. Since then, the facility has been in the post-operational phase under the operating licence, which is still valid. In post-operation, the focus is currently on the disposal of radioactive waste from operation as a preparatory measure for the decommissioning and dismantling of the facility.

On July 24, 2012, the last spent fuel elements were shipped to the USA. The reactor has been free of nuclear fuel since the end of July 2012. The experimental equipment from the research reactor was taken to research facilities in Delft (Netherlands) and St. Petersburg (Russia) for further use.

On March 21, 2013, an application was submitted for the decommissioning and dismantling of the FRG-1 and the research reactor facility (consisting of FRG-1 and remaining parts of FRG-2) and to release the facility from the supervision under the Atomic Energy Act. The dismantling of the research reactor facility is to be carried out under a single decommissioning and dismantling licence in accordance with Section 7 (3) of the Atomic Energy Act. On September 6, 2016, the application for decommissioning of the FRG-1 research reactor and for dismantling of the research reactor facility and the hot laboratory was specified in more detail. The reactor pressure vessel of *the nuclear ship Otto Hahn*, which is stored on the premises of the research centre, was included in the procedure as part of the clarification of the decommissioning application and is to be dismantled in a hall that is yet to be built.

On September 6, 2016, an application was submitted for a licence in accordance with pursuant to Section 7 of the German Radiation Protection Ordinance for the handling of radioactive substances for the operation of a storage facility for low- and intermediate-level radioactive waste (transport preparation hall) on the premises of the research reactor facility. A hearing for the two licensing procedures took place in 2017. The licensing procedure is ongoing. As the construction of the transport preparation hall cannot be implemented at present, the possibility of extending the use of the existing preparation hall beyond 2026 is being examined.

Geesthacht 2 Research Reactor (FRG-2)
Like FRG-1, FRG-2 was an open pool-type MTR reactor with a thermal output of 15 MW_{th} and a maximum thermal neutron flux of approx. $2 \cdot 10^{14}$ $1/cm^2 \cdot s$. It was commissioned on March 16, 1963, as a material testing reactor and was used for irradiation experiments for the further development of nuclear power plant components and reactor safety.

The FRG-2 was operated together with the FRG-1 in a shared reactor hall, but with separate reactor pools. Since a joint operating licence came into force on September 6, 1967, the two reactors have been considered as a single reactor facility for licensing purposes. This licence also permitted an increase in the thermal output of the FRG-2 from 5 MW_{th} to 15 MW_{th}. The reactor was operated continuously with HEU during its 30 years of operation.

On January 28, 1993, due to a decline in orders for material testing by irradiation, the Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH (GKSS) in agreement with the Federal Ministry of Research and Technology (now the Federal Ministry of Education and Research – BMBF) and industry, submitted an application for the decommissioning of the FRG-2 and partial dismantling of the reactor. The licence was granted on January 17, 1995. The fuel elements were shipped to the USA by September 20, 2000.

Further information on the research reactor facility can be found in the FRG-1 section.

3.3 Research reactors in decommissioning

At the end of 2024, there were six research reactors in decommissioning in the Federal Republic of Germany. Table II.3 of Annex II contains the most important data for this category.

Karlsruhe 2 Research Reactor (FR 2)
The FR 2 was a closed tank reactor operated with low-enriched uranium (2 %) and moderated and cooled with heavy water. It was the first German reactor facility developed and built according to a national concept. With 44 $MW_{th,}$ it was the most powerful German research reactor in terms of thermal output. With a thermal neutron flux

of $1 \cdot 10^{14}$ 1/cm²•s, the FR 2 was used as a neutron source for beam line experiments in basic research, as well as for irradiation experiments for fuel rod development and isotope production for medical purposes.

The reactor was commissioned on March 7, 1961, using natural uranium. In order to increase the original thermal neutron flux from $3.9 \cdot 10^{13}$ 1/cm² s to $1 \cdot 10^{14}$ 1/cm² s, the reactor was converted to fuel elements with low-enriched uranium (2 %) in 1966. The maximum thermal output of the reactor increased from 12 MW_{th} to 44 MW_{th} (approval dated January 26, 1966).

After twenty years of operation, the FR 2 was permanently shut down on December 21, 1981 for economic reasons. The fuel elements were delivered to Karlsruhe Reprocessing Plant for reprocessing by October 22, 1982. The first of several partial licences for decommissioning, partial dismantling, and *safe enclosure* for at least thirty years was granted on July 3, 1986. Since November 20, 1996, the reactor unit and the remaining part of the facility has been in *safe enclosure* as the remaining part of the plant. Since 1997, the reactor hall has been used for a permanent exhibition on the history of nuclear technology.

In March 2021, the operator submitted the safety review report of FR 2. The report was reviewed by the technical experts in February 2022. Compliance with the safety requirements for *safe enclosure* was confirmed. After *safe enclosure*, dismantling and the final removal of the reactor unit is planned. Planning is currently underway.

Munich Research Reactor (FRM)
The FRM was an American-designed pool-type reactor with a thermal output of 4 MW_{th} and a thermal neutron flux of $7 \cdot 10^{13}$ 1/cm² •s. The facility was commissioned on October 31, 1957, as the first reactor in Germany. Its purpose was to provide neutrons for beamline experiments and for irradiation, e.g., for the generation of radioisotopes, for the detection of trace elements, and for tumour therapy.

The facility went into operation in 1957 with LEU and a thermal output of 1 MW_{th}, but was converted to HEU as early as 1960. Over the course of its operation life, the thermal neutron flux was gradually increased from an initial $1 \cdot 10^{13}$ 1/cm² s to $7 \cdot 10^{13}$ 1/cm² s. To this end, the thermal power was increased to 2.5 MW_{th} in 1966 and to 4 MW_{th} in 1968, and a beryllium reflector was installed in 1982. Since 1991, the core has been operated as a mixed core and gradually converted from HEU to MEU.

On December 14, 1998, the Technical University of Munich (TUM) applied for the decommissioning of the facility in order to be able to transfer it to an adjacent facility of the new FRM-II (Chapter 3.1) in a later stage of the process. On July 28, 2000, the reactor was permanently shut down, and on June 3, 2002, the 47 remaining fuel elements were shipped to the USA. On April 3, 2014, the licence was granted in accordance with Section 7 of the Atomic Energy Act (AtG) for the dismantling of the FRM Garching reactor facility. No dismantling work can be carried out in the reactor hall until the ventilation system has been replaced. Planning for this system is currently underway. The dome structure of the FRM, known as the Garching Atomic Egg, has been listed as a historic monument.

Neuherberg Research Reactor (FRN)
The FRN was a TRIGA Mark III pool-type reactor with homogeneous fuel moderator elements made of LEU and zirconium hydride. The continuous thermal output of the facility was 1 MW_{th}, the thermal neutron flux $3 \cdot 10^{13}$ 1/cm² s. In pulse mode, the reactor could be operated for short periods of approx. 10 ms with power peaks of up to 2,000 MW_{th}. The facility was commissioned on August 23, 1972, and was used for isotope generation and beamline experiments in medical and biological research.

The reactor was permanently shut down on December 16, 1982. The fuel elements were removed in accordance with the operating licence and disposed of in the USA. The decommissioning licence dated May 30, 1983, covered the decommissioning of the facility and the dismantling of facility components, as well as the *safe enclosure* of the shielding block with the former reactor pool. The continued stay of the unit in *safe enclosure* was permitted by a separate licence notice dated May 24, 1984.

Braunschweig Research and Measurement Reactor (FMRB)
The FMRB was a light water-cooled and moderated pool-type reactor with two separate fissile material zones made of HEU, which were neutron-physically coupled via a 400-liter heavy water tank. The reactor went critical for the first time on October 3, 1967. The thermal output was 1 MW_{th} and the thermal neutron flux was $6 \cdot 10^{12}$ 1/cm²•s. The facility was used by the Physikalisch-Technische Bundesanstalt (PTB) as a neutron source for irradiation and beamline experiments, particularly in the fields of neutron metrology and dosimetry as well as condensed matter physics.

The reactor was permanently shut down on December 19, 1995, for economic reasons. The remaining fuel elements were shipped to the USA on August 28, 1996. The decommissioning licence for the facility was granted on March 2, 2001. The dismantling of the facility was completed in mid-2004. The radioactive waste and residual materials that had accrued during operation and dismantling were conditioned and transferred to a specially designed storage facility on the premises of the FMRB, by May 2005, and is still subject to supervision under nuclear law. The remaining reactor building and other building areas and land were gradually released from supervision under application of the Atomic Energy Act by July 28, 2005, and can now be used by the PTB for other purposes without restriction. The site on which the PTB operates the storage facility was transferred by an act of law to the Bundesanstalt für Immobilienaufgaben (BIMA) on January 1, 2012.

Jülich Research Reactor (FRJ-2)
The FRJ-2 (DIDO, derived from D_2O) was a British-designed closed tank reactor operated with HEU, cooled and moderated by heavy water. The reactor, with a thermal output of 23 MW_{th} and a thermal neutron flux of $2 \cdot 10^{14}$ 1/cm^2•s, was used for beamline experiments, irradiation, isotope generation and neutron activation analysis.

The facility was commissioned on November 14, 1962. In 1967, existing reserves were exploited to increase the thermal output from 10 MW_{th} to 15 MW_{th}. In 1972, conversion and upgrading measures resulted in a second increase in thermal output to 23 MW_{th}.

On May 2, 2006, the FRJ-2 was permanently shut down. The spent fuel elements were shipped to the USA in 2008 under the operating licence. On September 20, 2012, the North Rhine-Westphalian state authority granted licence for the decommissioning and dismantling of the reactor facility.

In order to continue the scientific work, the Jülich Research Centre (FZJ), which was responsible at the time, set up a branch office at the FRM-II research reactor in Garching (Chapter 3.1). There, the Jülich Centre for Neutron Sciences (JCNS) operates the Maier-Leibnitz-Centre together with the Technical University of Munich and the Helmholtz Centre.

On September 1, 2015, the decommissioning licence was transferred to the Jülich-based Arbeitsgemeinschaft Versuchsreaktor GmbH. Since January 1, 2016, the company has been operating under the name Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH (JEN). This now encompasses the nuclear areas of FZJ and Arbeitsgemeinschaft Versuchsreaktor (AVR) GmbH.

Decommissioning work continued during the reporting period. According to the operator's plans, the decommissioning of FRJ-2 is to be completed in 2042.

Siemens Training Reactor Aachen (SUR-AA)
The Siemens Training Reactor Aachen was operated by RWTH Aachen University. It was built in 1963 by Siemens-Schuckertwerke AG and went critical for the first time on September 22, 1965. The reactor's thermal output was 100 mW_{th}, and the thermal neutron flux was approximately $6 \cdot 10^6$ 1/cm^2•s. The research reactor was used for training and practice purposes as part of nuclear technology education and was also used to conduct experiments for student research projects and diploma theses. The reactor was shut down in 2002. The fuel, cylindrical plates made of a homogeneous mixture of polyethylene as a moderator and U_3O_8 with low U-235 enrichment (< 20 %), was transferred to the Technical University of Munich in 2008 for conditioning and disposal. In 2010, the operator submitted an application to the competent state authority for the decommissioning and dismantling of the facility.

On June 26, 2020, licence was granted for decommissioning and complete dismantling. Dismantling work has not yet begun due to capacity problems on the part of the operator.

3.4 Research reactors released from the Atomic Energy Act

In the Federal Republic of Germany, 31 research reactors were decommissioned by December 31, 2024. They have been released from the supervision under the Atomic Energy Act. Table II.4 in Annex II of the report provides an overview. Some of the research reactors in this category are described in more detail below. The others are summarized in short text.

TRIGA HD I Heidelberg Research Reactor (TRIGA HD I)
The TRIGA HD I was a TRIGA Mark I pool-type reactor with homogeneous fuel moderator elements made of LEU and zirconium hydride. The thermal output of the reactor was 250 kW_{th}, the thermal neutron flux $1 \cdot 10^{13}$ 1/$cm^2 \cdot s$. The facility was commissioned on August 26, 1966 as an irradiation source for nuclear medicine applications.

The reactor was permanently shut down on March 31, 1977, due to the construction of a second research reactor (TRIGA HD II, see below) at the German Cancer Research Centre in Heidelberg (DKFZ). The fuel elements were transferred to the new reactor facility for further use. The licence for decommissioning the facility, granted on June 30, 1980, included the dismantling of the components and the *safe enclosure* of the reactor tank and the *biological shield*, which was completed on December 11, 1980. As the building was scheduled for demolition, the DKFZ submitted an application for the dismantling of the remaining facility on April 25, 2003, which was approved on January 16, 2006. The dismantling of the facility and the clearance measurement of the building structure were carried out in the first half of 2006. On December 13, 2006, the TRIGA HD I was released from the supervision under the Atomic Energy Act. As part of the clearance process, the facility was demolished in a conventional manner in 2009 and the site was cleaned up completely.

TRIGA HD II Research Reactor in Heidelberg (TRIGA HD II)
Like the TRIGA HD I (see above), the TRIGA HD II was a TRIGA Mark I pool-type reactor with homogeneous fuel moderator elements made of LEU and zirconium hydride. The thermal output of the facility was also 250 kW_{th}, the thermal neutron flux was $1 \cdot 10^{13}$ 1/$cm^2 \cdot s$. The reactor went critical for the first time on February 28, 1978, and was used for neutron activation analysis and for the generation of short-lived radionuclides for medical purposes in cancer research.

Due to the takeover of isotope production by an accelerator at the DKFZ and the expected decline in reactor utilization, the facility was shut down on November 30, 1999. The fuel elements were shipped to the USA for disposal on June 1, 2001. On September 13, 2004, a licence was granted in accordance with Section 7 (3) of the Atomic Energy Act for the decommissioning and complete dismantling of the research reactor. The facility was completely dismantled in the course of 2005 and released from the supervision under the Atomic Energy Act on December 13, 2006.

Frankfurt 1 and Frankfurt 2 Research Reactors (FRF-1 and FRF-2)
FRF 2 was a light water-cooled and moderated reactor of the modified TRIGA type with homogeneous fuel moderator elements made of LEU and zirconium hydride. The reactor was installed in the remaining structures (reactor hall and reactor unit) of the dismantled predecessor reactor FRF 1 on the basis of the construction licence dated January 10, 1973. The FRF 1 was operated from January 10, 1958, to March 19, 1968, as a homogeneous solution reactor of the L54 type with a thermal output of 50 kW_{th}. The FRF 2 was intended as a neutron source for basic research in nuclear physics and solid-state physics, as well as for activation analyses and isotope generation. Following a decision by the Hessian Minister of Culture on July 11, 1980, an operating licence was not granted and the nuclear commissioning of the ready-to-operate reactor was abandoned.

On October 25, 1982, licence was granted for the decommissioning of FRF 2 and the dismantling of parts of the facility. The unused fuel elements from the reactor were shipped in 1981 to a foreign research reactor facility (TRIGA MARK II in Ljubljana) for further use. The residual activity in the facility originated exclusively from the former operation of FRF 1 and was in a safely enclosed state after the partial dismantling of the facility. After the reactor building was used for a time as a storage facility for low-level radioactive waste from the University of Frankfurt, the demolition of the remaining structures of the FRF – consisting of FRF 1 and FRF 2 – was approved on December 28, 2004. On October 31, 2006, following the dismantling of the activated concrete structures and the clearance of the remaining building structures and the facility site, the facility was released from the supervision under the Atomic Energy Act.

Research Reactor of the Hannover Medical School (FRH)
The FRH was a TRIGA Mark I pool-type reactor with homogeneous fuel moderator elements made of LEU and zirconium hydride. The thermal output of the facility was 250 kW_{th}, the thermal neutron flux was approximately $9 \cdot 10^{12}$ 1/$cm^2 \cdot s$. The reactor was commissioned on January 31, 1973. Its main areas of application as a neutron source were neutron activation analysis and the generation and activation of short-lived radionuclides for medical and biological applications.

Due to changes in the manufacturing processes for radiopharmaceuticals and declining demand for the use of the reactor, it was shut down on December 18, 1996. The fuel elements were shipped to the USA on July 9, 1999. On February 22, 2002, an application for decommissioning and dismantling of facility components was submitted and

approved on May 8, 2006. The facility was completely dismantled and cleared by August 2007. State supervision in accordance with Section 19 of the Atomic Energy Act was terminated on March 13, 2008.

Jülich Research Reactor 1 (FRJ-1)
The FRJ-1 (MERLIN, Medium Energy Research Light Water Moderated Industrial Nuclear Reactor) was an HEU-fuelled pool-type reactor of English design with MTR-type fuel elements. Its thermal output was ultimately 10 MW_{th}, and its thermal neutron flux was approximately $1 \cdot 10^{14}$ $1/cm^2 \cdot s$. The reactor went into operation on February 23, 1962, and was used for irradiation and beamline experiments.

In 1971, extensive modifications were made to the facility in order to increase the neutron flux from $6 \cdot 10^{13}$ $1/cm^2 \cdot s$ to the last available value of $1.1 \cdot 10^{14}$ $1/cm^2 \cdot s$. This involved, among other things, the use of new fuel elements with a higher uranium-235 mass and modifications to the primary and secondary circuits to dissipate the thermal output, which had doubled from 5 MW_{th} to 10 MW_{th}.

On March 22, 1985, the FRJ-1 was shut down. The fuel elements were removed from the reactor in accordance with the operating licence and shipped to the USA and Great Britain by October 1992. On June 8, 1995, licence was granted for the decommissioning of the facility. The facility was dismantled in stages on the basis of further partial licences and supplementary notices. Finally, on November 29, 2004, the decontamination of the reactor building and its extensions was licenced, creating the conditions for clearance measurement and release the FRJ-1 from the scope of application the Atomic Energy Act. This work was completed in the course of 2007 and the facility was released from the supervision under the Atomic Energy Act on November 23, 2007. The reactor building and its extensions were then dismantled in accordance with conventional regulations, so that the *greenfield site* could be created in the course of 2008.

Rossendorf Research Reactor (RFR)
The RFR was a Soviet-designed WWR-S(M) type light water moderated and cooled tank reactor. Its thermal output was ultimately 10 MW_{th} with a thermal neutron flux of approx. $1 \cdot 10^{14}$ $1/cm^2 \cdot s$. The facility was primarily used as a neutron source for isotope production, activation analysis, and materials research, as well as for training purposes in the GDR's nuclear energy program.

The reactor was commissioned on December 16, 1957, with LEU and a thermal output of 2 MW_{th}, which was gradually increased to 10 MW_{th} by 1967, partly through a conversion from LEU to MEU.

The licence for the operation of the reactor was granted in the form of temporary permits and was last extended on October 8, 1990 until June 30, 1991, by the nuclear regulatory authority responsible at the time. The reactor was permanently shut down on June 27, 1991. After taking over responsibility as the new nuclear regulatory authority, the Saxon State Ministry for the Environment and Agriculture issued a supervisory order according to Section 19 (3) of the Atomic Energy Act on June 28, 1991, ordering the cessation of the facilities fission-based operation.

The irradiated fuel elements were transferred between May 30, 2005, and June 13, 2005, in a total of 18 CASTOR® casks to the Ahaus Transport Cask Storage Facility (now: Ahaus Storage Facility for Fuel Elements).

Several partial licences were issued for the decommissioning and dismantling of the facility starting on January 30, 1998. On January 9, 2014, the licence notice was issued in accordance with Section 7 (3) of the Atomic Energy Act for the second amendment to the fourth licence 4653/18 VKTA 04/2. The purpose of the amendment was to extend the scope of the previous licence to include the total dismantling of the remaining facility under radiation protection conditions. The operator applied for the facility to be released from the Atomic Energy Act on June 21, 2018. On September 19, 2019, the State Ministry for the Environment and Agriculture of the Free State of Saxony granted licence for the release of the site of the former Rossendorf research reactor in accordance with Section 33 of the Radiation Protection Ordinance and certified the release of the facility from nuclear regulatory supervision. This marked the completion of the dismantling of the RFR.

Nuclear ship Otto Hahn (OH)
The *Otto Hahn* was the only nuclear ship operated in Germany and was formally classified as a research reactor. It was an *advanced pressurized water reactor (FDR)* using low-enriched uranium dioxide with a maximum enrichment of 5.42% uranium-235 and a thermal output of 38 MW_{th} which was used as a power source.

The main task of the *Otto Hahn* was to gather operational experience for nuclear-powered ships for civilian use. It was commissioned as a nuclear ship on October 11, 1968, and decommissioned on March 22, 1979. On December 1, 1980, a licence was granted for the decommissioning of the Otto Hahn in accordance with Section 7 of the

Atomic Energy Act in conjunction with Sections 3 and 4 of the Radiation Protection Ordinance (old). In June 1981, the reactor vessel was dismantled in the port of Hamburg and transported to the Gesellschaft für Kernenergieverwertung in Schiffbau und Schifffahrt mbH (GKSS), where it has since been stored in a specially constructed shaft structure (concrete shaft) for a follow-up examination program. After the reactor system was removed, the ship was decontaminated and cleared, and on September 1, 1982, it was released from nuclear regulatory supervision. The reactor pressure vessel of *the Otto Hahn* nuclear ship, which is stored on the site of what is now the Helmholtz Centre Geesthacht, was included in the procedure for decommissioning the FRG 1 and dismantling the research reactor facility in accordance with Section 7 of the Atomic Energy Act with an application dated September 6, 2016. The reactor pressure vessel is to be dismantled in a hall that is yet to be built.

With the exception of 49 irradiated and three unirradiated fuel rods, the fuel elements were shipped to the Karlsruhe Reprocessing Plant for reprocessing by autumn 1979. Fifty-two fuel rods initially remained with the former operator of the vessel and were transported to the French research centre CEA (Commissariat à l'Energie Atomique et aux Energies Alternatives) in Cadarache in July 2010. From there, they were transported in December 2010 as part of a collective transport with approximately 2,500 other fuel rods from the Karlsruhe Research Centre to the Storage Facility North.

Other research reactors

The remaining research reactors have already been dismantled or released from the supervision under the Atomic Energy Act. One of these facilities was not approved in accordance with Section 7 of the Atomic Energy Act, but in accordance with Section 9 of the Atomic Energy Act (SUAK). The reactors were based on different reactor concepts. They include training reactors (e.g., SUR-KI), reactors with fuel solution (e.g., ABDIKA), critical assemblies (e.g., ANEX), and Argonaut reactors (e.g., RRR). The individual reactors will not be discussed in detail here. An overview of this category can be found in Annex II, Table II.4.

4 Plants of the nuclear supply

Annex III contains essential data and information on nuclear fuel supply in the form of tables and figures. Figure III shows an overview map of the locations of nuclear supply facilities.

4.1 Uranium enrichment plants

Gronau Uranium Enrichment Facility (UAG)
The Gronau Uranium Enrichment Facility is the only enrichment plant in the Federal Republic of Germany. (see Table III.1)

At the facility, natural uranium in the form of uranium hexafluoride (UF_6) is enriched in centrifuge cascades to a maximum concentration of 6% of the fissile isotope uranium-235.

The facility commenced operation in mid-August 1985 with a capacity of 400 metric tonnes of separative work units per year (tSW/a). An application to expand production capacity to 4,500 tSW/a was submitted in September 1998. Approval was granted on February 14, 2005. It includes the construction and operation of a second uranium separation plant with a separation capacity of up to 2,700 tSW/a with a maximum enrichment level of 6 %. The licence also includes the storage of 58,962 t of depleted uranium (tails) in oxide form and 38,100 t as UF_6, 10,000 t of natural uranium (feed) as UF_6 and 1,250 t of enriched uranium (product) with a maximum enrichment level of 6 % uranium-235 as UF_6. The expanded Uranium Enrichment Facility-2 was commissioned in 2011. The UAG is operated by Urenco Deutschland GmbH and has a licenced nominal capacity of 4,500 tSW/a. In 2014, the construction of a storage hall with a capacity of up to 60,000 t of U_3O_8 was completed. According to licence 7/6 UAG, the approval of the supervisory authority is required for commissioning and operation. An application has not yet been submitted. According to the operator (in March 2022), the first storage of material is not expected before 2026. The documents for the periodic safety review submitted by Urenco Deutschland on June 30, 2021, after ten years period, are currently still being assessed by the experts. On October 25, 2024, Urenco submitted an application for licensing of a storage facility for defective and internally contaminated centrifuges.

4.2 Fuel fabrication factories

One fuel fabrication factory is still in operation in the Federal Republic of Germany on December 31, 2024. All other fuel fabrication factories have been fully dismantled and are no longer subject to the scope of the Atomic Energy Act (see also Tables III.2 and III.3 in Annex III).

4.2.1 Fuel fabrication factory in operation

Fuel fabrication plant Advanced Nuclear Fuels GmbH (ANF), Lingen
The ANF fuel fabrication plant manufactures uranium fuel elements with a maximum uranium235 content of 5 % for use primarily in light water reactors. Uranium dioxide (UO_2) powder, uranium hexafluoride (UF_6), or externally manufactured UO_2 tablets are used as starting material. The fuel element manufacturing process is divided into the following steps: conversion of uranium hexafluoride into UO_2, tablet production, fuel rod production, and fuel element production.

The fuel element production began in January 1979 with uranium pellets supplied from external sources. In March 1987, the fifth partial operating licence authorizing the production of up to 400 Mg of UO_2-tablets per year (production began in 1988). Dry conversion with uranium enriched to up to 5 % uranium-235 began in June 1994. In June 1996, a second fuel rod fabrication line and a storage and handling building for UO_2-tablets and powder were

licenced. The currently approved processing capacity is set at 800 Mg/a for dry conversion and 650 Mg/a for other facility components.

The licenced storage capacity for uranium hexafluoride is 275 Mg. The raw material UF_6 is stored in containers in a separate storage hall.

On June 12, 2014, a licence was granted in accordance with Section 7 of the Atomic Energy Act (AtG) to expand the storage areas for nuclear fuel by integrating the storage hall previously approved in accordance with Section 6 of the AtG for the storage of radioactive waste.

The licence to operate a maintenance hall for fuel element transport containers on the premises of the Lingen fuel element fabrication plant in accordance with Section 12 (1) No. 3 StrlSchG was granted on March 8, 2023.
The maintenance hall will be used to carry out periodic inspections and maintenance work on additional types of fuel transport casks. The new maintenance hall was constructed in accordance with the building permit granted, at a distance from existing buildings on the plant premises, within the fenced-off monitoring area. An environmental impact assessment was not required for the project due to the low level of handling radioactive material.

On March 10, 2022, ANF submitted an application for the manufacture of hexagonal fuel elements for Russian-designed nuclear power plants (VVER pressurized water reactors) in accordance with Section 7 (1) of the Atomic Energy Act. As justification, ANF referred, among other things, to a desired diversification in the supply of fuel elements for Eastern European nuclear power plants in accordance with the Euratom Supply Agency Report (2020). The aim is to increase the security of supply for Eastern European nuclear power plants. The fuel assembly design of the Russian company TVEL is to be used, and the corresponding structural parts are also to be supplied by TVEL. As part of the public participation process in accordance with the AtVfV, the application for the manufacture of hexagonal fuel elements was made available for inspection with the relevant documents from January 4, 2024, to March 3, 2024; 47 objections were raised in a timely manner. The BMUV has requested the Lower Saxony Ministry for the Environment, Energy, and Climate Protection to submit the draft of an approval notice or a related rejection notice for federal regulatory review.

4.2.2 Fuel fabrication factories released from the Atomic Energy Act

Siemens fuel element plant in Hanau, MOX processing division
In 1968 the facility started the production of mixed oxide (MOX) fuel elements on the basis of uranium dioxide/plutonium dioxide (UO_2/PuO_2), plutonium dioxide (PuO_2) or uranium dioxide (UO_2) fuel, mainly for light-water reactors, from 1968 onwards.
The Hessian Ministry of the Environment issued an order to halt operations according to Section 19 of the Atomic Energy Act following an incident involving contamination; it has therefore been at a standstill since the summer of 1991. The operator decided in April 1994 not to re-start the old unit, except for running it empty.
The licensing procedure to dismantle the Siemens MOX unit was discussed at a hearing in Hanau in March 2000, and the dismantling of the first production facilities was approved in December 2000. The 1st partial licence to dismantle the facility for the removal of radioactive material was issued in May 2001, the 2nd partial licence in March 2003, and a 3rd partial licence on January 3, 2005. It allowed some buildings and parts of the open-air site to be used for conventional purposes. The 4th and final partial licence was granted on March 16, 2005.
Dismantling work on the unit finished in July 2006, and the MOX processing section was released from supervision under the Atomic Energy Act in September 2006.
Dismantling of the non-contaminated new facility, which had to be carried out separately, was approved on December 7, 1998. The fission product storage facility designed to withstand air crashes was emptied, and is now available for other use.
The facility premises can now be used conventionally as an industrial site.

Siemens Fuel Element Plant Hanau, Uranium Processing Division
Since 1969, the plant had been used to manufacture uranium fuel elements with a maximum uranium-235 content of 5 % for use primarily in light water reactors. UF_6 was used as the starting material.

Siemens halted the production of uranium fuel elements at the site in October 1995 because of generally unfavourable conditions there. To prepare for decommissioning, several individual licences to dismantle plant components and remove nuclear fuel were granted between 1996 and 1998. Three partial licences and several individual licences for subsequent decommissioning work were granted between 1999 and March 2001.

The finally approved decommissioning procedure included dismantling the factory buildings and cleaning up the site on the basis of the 10 µSv concept. (This means that it is justifiable to release the materials, the objects or the facility from radiation protection supervision if the radiation exposure they create for individuals in the population is about 10 µSv per calendar year). After the control areas had been dismantled and the buildings demolished, a start was made on cleaning up the site. Since uranium had entered the soil and the groundwater as a result of operating the facility, it was also necessary to clean up the soil, the existing sewers, and the groundwater. After the remediation work was successfully completed in January 2006, the facility was released from supervision under the Atomic Energy Act in May 2006. The groundwater treatment unit of Siemens AG was decommissioned in November 2012. To check the uranium content, the groundwater was monitored at several measuring points until September 2016. The treatment unit licenced according to Section 7 of the Radiation Protection Ordinance was kept on hand during the monitoring process, and was not dismantled until the procedure had been concluded at the end of 2016.

Siemens Fuel Element Plant, Karlstein
Since 1966, the plant has been used to manufacture fuel elements from uranium oxide with a maximum content of 4 % uranium-235.
As part of the decision to decommission the Siemens facilities in Hanau, the comparatively small facility in Karlstein was also closed. The disposal of all the radioactive operational equipment has been completed. The Siemens fuel element factory, Karlstein section, was released from supervision under the Atomic Energy Act in March 1999.
Non-nuclear operations continued, and are used for the production of structural components for fuel elements (ANF Karlstein). Since 2001, the Karlstein plant has been a subsidiary of Framatome ANP, later renamed AREVA NP, and since January 30, 2018 named Framatome GmbH.

NUKEM-A fuel element plant, Hanau
The NUKEM company had produced fuel elements from uranium and thorium up to a uranium-235 enrichment of 94 % for research and material test reactors since 1962.
A first licence to dismantle parts of the unit in the area where the fuel elements were produced was issued on December 5, 1988. NUKEM applied to decommission the entire NUKEM plant on December 23, 1988. The licence for decommissioning was granted on March 10, 1993. Further licences for dismantling the non-safety-relevant parts of the plant followed.
It turned out that the so-called *Monosta* building located on the Degussa site (outside the ring fence of the NUKEM-A site), which had been used again by Degussa in the meantime, had to be included in the decommissioning procedure. Therefore, applications were made for two additional licences to demolish this building complex, and they were granted on November 9, 1999 and June 26, 2001.
All buildings inside the ring fence have since been demolished. Soil remediation was completed in May 2006, and the entire site was released from supervision under the Atomic Energy Act, except for a small area measuring 1,000 m^2. A groundwater remediation facility pursuant to Section 19 of the Atomic Energy Act was operated on this area until 2015. The radiological groundwater clean-up was discontinued by a decision of July 20, 2015, and the site was released from supervision under the Atomic Energy Act.

High Temperature Fuel Element Company (HOBEG)
The unit operated by Hochtemperaturreaktor Brennelement GmbH (HOBEG) at the Hanau nuclear site was operated from 1972 to 1988 for the production of spherical fuel elements for high-temperature reactors. The throughput was up to 200,000 fuel elements per year. A total of about 1 million fuel elements were produced. The HOBEG unit was initially operated with several individual licences according to Section 9 of the Atomic Energy Act. These were combined into a temporary overall licence on December 30, 1974. The facility was temporarily shut down on January 15, 1988, and subsequently decommissioned.
Altogether nine licences to decommission the facility were granted according to Section 7 paragraph 3 of the Atomic Energy Act between December 5, 1988 and April 7, 1995. The process-related components were dismantled, and most of them were sold. The building structures and the surrounding terrain were decontaminated.

Following appropriate measurements, the remaining building structures and the associated site were cleared, and released from supervision under the Atomic Energy Act on December 18, 1995.licence

4.3 The reprocessing of nuclear fuels

Germany started to develop the technology to reprocess spent fuel elements during the 1960s. The Karlsruhe reprocessing plant (WAK) was constructed as a pilot plant for this purpose. There were plans to construct a national waste management centre (Nukleares Entsorgungszentrum Gorleben) for storage, industrial reprocessing and disposal at one site.

After this plan and domestic reprocessing were abandoned, the German government accepted that spent fuel elements from German nuclear power plants would be disposed of through storage and reprocessing in other EU member states – through its decision on 6 June 1989; this was part of the integrated disposal concept and therefore provided proof of the precautionary measures for waste management. The construction of an industrial German reprocessing plant at Wackersdorf (WAW) was halted in the same year and the spent fuel elements were transported to France (formerly AREVA, now Framatome, La Hague) or to England (BNFL, Sellafield) for reprocessing. After the Atomic Energy Act was amended in 1994, direct disposal was placed on a par with reprocessing as a waste management alternative, so that fuel elements were also stored at the Gorleben and Ahaus storage facilities for direct disposal at a later time.

To minimise the risks associated with reprocessing or transporting waste for reprocessing, transport operations to reprocess waste abroad were prohibited after June 30, 2005 through the amendment to the Atomic Energy Act on April 27, 2002. The waste management of fuel elements was exclusively restricted to direct disposal from this time onwards.

4.3.1 Karlsruhe Reprocessing Plant (WAK) dismantling project

WAK (cf. Table III.7) at the Karlsruhe Research Centre site – now the Karlsruhe Institute of Technology – was a test facility for reprocessing spent nuclear substances from research, prototype and power reactors. Apart from gaining operating experience, development projects for a German reprocessing unit were conducted on an industrial scale. WAK started operation in 1971 under the management of WAK Betriebsgesellschaft mbH. During the time of operation, about 200 t of nuclear fuel from a large number of reactors were reprocessed. The uranium and plutonium recovered in the process was delivered to nuclear supply companies for further processing.

Following the abandonment of a large-scale reprocessing plant in Germany, operation was finally halted on December 31, 1990. At the end of the reprocessing operations, the plant consisted of the process building with the reprocessing equipment spent nuclear fuels, the storage buildings with casks and process units for the storage of HAWC, and intermediate-level liquid waste (MAW), and facilities and buildings to supply media and technical infrastructure. The 1st partial decommissioning licence for WAK was granted on March 22, 1993.

About 60 m^3 HAWC with an activity of $7.7 \cdot 10^{17}$ Bq accrued from operating the reprocessing unit, and it was last stored inside the LAVA building (facility for storing and evaporating high-level radioactive waste liquids). The HAWC was processed into 123 vitrified canisters at the Karlsruhe Vitrification Facility (VEK), which had been specially built for conditioning, between September 2009 and June 2010. The subsequent rinsing process produced a further 17 vitrified waste canisters. When the 140th and final waste receptacle was filled on November 25, 2010, operations at the Karlsruhe vitrification plant were finally halted. The waste canisters were placed in 5 transport and storage casks of the type CASTOR® HAW20/28, and transported to the EWN GmbH Storage Facility North in Lubmin near Greifswald in February 2011 (cf. Chapter 5.2). The low and intermediate-level operational radioactive waste from WAK was conditioned at the Nuclear Research Centre in Karlsruhe.

The overall concept for decommissioning, dismantling and disposal of WAK is to be achieved in six technically independent stages.
Stage 1: Deregulation measures after decommissioning of WAK
Stage 2: First deconstruction measures in the process building (PG)
Stage 3: Further dismantling of the PG until the controlled area is cleared (including supplementary measures to dismantle the PG).
Stage 4: Deregulation after end of vitrification
Stage 5: Complete dismantling of the LAVA, HWL (main waste storage), VEK and residual facilities.

Stage 6: Conventional building demolition

Stages 1 and 2 have been completed, Stage 3 is well advanced. The measures contained in step 4, including the decommissioning of the former HAWC storage facilities and VEK's process facilities, were completed. Stage 5 involves the dismantling of the HAWC storage facilities and the VEK. There are ten dismantling areas (RB5.1 to RB5.10), which only partially build on each other. The dismantling areas 5.1 Development of the HWL access and 5.2 Remote assembly of the MAW storage casks in the HWL room R.6 were completed. RB5.9a and 5.9b, which were licenced under the 24th and 25th decommissioning licences and concerned early dismantling at the VEK and the dismantling of the media and power supply in the VEK, have been completed.

There are two emptied HAWC casks in the “LAVA” (storage cask) and “HWL” (reserve casks) buildings, placed in thick-walled concrete cells that are only accessible remotely because of the high dose rate. Despite having been rinsed several times, solid HAWC residue was detected in the reserve cask (81B21) and in the two LAVA casks after they had been emptied. This solid residue will be recovered when the HAWC storage canisters are remotely dismantled; this was approved by the 22nd decommissioning licence (RB5.3) on December 8, 2010. The remote-controlled dismantling of the first HAWC cask (81B31) at the HWL was completed in 2018.

The 23rd decommissioning licence (RB5.4) was issued on December 14, 2011. It includes the dismantling of the LAVA high-activity laboratory and the LAVA (hot) cells L3, L4 and L5. The high-activity laboratory has been dismantled in the meantime. The decontamination and dismantling work in cell L4 have been completed.

An application was made to demolish the residual equipment and to abolish the HWL controlled area (RB5.5) on December 12, 2014. An application to dismantle the LAVA-ELMA pipe duct and to abolish the ELMA control area was also made on March 12, 2015 (RB5.7). Both applications are currently being examined by experts.

The licence to dismantle the facilities in the process cells of VEK (RB5.8) was granted on July 6, 2018, and is in the process of implementation.

Most recently, the 27th licence was issued on March 4, 2021, the 28th licence on June 1, 2021, and the 29th licence for the decommissioning and dismantling of WAK was granted on October 14, 2021. These licences contain amendments to Stage 3 of the overall concept to dismantle the process building, and thus serve the overall dismantling of the WAK plant.

On January 16, 2024, the 30th decommissioning the licence for dismantling of the remaining HWL facilities was granted.

4.3.2 Wackersdorf Reprocessing Plant (WAW)

Deutsche Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH (DWK) applied to the Bavarian State Ministry of Rural Development and the Environment to construct a reprocessing plant on the Wackersdorf site (Upper Palatinate/Bavaria) in 1982.

This application resulted from a decision made by the heads of the federal and state governments in 1979, which, according to the findings and technology at the time, considered reprocessing, including the return of the usable nuclear fuels and the disposal of radioactive waste from the reprocessing process, to be feasible in safety terms, and required the rapid construction of a reprocessing plant. Another reason was that the Lower Saxony State Premier, Ernst Albrecht (CDU), considered it politically impossible to establish the National Disposal Centre in Gorleben.
The 1st partial building licence was granted in September 1985. The Bavarian Administrative Court ruled that the development plan was illegal in January 1988. Construction had started in December 1985. Modifications to the concept then made it necessary to draw up a new safety report, hold another public hearing and examine the safety of the facility as a whole. DWK decided to withdraw the building application in December 1989. This marked the end of the procedure.

5 Facilities for nuclear waste management

5.1 Storage of spent fuel elements

5.1.1 Storage in nuclear power plants

After being removed from the reactor core, spent fuel elements from nuclear power plants are first stored for several years in the wet storage pools of the respective reactor facility to allow them to decay before being transferred to the storage facility for fuel elements belonging to the respective nuclear power plant site for dry interim storage in approved transport and storage casks (see Table IV.1 in Annex IV).

The storage of irradiated fuel elements in the wet storage pools of the reactor facilities is covered by their licence pursuant to Section 7 of the Atomic Energy Act (AtG).

The last remaining nuclear power plants were decommissioned on April 15, 2023. The Biblis A and B, Philippsburg 1 and 2, Brunsbüttel, Neckarwestheim 1, Unterweser, Krümmel, Isar 1, Grafenrheinfeld, and Gundremmingen B nuclear power plants are free of fuel elements and rods. The fuel elements in the wet storage pools have been completely packed into casks and placed in the fuel storage facilities at the respective sites. The Brokdorf, Grohnde, Gundremmingen C, Isar 2, Neckarwestheim 2, and Emsland nuclear power plants are aiming to be free of nuclear fuel in the second half of the decade.

At the Obrigheim Nuclear Power Plant, the operation of an additional wet storage facility built in 1984 in the earthquake-proof emergency building outside the reactor building was approved on October 26, 1998, in accordance with Section 7 of the Atomic Energy Act. In 2017, all 342 KWO fuel elements still present there were loaded into a total of 15 CASTOR® 440/84 mvK casks and transferred to the Neckarwestheim Storage Facility for storage. The dismantling of the external fuel element storage pool was the subject of the second decommissioning and dismantling licence for the Obrigheim Nuclear Power Plant, which was granted on October 24, 2011 (see Chapter 2.1).

5.1.2 Storage in storage facilities for fuel elements

The storage of nuclear fuels outside the reactor facility requires a licence in accordance with Section 6 of the Atomic Energy Act. Since July 30, 2016, the Federal Office for the Safety of Nuclear Waste Management has been the competent licensing authority for this. Until the Act on the Reorganization of the Organizational Structure in the Field of Disposal came into force, the Federal Office for Radiation Protection was the responsible authority.

For the storage of nuclear fuels in accordance with Section 6 of the Atomic Energy Act, there are twelve storage facilities for fuel elements at the nuclear power plant sites for the storage of the irradiated fuel elements produced there, and four storage facilities for the storage of irradiated nuclear fuels in the form of fuel elements from nuclear power plants and experimental and research reactors, and in the form of vitrified high-level radioactive waste from the reprocessing of irradiated fuel elements in Germany and abroad. The latter four storage facilities are the Ahaus Storage Facility for fuel elements, the Gorleben Storage Facility for fuel elements, the AVR Cask Storage Facility in Jülich, and the Storage facility North in Lubmin/Rubenow at the site of the former Greifswald nuclear power plant (see Table IV.1 in the Annex).

In accordance with Section 2 (3) and Section 3 (1) in conjunction with Table 1 of the Waste Management Transition Act (EntsorgÜG), the storage facilities for the storage of nuclear fuels could be transferred to BGZ Company for Storage mbH (BGZ) on January 1, 2019, after payment of the amounts due by the waste producers to the disposal fund (https://bgz.de/en/). The BGZ is an independent company organized under private law, whose costs are financed by the Fund for the Financing of Nuclear Waste Disposal. The sole shareholder of the BGZ is the Federal

Republic of Germany, represented by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection (BMUV).

According to Section 2 (3) and Section 3 (1) in conjunction with Table 1 of the EntsorgÜG, the prerequisite for the transfer was that the respective storage facility has a valid licence in accordance with Section 6 of the Atomic Energy Act and that the nuclear fuels are delivered in transport and storage casks that meet the acceptance criteria of the respective storage facility. After the transfer, the licences, permits, supplementary orders pursuant to Section 19 (3) AtG, and approvals for and against the BGZ granted to the previous operator remain valid by law.

Following their transfer, all BGZ's own storage facilities for the storage of nuclear fuels have been given new, uniform designations. The term "storage facility for fuel elements" is used below.

The Storage Facility North in Lubmin and the AVR Casks Storage Facility in Jülich are owned by EWN and JEN, a subsidiary of EWN, respectively. The storage facility at the Brunsbüttel nuclear power plant site could not yet be transferred to BGZ after the storage permit had been revoked by court order pursuant to Section 6 of the Atomic Energy Act and is still owned by Kernkraftwerk Brunsbüttel GmbH & Co. oHG. BGZ joined the new approval procedure pursuant to Section 6 AtG for the Brunsbüttel Storage Facility in January 2019.

The currently valid storage permits pursuant to Section 6 of the Atomic Energy Act for all storage facilities are limited to 40 years. For the storage facilities for fuel elements at nuclear power plant sites, this period begins on the date the first cask is emplaced for storage in the respective storage facility; for the other storage facilities, an end date is specified in the licence. The reason for limiting the permits to 40 years was the disposal concept at the time the permits were issued. For example, the storage licence for the Gorleben Storage Facility for Fuel Elements is limited until December 31, 2034, and the licence for the Ahaus Storage Facility for Fuel Elements is limited until December 31, 2036.

In addition, all licences limit the storage period for radioactive inventories in the individual transport and storage casks to a maximum of 40 years from the date of loading the cask. The first cask used in Germany for the dry storage of irradiated fuel elements, a CASTOR®THTR/AVR type with THTR fuel elements, currently stored in the Ahaus Storage Facility, was loaded in June 1992 and will reach its 40-year limit in 2032.

According to Section 6 paragraph 5 of the AtG, the storage of nuclear fuels in the storage facilities established in accordance with Section 9a paragraph 2 sentence 3 AtG shall not exceed 40 years from the date of the first storage of a cask. Storage permits may only be extended for compelling reasons and after prior consultation with the German Bundestag.

Based on the BGE's time estimates for the search for a final repository for heat-generating radioactive waste, it is now foreseeable that extended storage will be necessary in all storage facilities for fuel elements, as no final repository site for high-level radioactive waste will have been designated by the respective expiry date.

The BGZ has begun preparations to apply for longer storage periods, starting with the Gorleben Storage Facility for Spent Fuel Elements. No specific applications have not yet been submitted by the end of 2024.

Storage facilities for spent fuel elements at nuclear power plant sites (formerly: on-site storage facilities)
The storage facilities for fuel elements at the nuclear power plant sites are used to store the spent and irradiated fuel elements produced at the respective nuclear power plants. These storage facilities were established on the basis of the obligation of nuclear power plant operators pursuant to Section Section 9a (2) Sentence 3 of the Atomic Energy Act to store irradiated nuclear fuel generated in nuclear power plants until it is delivered to a final storage facility in a storage facility in accordance with Section 6 (1) and (3) AtG within the enclosed premises of the respective nuclear power plant or in the vicinity (near-site storage facilities). The obligation to store fuel elements at the site of nuclear power plants was enshrined in the 2002 amendment to the Atomic Energy Act in conjunction with the consensus agreement on phasing out the use of nuclear energy in 2001 and the associated change in the disposal concept for irradiated nuclear fuel.

Based on this obligation, between 1998 and 2000, nuclear power plant operators submitted applications for a total of 13 sites for the storage of nuclear fuel in the form of spent fuel elements in near-site storage facilities.
By the end of 2003, the storage of spent fuel elements had been approved for twelve storage facilities (see Table 5.1). The application for an on-site storage facility in Stade was withdrawn following the decision to decommission the nuclear power plant.

The storage facilities for fuel elements at the nuclear power plant sites are dry storage facilities for spent fuel elements in transport and storage casks, which are housed in storage halls or tunnel tubes. All of these storage facilities mainly use CASTOR®V/19 transport and storage casks for pressurized water reactor fuel elements and CASTOR®V/52 transport and storage casks for boiling water reactor fuel elements.

The licences granted for all storage facilities for fuel elements applied for up to the year 2000 allow the storage of spent fuel elements with a total heavy metal mass of 14,025 Mg in 1,435 storage spaces for CASTOR® transport and storage casks. The capacity was originally calculated so that all spent fuel elements that would have been produced until the final shutdown of the power plant based on the electricity quantities specified in 2002 could be stored in the storage facility for fuel elements and remain there even after the decommissioning of the nuclear power plant until the commissioning of a geological repository. With the entry into force of the 13th amendment to the Atomic Energy Act of July 31, 2011, the operating licences for a total of eight nuclear power plants expired on August 6, 2011, and the remaining operating periods of the last three nuclear power plants ended on April 15, 2023. Therefore, the storage capacities of the storage facilities for fuel elements will not fully be occupied by the storage of spent fuel elements that will accumulate in the future.

In addition to the nuclear licence for the storage of nuclear fuels, also a building licence for the construction of the facility in accordance with the building regulations of the respective federal state was also required for the establishment of the storage facilities for fuel elements. For the storage of nuclear fuels for periods of more than 10 years in the storage facilities to be constructed, which was applied for from 1999 onwards, the obligation to carry out an environmental impact assessment was imposed at the time on the basis of Directive 85/337/EEC, as amended by Directive 97/11/EC and the Environmental Impact Assessment Act (UVPG). This was carried out in the approval procedures for each storage facility as a joint environmental impact assessment, which also included the building licence required for the construction of the facility in accordance with the building regulations of the respective federal state. Due to the environmental impact assessment requirement, the approval procedures were carried out in accordance with the requirements of the Nuclear Regulatory Procedure Ordinance with formal public participation procedures. This procedure gives citizens the opportunity to raise objections and discuss them with the approval authority and the applicants at a formal hearing.

As part of the approval procedures, Section 6 (2) No. 4 of the AtG required, in particular, that the necessary protection against disruptive measures or other third-party interventions (SEWD) must be ensured. Since the terrorist attacks of September 11, 2001, it can no longer be ruled out that air traffic could be misused as a means of attack despite high security standards. Even though there have been no findings in recent years and currently with regard to SEWD that indicate a concrete threat to stationary nuclear facilities in Germany, the assessments pursuant to Section 6 (2) No. 4 AtG examined not only acts of terrorism and sabotage, but also the effects of a targeted crash of a large aircraft on a storage facility. The results of the tests showed that in all scenarios considered, the maximum effective dose determined for the reference person at the most unfavourable point of exposure is significantly lower than the guideline value of 100 mSv, which has now also been enshrined in law since September 2021 in Section 44 (2) Sentence 3 of the Atomic Energy Act.

Since the storage licences were granted, a total of 82 modifications licences have been issued for all storage facilities for fuel elements at nuclear power plant sites (see Table IV.1). Some of these concerned parts of the original applications that had not been decided upon, while others concerned new topics. The changes mainly concerned the use of new cask designs and inventory-related aspects that were necessary for the clearance of the wet storage pools at the nuclear power plants. Some approval procedures concerned the possibility of alternative loading variants for spent fuel elements and the storage of special fuel rods (e.g., defective fuel rods) in special quivers for storage in the cask.

Furthermore, since 2011, applications for the enhancement of physical protection of the storage facility building had been submitted for all storage facilities for fuel elements at nuclear power plant sites. With the granting of the sixth modification licence for the Grohnde Storage Facility for Fuel Elements on April 25, 2024, all licensing procedures concerning this topic have been completed. The enhancement measures for the Biblis, Gundremmingen, Grafenrheinfeld, Krümmel, Lingen, and Isar Storage Facilities for Fuel Elements have been completed, while they are still being implemented at the other sites.

In addition, between the end of 2011 and mid-2016, modification licences were granted for the storage facilities for fuel elements in Neckarwestheim, Philippsburg, Grafenrheinfeld, Gundremmingen, Isar, Biblis, Grohnde, Unterweser, Krümmel, and Brokdorf , as well as the Brunsbüttel Storage Facility, to upgrade the crane systems to ensure

fail-safe handling of the casks. The measures for installing the new crane systems have been completed at all of these storage facilities.

In all modification licensing procedures, preliminary environmental impact assessments are carried out in accordance with the Environmental Impact Assessment Act to determine whether the modification topic applied for could cause additional significant adverse or other significant adverse environmental effects and thus require an environmental impact assessment. To date, this has not been necessary in any modification licensing procedure.

In addition to considering acts of terrorism and sabotage in relation to the proposed change, the impact of a targeted crash of a large aircraft on a storage facility is also re-examined in each modification licensing procedure as part of the assessments pursuant to Section 6 (2) No. 4 of the Atomic Energy Act.

On January 1, 2019, in accordance with Section 3 in conjunction with Table 1 of the Waste Management Transition Act, all storage facilities for fuel elements at nuclear power plant sites were transferred to BGZ, with the exception of the Brunsbüttel Storage Facility, which requires a new licence following a court decision. For the transfer of responsibilities, BASE officially confirmed that BGZ would guarantee the continuation of operations for the affected storage facilities for spent fuel elements. The applicable storage licences, including all modification licences that had been granted to the previous operators, are now valid for BGZ.

In 2024, the assessments in the re-licensing procedure for the Brunsbüttel Storage Facility, for which the storage licence dated November 28, 2003, had been revoked in June 2013 by the Higher Administrative Court of Schleswig following a lawsuit filed by local residents, were continued. An environmental impact assessment is also being carried out as part of this re-licensing process.

Furthermore, in 2024, the assessments within the pending modification licensing procedures for the storage facilities for fuel elements at the nuclear power plant sites were continued. The modification licensing procedure for the Grohnde Storage Facility for Fuel Elements to extend protection against SEWD was completed with the granting of the 6th amendment approval dated April 25, 2024. The modification licencing procedure for the storage of vitrified high-level radioactive waste from the reprocessing of irradiated fuel elements in Sellafield (UK) in the Brokdorf Storage Facility for Fuel Elements was also completed with the 7th amendment approval dated March 27, 2024.

With regard to the return of waste from reprocessing in France and Great Britain, as agreed under international law, and in order to fulfill the obligation of nuclear power plant operators under Section 9a (2a) of the Atomic Energy Act to take back radioactive waste from the reprocessing of irradiated nuclear fuel and store it in storage facilities on the sites of the NPPs, the relevant applications for the storage of vitrified waste in the Philippsburg, Brokdorf, Biblis, and Isar storage facilities were submitted on September 29, 2017. The vitrified high-level radioactive waste from the reprocessing of irradiated fuel elements in Sellafield (UK) is to be stored in up to seven casks of the type CASTOR®HAW28M at the Biblis, Brokdorf, and Isar sites. The first licence for the storage of Sellafield glass molds in casks of the type CASTOR®HAW28M was granted on December 19, 2019, for the Biblis Storage Facility for Fuel Elements (BZB). In November 2020, six casks of the type CASTOR®HAW28M with waste from reprocessing in Sellafield were emplaced in the BZB. The 7th modification licence for the Brokdorf Storage Facility dated on March 27, 2024, permits the storage there of solidified high-level radioactive waste from the reprocessing of irradiated fuel elements in Sellafield (GB). This modification licence completed all approval procedures for the return of waste from reprocessing in the UK.

The return obligation originally agreed with France stipulated that a total of five casks of the type CASTOR®HAW28M with solidified intermediate-level radioactive waste (CSD-B) would be stored at the Philippsburg Storage Facility (BZP). The corresponding approval procedure was completed in December 2021 with the 9th modification licence for the BZP. In addition, a total of 152 containers with high-pressure compressed intermediate-level radioactive metal residues (CSD-C) from the reprocessed fuel elements were to be stored at the Ahaus Storage Facility. In 2021, the German government agreed on a new solution for the return of radioactive waste with France. Instead of returning intermediate-level radioactive waste, four CASTOR®HAW28M transport and storage casks with glass moulds from France will be stored at the Philippsburg Storage Facility for Spent Fuel Elements, as is the case at the Biblis, Isar, and Brokdorf sites. In addition, 24 empty fuel element transport casks were taken over by Germany and sent for recycling – if, contrary to plans, there was a need, these would be temporarily stored at the Ahaus Storage Facility. This new agreement reduced the previously planned 17 transports of intermediate-level radioactive waste to just one transport of high-level radioactive waste, while at the same time avoiding delays in the return of waste from France. Accordingly, BGZ submitted an application dated March 28, 2022, for the

storage of up to five CASTOR®HAW28M casks with vitrified high-level radioactive waste at the BZP. This application was approved on July 25, 2023, with the 10th amendment to the BZP licence. In 2024, the four CASTOR®HAW28M transport and storage casks with glass molds were stored at the Philippsburg Storage Facility for Spent Fuel Elements. The application for the storage of the empty spent fuel element transport casks at the BZA was submitted to BASE on June 26, 2023.

On October 13, 2020, BUND Landesverband Hessen e.V. filed a lawsuit with the Hessian Administrative Court against the 9th modification licence for the storage facility in Biblis, which was granted on December 19, 2019, and which permitted the storage of HAW glass molds from reprocessing in Sellafield. The plaintiff essentially complained about the failure to carry out an environmental impact assessment, a flawed repair concept for the containers, and a lack of protection for the storage facility against various disruptive measures and third-party interventions. On February 23, 2024, BUND Hessen withdrew its lawsuit.

Adressed to BASE, the city of Philippsburg lodged an appeal against the 9th modification licence for the BZP for the storage of five CASTOR®HAW28M casks with solidified intermediate-level radioactive waste (CSD-B) on March 23, 2022, and as well against the 10th modification licence for the BZP for the storage of four CASTOR®HAW28M casks with solidified high-level radioactive waste (CSD-V) on August 25, 2023. The objections were both rejected in notices dated July 30, 2024. The city of Philippsburg then filed a lawsuit with the VGH Mannheim on August 27, 2024. In a decision dated November 7, 2024, the VGH Mannheim rejected the city of Philippsburg's requests for a suspensive effect of its appeals.[1]

An appeal was also lodged by the municipality of Niederaichbach to BASE on May 15, 2023, against the 9th modification licence for the Isar Storage Facility for Fuel Elements, which authorizes the storage there of solidified high-level radioactive waste from the reprocessing of irradiated fuel elements in Sellafield (UK). After the objection was withdrawn, the proceedings were closed on May 7, 2024.

In June 2013, following a lawsuit filed by local residents, the Higher Administrative Court of Schleswig revoked the licence for the Brunsbüttel Storage Facility. In the court's opinion, the licensing authority had incorrectly determined and assessed both the necessary level of protection against terrorist attacks in the form of a targeted (guided) crash of a commercial aircraft and the risks of a terrorist attack on the storage facility with armour-piercing weapons. The ruling became final with the decision of the Federal Administrative Court (BVerwG) on January 8, 2015. Since then, the Brunsbüttel Storage Facility has been operating on the basis of an order issued by the nuclear supervisory authority of the state of Schleswig-Holstein, which applies until an enforceable storage licence is granted in accordance with Section 6 of the Atomic Energy Act for the stored nuclear fuels. The approval procedure is currently underway.

Another lawsuit against the licence for the Unterweser Storage Facility for Spent Fuel Elements dated on September 22, 2003, at the Higher Administrative Court of Lower Saxony was settled by mutual agreement in 2021.

In addition, several private individuals had filed a lawsuit addressed to the Bavarian Administrative Court with the aim of obliging BASE to revoke the storage licence for the Gundremmingen on-site Storage Facility (now: storage facility for nuclear fuel elements) granted on December 19, 2003. The plaintiffs essentially based their lawsuit on what they considered to be insufficient protection of the storage facility against terrorist attacks. In its ruling of April 8, 2024, the Bavarian Administrative Court decided that the lawsuit was unfounded and that the licence was lawful and therefore could not be revoked.

Table 5.1 provides an overview of the initial licence granted in each case, the approved heavy metal masses (HM) and storage locations, and the commissioning (i.e., the first storage of a loaded container) of the storage facilities for fuel elements. Further details on these storage facilities can be found in Table IV.1 in the Annex.

Table 5.1: Storage facilities for fuel elements

[1] After the editorial deadline: On February 12, 2025, the city of Philippsburg submitted an application for the withdrawal/revocation of the basic license for the BZP, including 1st-8th amendments.

Storage facilities for fuel elements	Granting of first licence pursuant to Section 6 AtG	Mass HM [Mg]	Total number of casks positions (occupied at the end of 2024)	Commissioning date
BZB (formerly: SZL Biblis)	September 22, 2003	1,400	135 (108)	May 18, 2006
BZF (formerly: SZL Brokdorf)	November 28, 2003	1,000	100 (61)	March 05, 2007
Brunsbüttel interim storage facility* (formerly SZL Brunsbüttel)	November 28, 2003	450	80 (20)	February 05, 2006
BZR (formerly: SZL Grafenrheinfeld)	February 12, 2003	80	88 (54)	February 27, 2006
BZD (formerly: SZL Grohnde)	December 20, 2002	1,000	100 (68)	April 27, 2006
BZM (formerly: SZL Gundremmingen)	December 19, 2003	1,850	192 (137)	August 25, 2006
BZI (formerly: SZL Isar)	September 22, 2003	1,500	152 (88)	March 12, 2007
BZK** (formerly: SZL Krümmel)	December 19, 2003	775	65 (42)	November 14, 2006
BZL (formerly: SZL Lingen)	November 06, 2002	1,250	125 (47)	December 10, 2002
BZN (formerly: SZL Neckarwestheim)	September 22, 2003	1,600	151 (99)	December 06, 2006
BZP (formerly: SZL Philippsburg)	December 19, 2003	1,600	152 (106)	March 19, 2007
BZU (formerly: SZL Unterweser)	September 22, 2003	80	80 (40)	June 18, 2007

* The licence for the Brunsbüttel storage facility was revoked. Storage will continue until a new licence can be obtained on the basis of a supervisory order.
** With the 4th modification licence for the Krümmel Storage Facility for fuel elements to extend protection against SEWD, the number of cask positions was reduced from 80 to 65 and, at the same time, the total thermal output was reduced from 3.0 MW to 2.28 MW.

Ahaus Storage Facility for Fuel Elements (BZA, formerly Ahaus Transport Cask Storage Facility)
The Ahaus Storage Facility for Fuel Elements was originally designed exclusively as an exclusively dry storage facility for spent fuel elements in transport and storage casks of the CASTOR®type. The need to set up this storage facility for the storage of irradiated fuel elements for a period of 40 years arose from the concept for management of spent fuel at the time, which envisaged for the temporary storage of irradiated fuel elements until their reprocessing or final disposal. The BZA consists of storage area I (western storage area) and storage area II (eastern storage area). The owners of the BZA are Brennelement-Zwischenlager Ahaus GmbH and BGZ.

The first licence for the storage of fuel elements from light water reactors in accordance with Section 6 of the Atomic Energy Act for a capacity of 1,500 Mg of heavy metal was granted on April 10, 1987. In June 1992, storage operations began with the first storage of CASTOR®THTR/AVR transport and storage casks with THTR fuel elements.

The BZA has a licence for the storage of spent spherical fuel elements from the THTR-300 in CASTOR®THTR/AVR transport and storage casks; it was issued on March 17, 1992. By the end of April 1995, all 305 CASTOR® THTR/AVR casks with fuel elements from the THTR-300 had been emplaced for storage.

Based on a comprehensive new application, a new licence was granted on November 7, 1997. It covers a total of 420 cask positions in storage areas I and II for the storage of a maximum of 3,960 Mg HM in the previously approved casks as well as in CASTOR®V/19, CASTOR®V/19 SN06, and CASTOR® V/52. The licence specifies the maximum storable activity as $2 \cdot 10^{20}$ Bq and the upper limit for the heat output of all casks in the hall as 17 MW. This storage licence limits the approved storage period to 40 years until December 31, 2036. In addition, the radioactive inventories in the individual casks are allowed to be stored for a maximum period of 40 years from the closure of the respective cask during loading.

With a view to a subsequent condition to be issued, if necessary, in accordance with Section 17 of the Atomic Energy Act, investigations were carried out into the effects of a targeted aircraft crash on the Ahaus Storage Facility for Fuel Elements. The expert findings showed that, in the event of a targeted aircraft crash, no danger to life and health is to be expected for the population in the surrounding area as a result of the release of a significant amount of radioactive substances, and that no drastic disaster control measures are necessary.

On March 20, 1998, in addition to the 305 CASTOR®THTR/AVR casks already in storage, two casks of the type CASTOR®V/19, one CASTOR®V/19 SN06 cask, and three CASTOR®V/52 casks with LWR fuel elements were transferred to the Ahaus Storage Facility for Fuel Elements. On the basis of the third modification licence dated March 30, 2004, which permits the storage of nuclear fuels in form of irradiated fuel elements from the Rossendorf research reactor (RFR fuel elements), in transport and storage casks of the type CASTOR®MTR 2, 18 casks of this type containing RFR fuel elements were emplaced in the Ahaus Storage Facility.

On November 9, 2009, the Münster district government granted a licence in accordance with § 7 of the Radiation Protection Ordinance for the temporary storage of other radioactive materials from the operation and decommissioning of German nuclear power plants with a maximum total activity of 10^{17} Bq. The radioactive waste can be temporarily stored in various concrete, cast iron, and steel containers in the western half of the hall (storage area I). This waste is to be transferred later to the approved federal final repository currently under construction, Schacht Konrad near Salzgitter.

With its approval dated July 17, 2020, the competent district government in Münster granted a licence on the basis of Section 12 (1) No. 3 of the Radiation Protection Act for the continued storage of low- and intermediate-level radioactive waste in storage area I of the BZA until December 31, 2057 (labelled as Ahaus Waste Storage Facility, AZA), see Table IV.2).

Between 2000 and 2017, a total of nine modification licences were also granted for the BZA pursuant to Section 6 Atomic Energy Act (see Table IV.1).

Among other things, the 7th modification licence dated February 8, 2016, approved the enhancement of physical protection of the storage facility building of the BZA. Against the backdrop of the expiry of the licence for the AVR Cask Storage Facility in Jülich in 2013 (see below), the 8th modification licence was granted on July 21, 2016, approving the storage of the AVR inventory in the BZA in response to the application dated September 24, 2009. On the basis of this licence, a total of 152 CASTOR®THTR/AVR casks can be stored in the eastern half of the hall (storage area II) alongside the 305 CASTOR®THTR/AVR casks loaded with fuel elements from the THTR already stored there. On December 12, 2017, the city of Ahaus and a private individual filed a lawsuit against this licence before the Higher Administrative Court of North Rhine-Westphalia. In its ruling of December 3, 2024, the Higher Administrative Court dismissed the lawsuit.

The 9th modification licence dated on August 1, 2017, regulated the transfer of the licence for the Ahaus Transport Cask Storage Facility from GNS to BGZ. This was carried out in accordance with Section 3 in conjunction with Table 1 of the Waste Management Transfer Act as a transfer under company law. In this context, the Ahaus Transport Cask Storage Facility was renamed the Ahaus Storage Facility for Fuel Elements. With the transfer, BGZ joined all ongoing amendment approval procedures pursuant to Section 6 AtG for the BZA.

On December 20, 2006, GNS and Brennelement-Zwischenlager Ahaus GmbH filed an application pursuant to Section 6 AtG for the storage of high-pressure compacted intermediate-level radioactive waste (CSD-C) from the reprocessing of irradiated nuclear fuel in transport and storage casks of the type TGC36. For the storage of this CSD-

C waste, a new transport and storage cask type TGC27 has been under development since2012. This waste was originally intended to be stored in approximately 150 containers. Due to the new agreement reached in 2021 on the return of radioactive waste from France, development of the TGC27 has been discontinued since 2021. Instead, as part of the return agreements with France (see subchapter: Storage facilities for spent fuel elements at nuclear power plant sites), the storage of 25 empty fuel element transport casks (*end-used casks – EUC)* is planned at the BZA. On June 26, 2023, the corresponding application for the storage of up to 25 disused, unloaded, internally contaminated transport casks at the BZA was submitted to BASE. However, the applicant did not actively pursue this application at first. By the end of 2024, the empty fuel element transport casks have been transported to the USA for conditioning.

In letters dated April 2, 2013, and April 3, 2013, GNS and Brennelement-Ahaus-Zwischenlager GmbH applied for a licence to replace the existing storage hall by an upgraded crane-system in order to meet the increased requirements of KTA 3902 Section 4.3, ensuring fail-safe handling of the casks and initially submitted conceptual application documents for this purpose. Since 2020, the application has been supplemented with more detailed application documents, which are currently being reviewed by BASE.

In a letter dated September 30, 2014, GNS requested to resume the nuclear licensing procedure for the storage of irradiated fuel elements from the Heinz Maier-Leibnitz Research Neutron Source at the Technical University of Munich (FRM II) in the BZA. The fuel elements are to be stored in casks of the new type CASTOR®MTR3 in storage area II. In a letter dated May 7, 2020, BGZ also requested the resumption of the licensing procedure for the storage of irradiated fuel elements from the Berlin Experimental Reactor (BER II) at the Helmholtz Centre Berlin for Materials and Energy in CASTOR®MTR3 casks. In contrast to the storage of fuel elements from the FRM II, a modified version of the CASTOR®MTR3 cask-type with a modified primary lid and a new fuel basket is to be used for the storage of the BER II fuel elements. The requested storage of irradiated fuel elements from German research reactors is part of the comprehensive joint application initially submitted by Brennelement-Zwischenlager Ahaus GmbH and GNS on September 15, 1995, which, with regard to research reactor fuel elements, has so far only been approved for fuel elements from the Rossendorf research reactor. The assessments in the relevant licensing procedures were continued in 2024.

Gorleben Storage Facility for Fuel Elements (BZG, formerly Gorleben Transport Cask Storage Facility)
The Gorleben Storage Facility for Fuel Elements (BZG) is a dry storage facility for spent fuel elements from nuclear power plants with light water reactors and HAW glass moulds from reprocessing in transport and storage containers.

On the basis of an application dated September 1980, the nuclear storage licence pursuant to Section 6 of the Atomic Energy Act was granted on September 5, 1983, for a capacity of 1,500 Mg HM. This was preceded by the public disclosure of the safety report and the brief description, as well as a hearing. Storage operations commenced on April 25, 1995.

A new licence dated June 2, 1995, in addition to the increase to a total of 3,800 Mg HM and the storage of solidified high-level radioactive fission product solutions, the storage of fuel elements containing mixed oxide (MOX) and the storage of nuclear fuels in the form of waste, as well as waste containing nuclear fuels and other radioactive material. The storable activity was limited to $2 \cdot 10^{20}$ Bq. Prior this decision a public participation was carried out.

As part of investigations into a possible subsequent condition pursuant to Section 17 of the Atomic Energy Act, investigations into the effects of a deliberately caused aircraft crash were also carried out for the Gorleben Storage Facility for Fuel Elements. The expert findings showed that, in the event of a deliberately caused aircraft crash, no danger to life and health is to be expected for the population in the surrounding area as a result of the release of a significant amount of radioactive substances, and that no drastic disaster control measures are necessary.

The valid storage permit dated June 2, 1995, limits the approved storage period to 40 years until December 31, 2034. In addition, the radioactive inventories in the individual casks may be stored for a maximum period of 40 years from the date of closure of the respective cask during loading. The need to store irradiated fuel elements and solidified high-level radioactive fission product solutions for a period of 40 years in the BZG arose from the nuclear waste management concept at that time. In 2024, the BGZ began conceptual preparatory work to apply for a longer storage period for the BZG. Specifically, only a preparatory procedure pursuant to Section 15 of the Environmental Impact Assessment Act was applied for; applications under nuclear law have not yet been submitted.

The 5th modification licence dated August 1, 2017, regulated the transfer of the licence for the Gorleben Transport Cask Storage Facility from GNS to BGZ. This was carried out in accordance with Section 3 in conjunction with Table 1 of the Waste Management Transfer Act as a transfer under company law. In this context, the Gorleben Transport Cask Storage Facility was renamed the Gorleben Storage Facility for Spent Fuel (BZG). With the transfer, BGZ joined all ongoing amendment approval procedures for the BZG in accordance with Section 6 of the Atomic Energy Act.

The 6th modification licence dated June 21, 2018, most recently approved the safety retrofitting of the BZG (see Table IV.1).

By 2011, five casks with spent fuel elements (1 CASTOR®Ic, 1 CASTOR® IIa, 3 CASTOR®V/19) and 108 casks with HAW glass moulds from France (1 TS 28 V, 74 CASTOR®HAW 20/28 CG, 21 CASTOR®HAW 28 M, and 12 TN85) were stored in the BZG.

Originally, a further 21 casks of the CASTOR®HAW28M type with HAW glass moulds and a further five casks of the CASTOR®HAW28M type with solidified intermediate-level radioactive waste (MAW glass moulds) from reprocessing of irradiated fuel elements at AREVA NC in France were to be stored at the BZG.

Following an amendment to the Atomic Energy Act in conjunction with the Site Selection Act (StandAG) of July 23, 2013, the storage of these casks in the BZG has been legally ruled out. The casks are now to be distributed to individual storage facilities for fuel elements at the sites of the nuclear power plants (see subchapter: Storage facilities for fuel elements at the sites of nuclear power plants).

In letters dated December 5, 2013, and December 12, 2013, GNS and Gorleben Fuel Element Storage Facility GmbH (BLG) applied for the storage licence to be extended to include the storage of other radioactive material in the BZG in accordance with Section 7 (2) of the Radiation Protection Ordinance. As part of this mixed storage, it is now intended to store waste suitable for final disposal in a part of the storage area. The waste is to be conditioned beforehand at the site in an extension building to the Gorleben Waste Storage Facility that is yet to be built.

AVR Casks Storage Facility in Jülich

The AVR Cask Storage Facility is a dry storage facility for spent spherical fuel elements from AVR Jülich (AVR fuel elements) in CASTOR®THTR/AVR transport and storage casks. It forms part of waste storage hall II in the Decontamination Department of Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH (JEN), formerly Jülich Research Centre (FZJ).

Based on a storage licence pursuant to Section 6 of the Atomic Energy Act dated June 17, 1993, storage operations commenced on August 23, 1993. Since 2009, a total of 152 CASTOR®THTR/AVR casks loaded with AVR fuel elements have been stored in the AVR Cask Storage Facility.

The storage licence dated June 17, 1993, was limited to 20 years until June 30, 2013. It contained a collateral clause due to which the licensee had to provide the nuclear regulatory authority with proof of the further whereabouts of the AVR fuel elements by June 30, 2007, at the latest. Therefore, in 2007, the FZJ initially applied for an extension of the permit for storage in Jülich and, in 2009, specified a period of three years for further storage in Jülich.

In addition, the FZJ commissioned GNS to apply for storage of the AVR fuel elements in the Ahaus Transport Cask Storage Facility (now: Ahaus Storage Facility for Fuel Elements). This application was submitted on September 24, 2009. A transport licence was applied for in 2010.

Due to the applications for storage of the AVR fuel elements in the Ahaus Transport Cask Storage Facility, the FZJ requested on July 16, 2010, that the approval procedure for the extension of storage in Jülich be suspended. In 2012, the FZJ changed its plans again and applied to resume the procedure for the continued storage of AVR fuel elements in Jülich.

At the request of the applicant GNS on behalf of the FZJ, the approval procedure for the storage of the AVR fuel elements in the Ahaus Transport Cask Storage Facility was initially suspended in 2013. After the FZJ announced in 2014 that it also wanted to pursue the option of transporting the fuel elements to the Ahaus Storage Facility, approval was granted on July 21, 2016, for the storage of the AVR fuel elements in the storage facility. The city of Ahaus and a private individual filed a lawsuit against this approval to the Higher Administrative Court of North Rhine-Westphalia. In its ruling of December 3, 2024, the Higher Administrative Court dismissed this lawsuit.

From mid-2012, JEN examined the possibility of transporting the AVR fuel elements to the USA. However, according to publicly available information from JEN, this option was abandoned in October 2022 in consultation with the relevant federal and state ministries.[2]

Since the original temporary storage licence for the AVR Cask Storage Facility in Jülich, granted on June 17, 1993, pursuant to Section 6 of the Atomic Energy Act, expired on June 30, 2013, the AVR Cask Storage Facility has been operated on the basis of a supervisory order issued by the state of North Rhine-Westphalia.

The approval procedure pursuant to Section 6 of the Atomic Energy Act for the continued storage of AVR fuel elements in the existing AVR Cask Storage Facility in Jülich is currently being pursued. A new approval for a period of nine years has been applied for.

Another alternative being considered is the construction of a new storage facility at the Jülich site. An application for this has not yet been submitted.

Transport Cask Storage Facility at the Storage Facility North (ZLN) in Rubenow

The Transport Cask Storage Facility at the Storage Facility North is a dry storage facility for spent fuel elements in transport and storage casks. It is located in hall 8 of the Storage facility North on the EWN site at the former Greifswald Nuclear Power Plant in Lubmin/Rubenow. The ZLN is primarily used to store spent fuel elements, nuclear fuels, and other radioactive waste from the Rheinsberg and Greifswald reactors.

On November 5, 1999, the storage licence was granted in accordance with Section 6 of the Atomic Energy Act after a corresponding application had been submitted in April 1993. A capacity of max. 585 Mg HM in max. 80 CASTOR®440/84 containers was approved. The storable activity inventory was limited to $7.5 \cdot 10^{18}$ Bq. The storage licence is valid until October 31, 2039.

On December 11, 1999, storage of CASTOR®casks began. By 2011, a total of 74 loaded CASTOR®casks (62 CASTOR®440/84, 3 CASTOR®KRB-MOX, 5 CASTOR®HAW 20/28 CG SN 16, and 4 CASTOR®KNK) were stored at the ZLN (see Table IV.1 in the Annex).

Investigations into the Transport Cask Storage Facility at the Storage Facility North in Rubenow with regard to a possible subsequent condition pursuant to Section 17 of the Atomic Energy Act also concluded that in the event of a hypothetical targeted aircraft crash, no danger to life and health is to be expected for the population in the surrounding area as a result of the release of a significant amount of radioactive substances, and that no drastic disaster control measures are necessary.

In a letter dated May 29, 2019, EWN submitted an application pursuant to Section 6 of the Atomic Energy Act for the storage of the 74 transport and storage casks in the new Transport Cask Storage Facility (ESTRAL) to be built northeast of the ZLN in Rubenow. In this approval procedure, the application letter and the application documents relevant for public participation were made available for public inspection from February 11 to April 11, 2022, as part of the environmental impact assessment, which includes a formal public participation procedure in accordance with the Nuclear Regulatory Procedure Ordinance. The discussion meeting took place in Greifswald from November 1 to November 2, 2022. More detailed application documents are currently being reviewed to verify compliance with the nuclear licensing requirements.

In addition to the nuclear licence, a building licence, which also includes nature conservation decisions, and a permission under water law are required for the construction and operation of ESTRAL. A joint environmental impact assessment as defined by Section 31 of the Environmental Impact Assessment Act will be carried out under the leadership of BASE including the matters of all approvals required for the overall ESTRAL project.

[2] Source: "Zukünftiger Verbleib der AVR-Brennlemente – aktueller Stand der Optionen“, Jülicher Nachbarschaftsdialog, Jülich FZJ, March 6, 2023.

5.2 Storage of radioactive waste and nuclear fuels

5.2.1 Storage of radioactive waste

Low- and intermediate-level radioactive waste is also referred to as radioactive waste with negligible heat generation. This waste is produced during the operation and decommissioning of nuclear facilities.
Both central storage facilities and decentralized storage facilities at nuclear power plant sites are available for the storage of radioactive waste with negligible heat generation from nuclear power plants and the nuclear industry. For waste generated during the use and handling of radioisotopes in research, industry, and medicine, the state collection points operated by the federal states are used as storage facilities.
The central storage facilities for radioactive waste are listed in Table IV.2a. The BGZ's own decentralized storage facilities for radioactive waste at nuclear power plant sites are addressed directly in Chapter 2.1 of this report in the brief descriptions of the status of the nuclear power plants and are also listed in Table IV.2b.

5.2.2 State custody of nuclear fuels

In the interest of complete state control over the whereabouts of nuclear fuels, regulations govern Section 5 (4) of the Atomic Energy Act stipulates that nuclear fuels for which the owner cannot be identified or cannot be held accountable must be stored by the state. This may be the case, in particular, if nuclear fuels are found or seized during border controls. Since July 30, 2016, the responsible authority for state custody has been the Federal Office for the Safety of Nuclear Waste Management, which took over this task from the Federal Office for Radiation Protection, which had been responsible until then.

For smaller quantities of nuclear fuels that must be stored in accordance with Section 5 (4) of the Atomic Energy Act, BASE has rented storage space at the Storage Facility North near Lubmin as a precautionary measure, but this space is not currently being used.
If, contrary to expectations, larger quantities of nuclear fuel requiring state storage were to arise, these would initially be stored on site. In this case, BASE would take measures to ensure that the storage of nuclear fuel on site complies with the requirements that would arise for the storage of nuclear fuel in accordance with Section 6 of the Atomic Energy Act.
One plutonium-beryllium source is currently in state custody in Germany.

5.3 Conditioning of fuel elements

Gorleben Pilot Conditioning Plant (PKA)
(See also Table IV.3 in Annex IV)

A pilot conditioning plant for spent fuel elements and radioactive waste was built at the Gorleben site to further develop techniques for direct final storage. This is a multi-purpose plant in which, in addition to fuel elements, all types of radioactive waste from nuclear facilities can be transferred or conditioned so that they are suitable for disposal. The plant is designed for a capacity of 35 Mg HM per year.

In January 1990, the first partial nuclear licence was granted for the construction of the shell, the fence and earth wall surrounding the plant, and the preliminary positive overall assessment of the plant concept.

In a decision dated July 21, 1994, the Lower Saxony Ministry of the Environment granted the second partial licence for the construction of the PKA. It covers the entire mechanical and electrical engineering aspects as well as the control technology of the PKA.
The third partial licence, which includes the operating licence, was granted in December 2000. Until the federal government designates a final storage site, the operation of the PKA is limited by an ancillary provision of the permit granted to the repair of damaged transport and storage casks in the event that repairs are necessary on one of the transport and storage casks stored at the same location in the Gorleben Transport Cask Storage Facility (now: Gorleben Storage Facility for Fuel Elements). On December 18, 2001, the Lower Saxony Ministry of the Environment issued a subsequent condition to the second partial licence dated July 21, 1994, which stipulates the "cold operation" of certain systems and plant components. With modification licence 1/2017 dated August 1, 2017, the Lower Saxony Ministry of the Environment, Energy, and Climate Protection permitted a change in the licence holder. BGZ took over, and GNS withdrew.

Due to the search for a final repository, which was restarted with the Site Selection Act, a conditioning plant is no longer planned. It is currently being kept on standby for possible container maintenance (see licences). The operator plans to dismantle the PKA quickly as soon as alternative solutions are available for the plant's currently relevant functions.

5.4 Final Disposal

In Germany, all low-, intermediate- and high-level radioactive waste is to be transported to deep geological formations and stored there safely. This is intended to ensure the *safe containment* of radionuclides over long periods of time and the isolation of this waste from the biosphere. Furthermore, the disposal issue must be solved in a way that is intergenerationally equitable. Deep geological repositories are also internationally recognized as the safest way to treat radioactive waste and spent fuel elements. The BMUV bears overall political responsibility for final storage. The implementing agency for all final storage projects for radioactive waste in Germany is the Federal Company for Radioactive Waste Disposal. Nuclear regulatory supervision is exercised by BASE.

There are currently three projects in Germany for low- and intermediate-level radioactive waste. The Konrad final repository is under construction and, according to the BGE's current plans, is scheduled for completion at the end of 2029, after which it will begin to store low- and intermediate-level radioactive waste. The Morsleben Radioactive Waste Repository (ERAM) was established by the former GDR and is currently in the planning stage for decommissioning. Waste is to be retrieved from the Asse II mine, as its stability is at risk (see Chapter 5.4.2).

The high-level radioactive waste produced in Germany from the peaceful use of nuclear energy must also be safely enclosed in a deep geological repository. This waste includes spent fuel elements and waste from reprocessing. What all these waste materials have in common is their heat generation and emission due to the high activity of the radiological inventory they contain. As part of the restart of the search for a final repository, exploration of the Gorleben salt dome was halted, the first Site Selection Act (StandAG) was passed in 2013, and amended in 2017 based on the recommendations of the Final Repository Commission. The legislature has thus established a new participatory, science-based, transparent, self-questioning, and learning process for determining the site with the best possible safety for a final storage facility. The site selection process is divided into three phases. At the end of each phase, a decision is made by the Bundestag.

5.4.1 Status of the site selection process for a final repository for high-level radioactive waste

Phase 1 of the site selection process is currently underway. As the project implementor, the privately organized Federal Company for Radioactive Waste Disposal (BGE), whose sole shareholder is the Federal Republic of Germany, submitted the *Interim Report on Sub-Areas* to the supervisory authority, the Federal Office for the Safety of Nuclear Waste Management (BASE), on September 28, 2020, and published it. In this report, the BGE outlines where in its assessment, favourable geological conditions for the safe final disposal of high-level radioactive waste can be expected. It has identified a total of 90 sub-areas with favourable geological conditions. All three host rocks designated as potentially suitable in the Site Selection Act (StandAG) (rock salt, clay rock, crystalline rock) are represented. The Gorleben salt dome has been eliminated from the search for a final repository for geological reasons in the interim report on sub-areas.

The publication of the interim report also marked the start of the first legally required participation format: the Sub-Areas Conference. The kick-off event took place on October 17 and 18, 2020. This was followed by three consultation meetings until August 2021. As part of the specialist conference, BASE set up an online participation platform on October 18, 2020, as an additional service. This made it possible to address comments, criticism, or questions about the interim report independently of the specialist conference dates. BASE ensured that these submissions were collected, published, and forwarded to the expert conference during the consultation meetings and to the BGE after the conference had concluded.

After further processing steps, the BGE will propose site regions for surface exploration from the sub-areas. In phase 1, the areas will be evaluated exclusively on the basis of existing data. In phases 2 and 3, geoscientific explorations will be carried out. The BGE's proposals will be reviewed by BASE at the end of each phase. The site decision at the end of phase 3 will be made by the legislature.

At the end of October 2022, the BGE presented its first detailed estimate of the time required in the form of a framework schedule for the individual phases and steps of the site selection process. The estimate focuses on the BGE's own activities. The legal tasks of other stakeholders involved (e.g., examination by BASE, work of the regional conferences, legislation) are only outlined in very general terms. According to this plan by the BGE, the site selection process will not be completed before 2046 and, in the worst-case scenario considered there, not until 2068. The BASE has expressed the opinion that all parties involved should aim for 2046 as the earliest possible date. The time required for the process also embodies a safety aspect in the sense of ensuring that the process is completed safely. BASE has entered into an internal evaluation process with the BMUV to explore potential for optimization in terms of time and procedure in phase 1 of the site selection process.

In November 2024, the BGE published the status of its ongoing work on area categorization for the first time. For 13 of the 90 sub-areas, initial areas were identified that are not expected to be suitable as proposals for site regions for above-ground exploration. The next publication of the status of the work by the BGE is planned for the end of 2025.

5.4.2 Construction, operation, and decommissioning of final repositories

KONRAD Final Repository
The Konrad Final Repository is located in Salzgitter in Lower Saxony. It is the first final repository in Germany to be approved under nuclear law. Approval for the construction and operation of the final repository has been in place since 2002. The former iron ore mine is currently being converted into a final repository.

The Konrad mine, consisting of shafts 1 and 2, has opened up the iron ore deposit known since 1933 at a depth of between approximately 800 m and 1,300 m. Iron ore was mined here between 1957 and 1976, but mining was discontinued for economic reasons. Starting in 1977, the mine was initially examined for its basic geoscientific suitability for storing radioactive waste. After these investigations were completed with positive results, the Physikalisch-Technische Bundesanstalt, which was responsible at the time, submitted an application on August 31, 1982, to initiate a planning approval procedure in accordance with Section 9b of the Atomic Energy Act. The plan envisaged the final storage of up to 650,000 m^3 of radioactive waste with negligible heat generation in newly excavated storage chambers. Based on previous estimates of the expected waste volume for national requirements, the volume approved for final storage was limited to 303,000 m^3. This radioactive waste is generated in particular by the use of nuclear energy for electricity generation until the shutdown of nuclear power plants, during the decommissioning and dismantling of nuclear power plants and other nuclear facilities. Other, comparatively very small proportions of waste come from the use of radioisotopes in industry, medicine, the armed forces, and research and development work.

The planning approval procedure, which began in 1982, was concluded with a planning approval decision (PFB) on May 22, 2002. In March 2006, the pending lawsuits against the PFB were dismissed by the Higher Administrative Court in Lüneburg, and an appeal was not allowed. The Federal Administrative Court rejected the plaintiffs' appeal against the non-admission of the appeal in its decision of March 26, 2007. The planning approval decision is therefore legally binding. Since then, the Konrad mine has been converted and expanded into a final repository. The mining law approval from the responsible mining authority, which is required in addition to the PFB under the Atomic Energy Act, was granted with the approval of the main operating plan. On May 27, 2021, the environmental associations BUND Lower Saxony and NABU Lower Saxony submitted applications to the Lower Saxony Ministry of Environment, Energy, Building, and Climate Protection (MU) for the withdrawal or revocation of the PFB and for an immediate halt to construction. The application was rejected by the MU in September 2024. The applicants then filed a lawsuit against this decision with the Higher Administrative Court in Lüneburg.
In its report *Konrad auf der Zielgeraden* (Konrad on the home stretch) dated June 12, 2023, the BGE announced that construction of the Konrad final repository was expected to be completed in 2029.

All necessary safety-related evidence for the Konrad repository has been provided as part of the nuclear licensing procedure. There is currently no knowledge of any possible safety deficits. Nevertheless, as the operator, the BGE has a duty to keep abreast of the latest scientific and technical developments. The plans for the repository are reviewed and, if necessary, adapted to the state of the art in science and technology and to the current technical regulations. Further reviews based on the current state of the art are also planned for the operational and closure phases.

MORSLEBEN Radioactive Waste Repository (ERAM)
The Morsleben Radioactive Waste Repository (ERAM), established by the GDR in the former Bartensleben potash and rock salt mine, became the responsibility of the Federal Republic of Germany under the 1990 Unification Treaty. Since 1990, the Federal Office for Radiation Protection (BfS) has been the holder of the permanent operating licence due to a legal transfer. On April 25, 2017, the operating responsibilities for the repository were transferred to the BGE.

With an interruption in storage between 1991 and 1994, ERAM was used until 1998 for the final storage of low- and intermediate-level radioactive waste with predominantly short half-lives. From 1971 to February 1991, a total of approx. 14,432 m³ and from January 1994 to September 1998 approx. 22,320 m³ low- and intermediate-level radioactive waste was disposed of. In addition, ERAM contains radiation sources and a container with radium waste for interim storage.

On May 21, 1999, the BfS announced that, for safety reasons, the storage of radioactive waste at ERAM would not be resumed after the interruption ordered by court decision in September 1998. On April 12, 2001, the final decision was made to discontinue the storage of radioactive waste, which means that no radioactive waste has been accepted for disposal since then. With the amendment of the Atomic Energy Act in 2002, Section 57a AtG was amended to the effect that the permanent operating licence for ERAM dated April 22, 1986, continues to apply indefinitely as a planning approval decision within the meaning of Section 9b AtG, but the regulations for the acceptance and final storage of radioactive waste from third parties are invalid.

The application submitted by the BfS on October 13, 1992, to the current Ministry of Science, Energy, Climate Protection, and Environment of the State of Saxony-Anhalt (MWU) for the continued operation of ERAM was restricted by the BfS on May 9, 1997, to the decommissioning of ERAM. The planning approval procedure not only covers the decommissioning, but also the disposal of the radioactive waste temporarily stored at the facility at this time and the disposal of any operating radioactive waste that accrues during the decommissioning process.
The BGE is currently carrying out extensive work to supplement the planning approval documents in accordance with the recommendations of the Federal Waste Management Commission and the additional requirements of the MWU experts.

ASSE II mine
The Asse II mine near Wolfenbüttel is a 100-year-old potash and rock salt mine in which around 47,000 m³ of radioactive waste in approximately 125,000 barrels were stored between 1967 and 1978. The Helmholtz Zentrum München used the mine from 1965 to 1995 on behalf of the Federal Ministry of Research to test the handling and storage of radioactive waste in a final repository. In September 2008, the ministries involved agreed to treat Asse as a final repository in the future. At the beginning of 2009, the Federal Office for Radiation Protection replaced the Helmholtz Zentrum München as the operator of Asse. On April 25, 2017, the BfS transferred the operatorship to the BGE.

Since water is seeping into the mine and the stability of the mine structure is at risk, the Lex Asse (§ 57 b AtG), the *Act to Accelerate the Retrieval of Radioactive Waste and the Decommissioning of the Asse II mine*, came into force on April 24, 2013. The law creates an important legal basis for the retrieval of radioactive waste. Through simplified procedures and the possibility of carrying out work in parallel, the Lex Asse enables the work to be accelerated. In addition, the public's right to comprehensive information is strengthened.

The open-pit operation and the fact-finding work are carried out on the basis of the approvals granted by the Lower Saxony Ministry for the Environment, Energy, Building, and Environmental Protection (MU) in accordance with Section 7 of the Radiation Protection Ordinance and Section 9 of the Atomic Energy Act, which have been in place since July 2010 and April 2011, respectively. Mining law, in particular the requirement for operating plans, must be observed.

The prerequisites for the continued operation of the shaft facility are the stabilization of the mine building and precautions to minimize the consequences of flooding of the Asse II shaft facility. The deformation of the rock mass is reduced by stabilizing the heavily excavated southern flank of the mine (ridge gap filling). The emergency plan provides for various measures to significantly reduce the spread of radionuclides from the waste in the storage chamber (ELK) to the biosphere and humans.

Before retrieval can begin, a retrieval shaft and a retrieval mine must be constructed. In addition, a conditioning plant and a ready-to-use storage facility for the waste must be put into operation. In 2020, the BGE published

documents on the planned retrieval procedure and the planned approval structure. In December 2020, the Lower Saxony Ministry for the Environment, Energy, Building, and Climate Protection held an initial application conference on the approval procedure, involving other public interest bodies. In preparation for retrieval, the BGE initiated a regional planning procedure with the Lower Saxony Ministry of Agriculture. An application conference on this took place in July 2022. Also in July 2022, the MU approved the inspection of storage chamber 8a/511 (MAW chamber) for remote-controlled examination of the storage chamber. Drilling of storage chamber 12/750 as part of the fact-finding process began in 2023, following extensive preparations by the BGE in 2022.

Annexes – Overview

Annex I – Nuclear power plants

As of: December 31, 2024

Table I.1 : Federal and state licensing and supervisory authorities for the storage of nuclear fuels pursuant to Section 6 of the Atomic Energy Act (AtG) and facilities pursuant to Section 7 of the Atomic Energy Act

	Authority for licences according to Section 6 AtG	**Supervisory authority pursuant to Section 19 in conjunction with Section 6 AtG**
	Federal Office for the Safety of Nuclear Waste Disposal	Supervisory authorities of the federal states
Federal state	Licencing authority for facilities according to Section 7 AtG	Supervisory authority pursuant to Section 19 in conjunction with Sections 6 and 7 AtG
Baden-Württemberg (BW)	Ministry of the Environment, Climate, and Energy in agreement with the Ministry of the Interior, Digitalization, and Municipalities	Ministry of the Environment, Climate and Energy Baden-Württemberg Württemberg
Bavaria (BY)	Bavarian State Ministry for Environment and Consumer Protection	
Berlin (BE)	Senate Department for Mobility, Transport, Climate Protection, and Environment	
Brandenburg (BB)	Ministry of Social Affairs, Health, Integration, and Consumer Protection	
Bremen (HB)	Senator for Climate Protection, Environment, Mobility, Urban Development, and Housing in consultation with the Senator for Health, Women, and Consumer Protection	
Hamburg (HH)	Ministry for the Environment, Climate, Energy, and Agriculture	
Hesse (HE)	Hesse Ministry of Agriculture, Environment, Viticulture, Forestry, Hunting, and Home Affairs	
Mecklenburg-Western Pomerania (MV)	Ministry for Climate Protection, Agriculture, Rural Areas and Environment	
Lower Saxony (NI)	Lower Saxony Ministry for the Environment, Energy, and Climate Protection	
North Rhine-Westphalia (NW)	Ministry for Economic Affairs, Industry, Climate Protection, and Energy of the State of North Rhine-Westphalia	
Rhineland-Palatinate (RP)	Ministry for Climate Protection, Environment, Energy, and Mobility	
Saarland (SL)	Ministry for the Environment, Climate, Mobility, Agriculture and Consumer Protection of Saarland	
Saxony (SN)	Saxon State Ministry for Energy, Climate Protection, Environment, and Agriculture	
Saxony-Anhalt (ST)	Ministry of Science, Energy, Climate Protection, and Environment of the State of Saxony-Anhalt	
Schleswig-Holstein (SH)	Ministry for Energy Transition, Climate Protection, Environment, and Nature of the State of Schleswig-Holstein	
Thuringia (TH)	Thuringian Ministry for the Environment, Energy, and Nature Conservation	

Table I.2: Nuclear power plants in decommissioning, as of December 31, 2024

No	Name	Short designation	Reactor type	Capacity MW_e (gross)	First criticality	In power operation	Taken out of service	First decommissioning licence	Operator	Location
1	Rheinsberg (PSF)	KKR	PWR / WWER	70	March 11, 1966	1966	June 1, 1990	April 28, 1995	Entsorgungswerk für Nuklearanlagen GmbH (EWN)	Rheinsberg (BB)
2	Compact sodium-cooled nuclear facility (PSF)	KNK II	FNR	21	October 10, 1977	1979	August 23, 1991	August 26, 1993	Kerntechnische Entsorgung Karlsruhe GmbH (EWN company)	Eggenstein-Leopoldshafen (BW)
3	Multi-purpose research reactor (PSF) Heavy water-moderated and heavy water-cooled cooled pressure vessel reactor with natural uranium	MZFR	PWR / D_2O	57	September 29, 1965	1966	May 3, 1984	November 17, 1987	Kerntechnische Entsorgung Karlsruhe GmbH (EWN company)	Eggenstein-Leopoldshafen (BW)
4	Obrigheim	KWO	PWR	357	September 22, 1968	1969	May 11, 2005	August 28, 2008	EnBW Kernkraft GmbH (EnKK)	Obrigheim (BW)
5	Neckarwestheim 1	GKN 1	PWR	840	May 26, 1976	1976	June 08, 2011	February 3, 2017	EnBW Kernkraft GmbH (EnKK)	Neckarwestheim (BW)
6	Neckarwestheim 2	GKN 2	PWR	1,400	December 29, 1988	1989	April 15, 2023	April 04, 2023	EnBW Kernkraft GmbH (EnKK)	Neckarwestheim (BW)
7	Philippsburg 1	KKP 1	BWR	926	March 9, 1979	1980	June 08, 2011	July 04, 2017	EnBW Nuclear Power GmbH (EnKK)	Philippsburg (BW)
8	Philippsburg 2	KKP 2	PWR	1,468	December 13, 1984	1985	December 31, 2019	December 17, 2019	EnBW Kernkraft GmbH (EnKK)	Philippsburg (BW)
9	Isar 1	KKI 1	BWR	912	November 20, 1977	1979	August 6, 2011	January 17, 2017	PreussenElektra GmbH	Essenbach (BY)

No	Name	Short designation	Reactor type	Capacity MW_e (gross)	First criticality	In power operation	Taken out of service	First decommissioning licence	Operator	Location
10	Isar 2	KKI 2	PWR	1,485	January 15, 1988	1988	April 15, 2023	March 21, 2024	PreussenElektra GmbH	Essenbach (BY)
11	Gundremmingen A	KRB A	BWR	250	August 14, 1966	1967	January 13, 1977	May 26, 1983	RWE Nuclear GmbH	Gundremmingen (BY)
12	Grafenrheinfeld	KKG	PWR	1,345	December 9, 1981	1982	June 27, 2015	April 11, 2018	PreussenElektra GmbH	Grafenrheinfeld (BY)
13	Gundremmingen B	KRB II B	BWR	1,344	03/09/1984	1984	December 31, 2017	March 19, 2019	RWE Nuclear GmbH	Gundremmingen (BY)
14	Gundremmingen C	KRB II C	BWR	1,344	October 26, 1984	1985	December 31, 2021	May 26, 2021	RWE Nuclear GmbH	Gundremmingen (BY)
15	Biblis-A	KWB A	PWR	1,225	July 16, 1974	1975	June 08, 2011	March 30, 2017	RWE Nuclear GmbH	Biblis (HE)
16	Biblis-B	KWB B	PWR	1,300	March 25, 1976	1977	June 08, 2011	March 30, 2017	RWE Nuclear GmbH	Biblis (HE)
17	Greifswald-1 (PSF)	KGR 1	PWR / WWER	440	December 3, 1973	1974	December 18, 1990	June 30, 1995	Entsorgungswerk für Nuklearanlagen GmbH (EWN)	Lubmin (MV)
18	Greifswald-2 (PSF)	KGR 2	PWR / WWER	440	03.12.1974	1975	February 14, 1990	June 30, 1995	Entsorgungswerk für Nuklearanlagen GmbH (EWN)	Lubmin (MV)
19	Greifswald-3 (PSF)	KGR 3	PWR / WWER	440	October 6, 1977	1978	February 28, 1990	June 30, 1995	Entsorgungswerk für Nuklearanlagen GmbH (EWN)	Lubmin (MV)

No	Name	Short designation	Reactor type	Capacity MW_e (gross)	First criticality	In power operation	Taken out of service	First decommissioning licence	Operator	Location
20	Greifswald-4 (PSF)	KGR 4	PWR / WWER	440	July 22, 1979	1979	June 2, 1990	June 30, 1995	Entsorgungswerk für Nuklearanlagen GmbH (EWN)	Lubmin (MV)
2	Greifswald-5 (PSF)	KGR 5	PWR / WWER	440	March 26, 1989	-	November 30, 1989	June 30, 1995	Entsorgungswerk für Nuklearanlagen GmbH (EWN)	Lubmin (MV)
22	Lingen 268 MW_e was the electrical output at the generator, including additional fossil fuel components; electrical output from nuclear energy generation was 252 MW_e .	KWL	BWR	252	January 31, 1968	1968	January 5, 1977	November 21, 1985 March 30, 1988 SE December 21, 2015 (decommissioning of the plant)	Lingen Nuclear Power Plant GmbH	Lingen (NI)
23	Stade	KKS	PWR	672	January 8, 1972	1972	November 14, 2003	09/07/2005	PreussenElektra GmbH	Stade (NI)
24	Unterweser	KKU	PWR	1,410	September 16, 1978	1979	August 06, 2011	February 5, 2018	PreussenElektra GmbH	Esenshamm (NI)
25	Grohnde	KWG	PWR	1,430	September 1, 1984	1985	December 31, 2021	December 6, 2023	PreussenElektra GmbH	Emmerthal (NI)
26	Emsland	KKE	PWR	1,406	April 14, 1988	1988	April 15, 2023	September 26, 2024	RWE Nuclear GmbH	Lingen (NI)
27	Working Group Experimental Reactor Jülich (PSF)	AVR	HTR	15	August 26, 1966	1969	December 31, 1988	September 03, 1994	JEN (EWN company), formerly Arbeitsgemeinschaft Versuchsreaktor GmbH	Jülich (North Rhine-Westphalia)

No	Name	Short designation	Reactor type	Capacity MW_e (gross)	First criticality	In power operation	Taken out of service	First decommissioning licence	Operator	Location
28	Thorium high-temperature reactor (PSF)	THTR-300	HTR	308	September 13, 1983	1987	September 29, 1988	October 22, 1993, May, 1997 SE	HKG	Hamm-Uentrop (North Rhine-Westphalia)
29	Würgassen	KWW	BWR	670	October 22, 1971	1975	August 26, 1994 Decision by the operator to shut down on May 29, 1995	April 14, 1997	PreussenElektra GmbH	Würgassen (North Rhine-Westphalia)
30	Mülheim-Kärlich	KMK	PWR	1302	March 1, 1986	1987	September 09, 1988	July 16, 2004	RWE Nuclear GmbH	Mülheim-Kärlich (RP)
31	Brunsbüttel	KKB	BWR	806	June 23,1976	1977	August 06, 2011	December 21, 2018	Brunsbüttel Nuclear Power Plant GmbH & Co. oHG	Brunsbüttel (SH)
32	Krümmel	KKK	BWR	1,402	September 14, 1983	1984	August 06, 2011	June 20, 2024	Krümmel Nuclear Power Plant GmbH & Co. oHG	Krümmel (SH)
33	Brokdorf	KBR	PWR	1,480	October 8, 1986	1986	December 31, 2021	October 23, 2024	PreussenElektra GmbH	Brokdorf (SH)

PSF Public sector financing
SE Safe enclosure

Table I.3: Nuclear power plants released from the AtG

No	Name	Short designation	Reactor type	Capacity MW_e (gross)	First criticality	in power operation	except operation	First decommissioning licence/decommissioning completed	Operator	Location
1	Grosswelzheim superheated steam reactor (above ground)	HDR	HSR (hot steam reactor)	25	October 14, 1969	1970 (trial operation only)	April 20, 1971	Feburary 16, 1983/ Released from AtG: May 14, 1998 Dismantled: October 15, 1998	Karlsruhe Research Centre GmbH	Karlstein (BY)
2	Niederaichbach (PSF) Heavy water-moderated pressure tube reactor with CO_2-gas cooling	KKN	HWCR/ D_2O moderator	106	December 17, 1972	1973 (trial operation only)	July 31, 1974	October 21, 1975/ Released from AtG: August 17, 1994 Dismantled: August 17, 1995	Karlsruhe Research Centre GmbH	Niederaichbach (BY)
3	Kahl Experimental Nuclear Power Plant	VAK	BWR	16	November 13, 1960	1962	November 25, 1985	May 05, 1988/ Released from AtG: May 17, 2010 Dismantled: September 24, 2010	VAK	Karlstein (BY)

PSF Public sector financing

Table I.4: Nuclear power plant projects that have been discontinued

No	Name	Abbreviation	Operator	Type	Gross output [MW_e]	Comments
1	Greifswald-6 Note: Construction of Unit 6 was well advanced, but has not reached a critical stage. Unit 6 is part of the nuclear facility and therefore included in EWN's reduction volume.	KGR 6	Energiewerke Nord GmbH	PWR	440	Final shutdown: November 30, 1989 General decommissioning/ Dismantling licence of the complete facility: June 30, 1995 ff.
2	Greifswald-7	KGR 7	Energiewerke Nord GmbH	PWR	440	Project discontinued
3	Greifswald-8	KGR 8	Energiewerke Nord GmbH	PWR	440	Project discontinued
4	Sodium-cooled Fast-breeder Reactor Kalkar	SNR 300	Schneller Brüter-Kernkraftwerks-gesellschaft mbH	SNR	327	Project discontinued March 20, 1991
5	Stendal Nuclear Power Plant Unit A	Stendal A	Altmark Industrie GmbH	PWR	1,000	Project discontinued
6	Stendal nuclear power plant Unit B	Stendal B	Altmark Industrie GmbH	PWR	1,000	Project discontinued

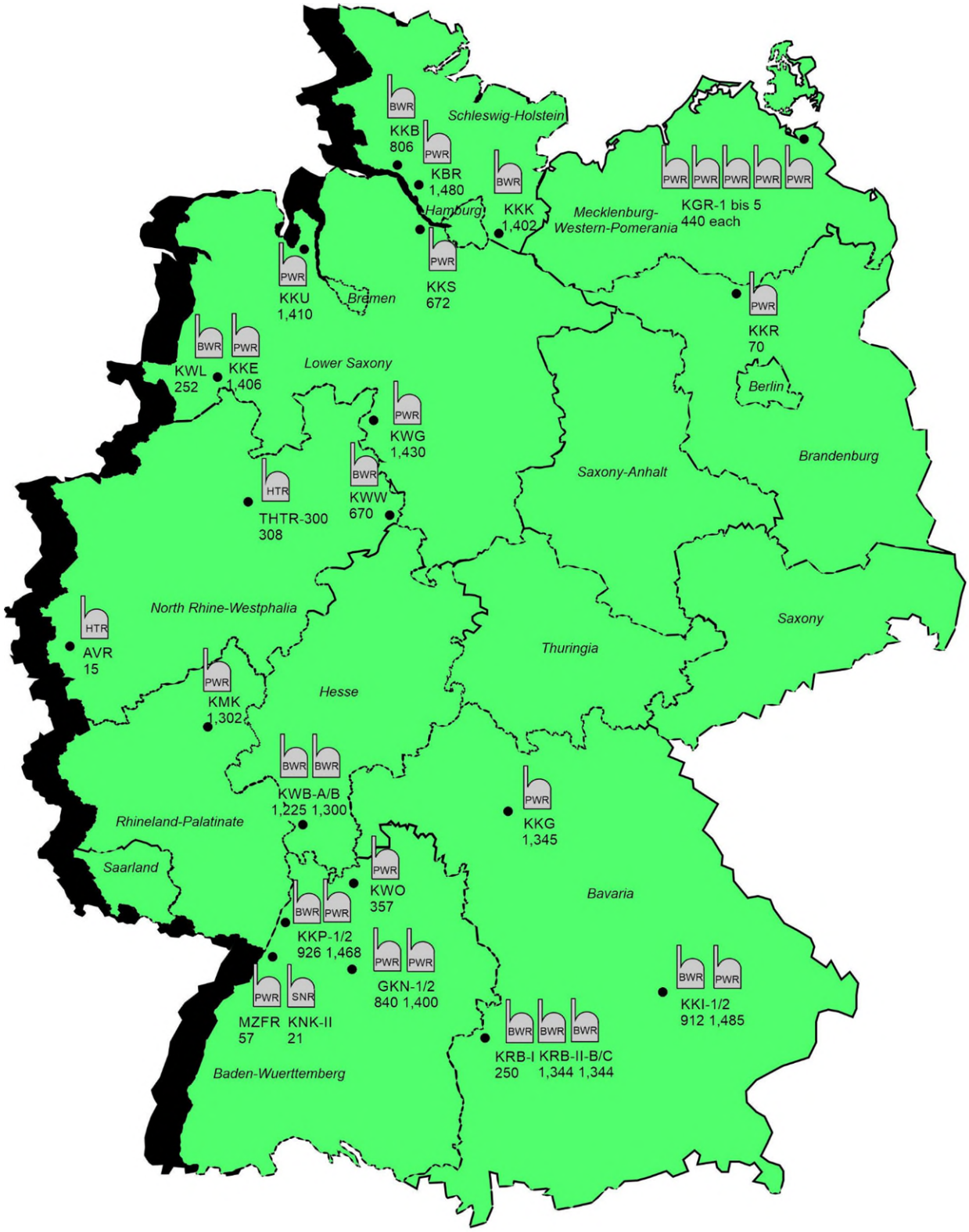


Fig. I.1: Nuclear power plants in the Federal Republic of Germany

Annex II – Research reactors

As of: December 31, 2024

Table II.1: Research reactors in operation

No	Name	Abbreviation	Design/Reactor type; Thermal output	First criticality	Operator	Location
1	SUR Furtwangen	SUR-FW	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	June 28, 1973	Furtwangen University Laboratory for Radiation Measurement Technology	Furtwangen (BW)
2	SUR Stuttgart 1969 Renovation and relocation to another building	SUR-S	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	August 24, 1964 / June 12, 1969	University of Stuttgart, Institute for Nuclear Energy and Energy Systems	Stuttgart (BW)
3	SUR Ulm	SUR-U	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	December 1, 1965	Ulm University of Technology, Institute for Radiation Measurement Technology	Ulm (BW)
4	High-flux neutron source Munich/Garching	FRM-II	Pool-type / compact core with D_2O moderator; 20 MW_{th}	February 03, /2004	Technical University of Munich	Garching (BY)
5	Mainz Research Reactor	FRMZ	Pool-type / TRIGA MARK-II; 0.1 MW_{th}	August 3, 1965	Johannes Gutenberg University Mainz, Department of Chemistry	Mainz (RP)
6	Nuclear training reactor Licence was limited until June 30, 2005, in accordance with Section 57a of the Atomic Energy Act; converted to AKR-2 in 2004. First criticality as AKR-2 on March 22, 2005.	AKR/ AKR-2	Homogeneous (S) / SUR type; 2.0E-06 MW_{th}	July 28, 1978 / March 22, 2005	Dresden University of Technology, Institute for Energy Technology	Dresden (SN)

Table II.2: Research reactors permanently shut down

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	Application for decommissioning	Operator	Location
1	Berlin Experimental Reactor II	BER II	Pool-type / MTR; 10 MW_{th}	December 9, 1973	November 12, 2019	April 24, 2017	Helmholtz Centre Berlin for Materials and Energy GmbH, formerly Hahn-Meitner Institute	Berlin (BE)
2	Geesthacht-1 research reactor	FRG-1	Pool-type / MTR; 5 MW_{th}	October 23, 1958	June 28, 2010	March 21, 2013[1]	Helmholtz-Zentrum Hereon GmbH, formerly Helmholtz-Zentrum Geesthacht Center for Materials and Coastal Research GmbH	Geesthacht (SH)
3	Geesthacht-2 research reactor	FRG-2	Pool-type / MTR; 15 MW_{th}	March 16, 1963	January 28, 1993 Application for decommissioning Jan. 17, 1995 General decommissioning and partial dismantling	March 21, 2013 Application for dismantling of the research reactor facility (consisting of the FRG-1 and remaining parts of the FRG-2)	Helmholtz-Zentrum Hereon GmbH, formerly Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH	Geesthacht (SH)

[1] On September 6, 2016, the application for decommissioning and dismantling of the FRG-1 and dismantling of the research reactor facility and the hot laboratory was specified in more detail. The reactor pressure vessel of the nuclear research vessel "Otto Hahn" stored on the site of the research reactor facility (consisting of FRG-1 and remaining parts of FRG-2) is to be included in the procedure.

Table II.3: Research reactors in decommissioning

No.	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissioning licence	Operator	Location
1	Research Reactor-2	FR-2	Tank / D_2O; 44 MW_{th}	07.03.1961	December 21, 1981	March 07, 1986 | November 20, 1996 SE	Kerntechnische Entsorgung Karlsruhe GmbH (EWN company)	Eggenstein-Leopoldshafen (BW)
2	Munich Research Reactor	FRM	Pool-type / MTR; 4 MW_{th}	October 31, 1957	July 28, 2000	April 03, 2014	Technical University of Munich	Garching (BY)
3	Neuherberg Research Reactor	FRN	Pool-type / TRIGA MARK-III; 1 MW_{th}	August 23, 1972	Dec. 16, 1982	May 30, 1983 | May 24, 1984 SE	Helmholtz Zentrum München – German Research Center for Environmental Health (GmbH)	Oberschleißheim (BY)
4	Braunschweig Research and Measurement Reactor	FMRB	Pool-type / MTR; 1 MW_{th}	October 3, 1967	Dec. 19, 1995	February 03, 2001 July 28, 2005 (Facility except for storage released from the AtG)	Physikalisch-Technische Bundesanstalt	Braunschweig (NI)
5	DIDO	FRJ-2	Tank / D_2O; 23 MW_{th}	November 14, 1962	May 2, 2006	September 20, 2012	JEN (company belonging to EWN-GmbH), formerly Forschungszentrum Jülich GmbH	Jülich (NRW)
6	Siemens Training Reactor Aachen	SUR-AA	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	September 22, 1965	2002 (The plant has been nuclear fuel-free since 2008)	June 26, 2020	Rheinisch-Westfälische Technische Hochschule Aachen, Institute for Electrical Systems and Energy Economics	Aachen (NRW)

SE Safe enclosure

Table II.4: Research reactors released from the Atomic Energy Act

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissioning | Decommissioning completed	Operator	Location
1	Fast zero-energy arrangement	SNEAK	Homogeneous (S); 1.0E-03 MW_{th}	Dec. 15, 1966	November 1985	March 06, 1986 May 6, 1987	Nuclear Research Centre Karlsruhe GmbH	Eggenstein-Leopoldshafen (BW)
2	Fast subcritical assembly Approval pursuant to Section 9 AtG	SUAK	Fast subcritical assembly; 0 MW_{th}	November 20, 1964 Commissioning	December 7, 1978		Nuclear Research Centre Karlsruhe GmbH	Eggenstein-Leopoldshafen (BW)
3	Fast thermal argon autoclave reactor	STARK	Argonaut; 1.0E-05 MW_{th} modified fast thermal argonaut reactor	January 11, 1963	March 1976	1976 | 1977	Nuclear Research Centre Karlsruhe GmbH	Eggenstein-Leopoldshafen (BW)
4	Siemens Training Reactor Karlsruhe	SUR-KA	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	July 03, 1966	September 1996	November 25, 1996 June 26, 1998 Reactor is exhibited without nuclear fuel at the Mannheim Technical Museum.	Nuclear Research Centre Karlsruhe GmbH	Eggenstein-Leopoldshafen (BW)
5	TRIGA Heidelberg I	TRIGA HD I	Pool-type / TRIGA MARK-I; 0.25 MW_{th}	August 26, 1966	March 31, 1977	June 30, 1980 December 11, 1980 (SE) January 16, 2006 (AG) 13.12.2006 Facility demolished and site completely redeveloped (2009)	German Cancer Research Centre	Heidelberg (BW)

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissio-ning | Decommissioning completed	Operator	Location
6	TRIGA Heidelberg II	TRIGA HD II	Pool-type / TRIGA MARK-I; 0.25 MW_{th}	February 28, 1978	November 30, 1999	September 13, 2004 December 13, 2006	German Cancer Research Centre	Heidelberg (BW)
7	AEG zero-energy reactor, thermally critical arrangement	TKA	Tank / thermally critical assembly; 1.0E-04 MW_{th}	June 23, 1967	1973	September 28, 1981 December 21, 1981	Kraftwerk Union AG	Karlstein (BY)
8	AEG test reactor	PR-10	Argonaut; 1.80E-04 MW_{th}	January 27, 1961	1976	July 27, 1976 February 22, 1978	Kraftwerk Union AG	Karlstein (BY)
9	Siemens Argonaut reactor	SAR	Argonaut; 1.0E-03 MW_{th}	June 23, 1959	October 31, 1968	January 8, 1992 (AG) March 20, 1998	Technical University Munich	Garching (BY)
10	Siemens Subcritical arrangement SUA was an accessory to the SUR Munich	SUA	Subcritical arrangement; 0 MW_{th}	06/1959 Commissioning	1968	October 31, 1968 August 28, 1992 (AG) March 20, 1998	Technical University Munich	Garching (BY)
11	Siemens Training Reactor Munich	SUR-M	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	February 28, 1962	August 10, 1981	28.08.1992 (AG) March 20, 1998	Technical University Munich	Garching (BY)
12	Berlin Experimental Reactor	BER I	Homogeneous (L) / L-54(L); 0.05 MW_{th}	July 24, 1958	Summer 1972	February 15, 1974 (Revocation of operating licence) April 23, 1974	Hahn Meitner Institute (now: Helmholtz Centre Berlin for Materials and Energy)	Berlin (BE)
13	Siemens Training Reactor Berlin	SUR-B	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	July 26, 1963	October 15, 2007	December 01, 2008 Apr. 16, 2013	Technical University of Berlin, Institute for Energy Technology, Department of Nuclear Engineering	Berlin (BE)

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissioning | Decommissioning completed	Operator	Location
14	Siemens Training Reactor Bremen	SUR-HB	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	October 10, 1967	June 17, 1993	June 05, 1997 27.07.1999 (AG) 03/2000	Bremen University of Applied Sciences	Bremen (HB)
15	Siemens Training Reactor Hamburg	SUR-HH	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	Jan. 15, 1965	August 1992	March 31, 1999 12/1999	Hamburg University of Applied Sciences	Hamburg (HH)
16	Frankfurt Research Reactor -1	FRF-1	Homogeneous (L) / L-54(L); 0.05 MW_{th}	Jan. 10, 1958	March 19, 1968	1970 October 31, 2006	Johann Wolfgang Goethe University	Frankfurt (HE)
17	Frankfurt Research Reactor -2	FRF-2	Pool-type / modified TRIGA; 1 MW_{th}	No criticality	Not in operation	October 25, 1982 October 31, 2006	Johann Wolfgang Goethe University	Frankfurt (HE)
18	Siemens teaching reactor Darmstadt	SUR-DA	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	September 23, 1963	February 22, 1985	November 23, 1989 February 08, 1990 (AG) 11/29/1996	Darmstadt Technical University	Darmstadt (HE)
19	TRIGA Hanover	FRH/TRIGA MHH	Pool-type / TRIGA Mark-I; 0.25 MW_{th}	31.01.1973	18.12.1996	May 8, 2006 March 13, 2008	Hanover Medical School	Hanover (NI)
20	Siemens Training Reactor Hanover	SUR-H	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	December 9, 1971	The plant has been free of nuclear fuel since 2008	April 09, 2017 September 18, 2019	Leibniz University Hannover Institute for Nuclear Technology and Non-Destructive Testing	Hanover (NI)
21	MERLIN research reactor	FRJ-1	Pool-type / MTR; 10 MW_{th}	February 24, 1962	March 22, 1985	June 08, 1995 November 23, 2007	Jülich Research Centre GmbH	Jülich (NRW)

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissio-ning | Decommissioning completed	Operator	Location
22	Burnup measurement of differential fuel elements with critical arrangement	ADIBKA	Homogeneous (L) / L77A; 1.0E-04 MW_{th}	March 18, 1967	October 30, 1972	July 07, 1977 December 1977	Hochtemperatur-Reaktorbau GmbH	Jülich (NRW)

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissioning | Decommissioning completed	Operator	Location
23	Critical arrangement for high-temperature reactors	KAHTER	Critical assembly; 1.0E-04 MW_{th}	July 2, 1973	March 02, 1984	November 09, 1987 June 1988	Jülich Nuclear Research Facility	Jülich (NRW)
24	Critical experiment on the Incore thermionic reactor	KEITER	Critical arrangement; 1.0E-06 MW_{th}	June 15, 1971	1982	March 18, 1982 June 1988	Jülich Nuclear Research Facility	Jülich (NRW)
25	Rossendorf arrangement for critical experiments	RAKE	Tank / critical assembly; 1.0E-05 MW_{th}	October 3, 1969	November 26, 1991	August 19, 1997 October 28, 1998	Association for Nuclear Process Engineering and Analytics Rossendorf e.V.	Rossendorf (SN)
26	Rossendorf Ring Zone Reactor	RRR	Argonaut; 1.0E-03 MW_{th}	December 16, 1962	September 25, 1991	March 31, 1999 May 11, 2000	Association for Nuclear Process Engineering and Analytics Rossendorf e.V.	Rossendorf (SN)
27	Zittau Teaching and Research Reactor Approval pursuant to Section 57a of the Atomic Energy Act (AtG) limited until June 30, 2005	ZLFR	Tank / WWR-M; 1.0E-05 MW_{th}	May 25, 1979	March 24, 2005 Last operation	July 1, 2005 May 3, 2006	Zittau/Görlitz University of Applied Sciences (FH) Department of Mechanical Engineering	Zittau (SN)
28	Rossendorf Research Reactor	RFR	Tank / WWR-SM; 10 MW_{th}	December 16, 1957	June 27, 1991	January 30, 1998 September 19, 2019	VKTA Radiation Protection, Analysis and Disposal Rossendorf e.V.; formerly: Association for Nuclear Process Engineering and Analysis Rossendorf e.V.	Rossendorf (SN)

No	Name	Short designation	Design/Reactor type; Thermal output	First Criticality	Out of service	First decommissio-ning | Decommissioning completed	Operator	Location
29	Facility for zero-power experiments	ANEX	Critical arrangement; 1.0E-04 MW_{th}	May 1964	May 02, 1975	March 19, 1979 (AG) January 1980	GKSS Research Center Geesthacht GmbH	Geesthacht (SH)
30	Nuclear ship "Otto Hahn" Competent nuclear regulatory authority in the Free and Hanseatic City of Hamburg	OH	PWR / ship reactor; 38 MW_{th} Assigned to the FR in Germany	August 26, 1968	March 22, 1979	December 01, 1980 January 09, 1982	GKSS Research Center Geesthacht GmbH	Geesthacht (SH)
31	Siemens teaching reactor Kiel	SUR-KI	Homogeneous (S) / SUR-100; 1.0E-07 MW_{th}	March 29, 1966	December 11, 1997	March 19, 2008 April 02, 2008	Kiel University of Applied Sciences	Kiel (SH)

AG Dismantling licence
SE Safe enclosure

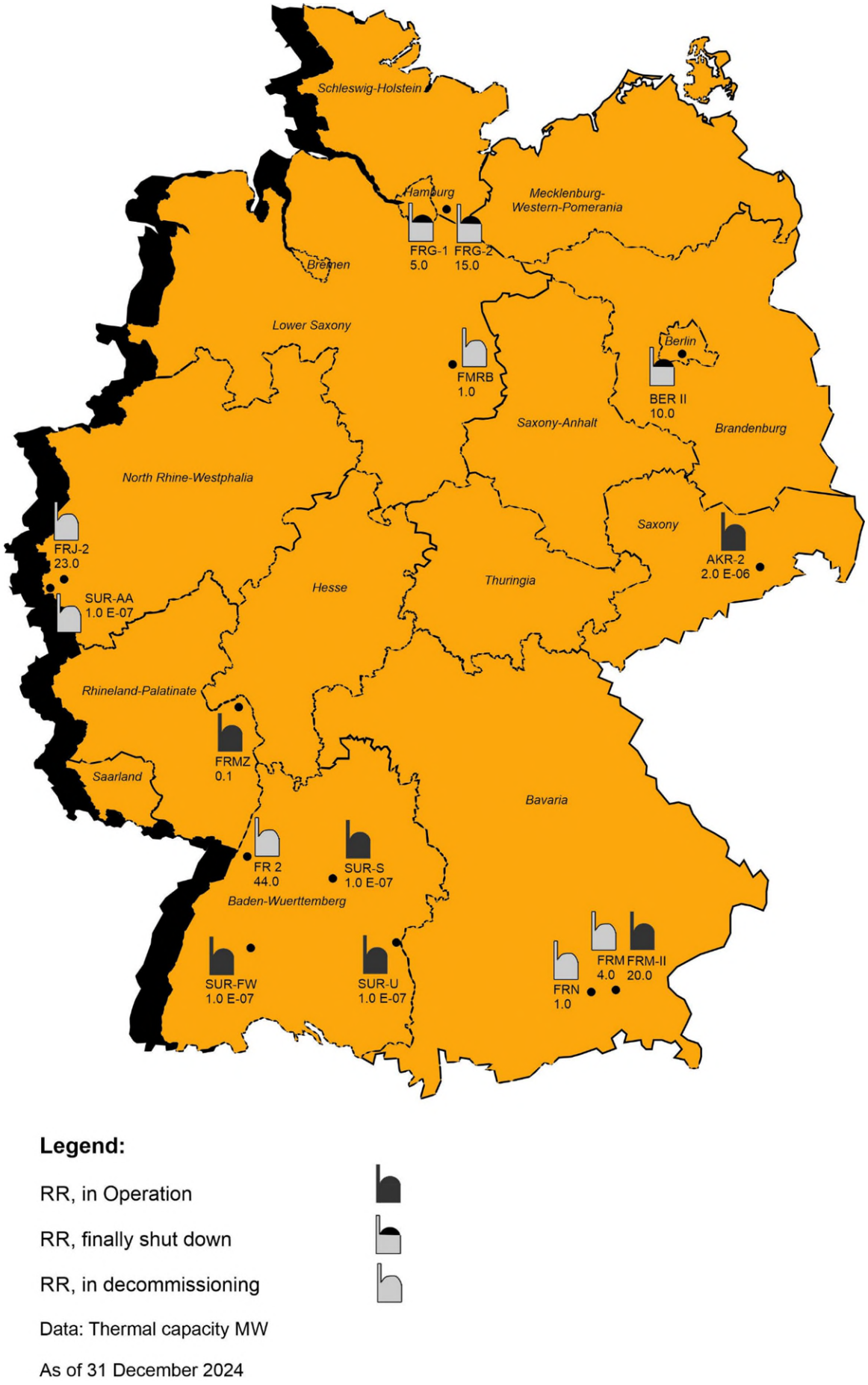


Fig. II.1 : Research reactors in the Federal Republic of Germany

Annex III – Nuclear supply facilities

As of December 31, 2024

Table III.1: Uranium enrichment facilities

No	Name of facility and location	Purpose of the plant	Capacity as per licence	Approval	Comments
1	Gronau Uranium Enrichment Facility (UAG) Gronau (NW)	Enrichment of uranium	4,500 t of uranium separation per year (SW/a) According to the decision of February 14, 2005	3rd partial licence dated June 4, 1985 (operating licence); 9th partial licence dated October 31, 1997 extending capacity to 1.800 tSW/a; Decision No. 7/Ä2 dated November 27, 1998 2nd Change approval for 2 additional separation buildings; Notification No. 7/6 dated February 14, 2005 to increase the production capacity to 4,500 tSW/a	The licence dated February 14, 2005 also covers the handling of depleted and enriched (up to max. 6 % U-235) uranium. The extended facility was constructed in mid-2008 and gradually commissioned. The facility is operated at a nominal capacity of 4,500 tSW/a. The construction of a storage facility with a capacity of up to 60,000 t U_3O_8 was completed in 2014, but has not yet been commissioned.

Table III.2: Fuel element factories in operation

No	Name of facility and location	Purpose of the plant	Capacity as per licence	Licence	Comments
1	ANF Fuel Element Fabrication Factory Lingen Lingen (NI)	Production of predominantly LWR fuel elements from low-enriched uranium dioxide	Processing and treatment of a total of 800 Mg of uranium per year in the form of uranium powder or uranium pellets with up to 5 % U-235 content (dry conversion), 650 Mg of uranium/a for sub-plants	Operating licence dated January 18, 1979 7th partial operating licence dated June 08, 1994 (operating the conversion unit with enriched uranium) March 7, 1997: Capacity increase in fuel element production by 250 Mg of externally manufactured uranium tablets per year January 11, 2005: Increase of the uranium powder throughput to 650 Mg/a December 2, 2009: Capacity increased to 800 Mg/a June 12, 2014: Expansion of storage areas for nuclear fuel	The ANF stores radioactive waste designated for final disposal in accordance with Section 6 of the Atomic Energy Act at a waste storage facility. The raw material UF_6 is stored in special containers in a separate storage hall.

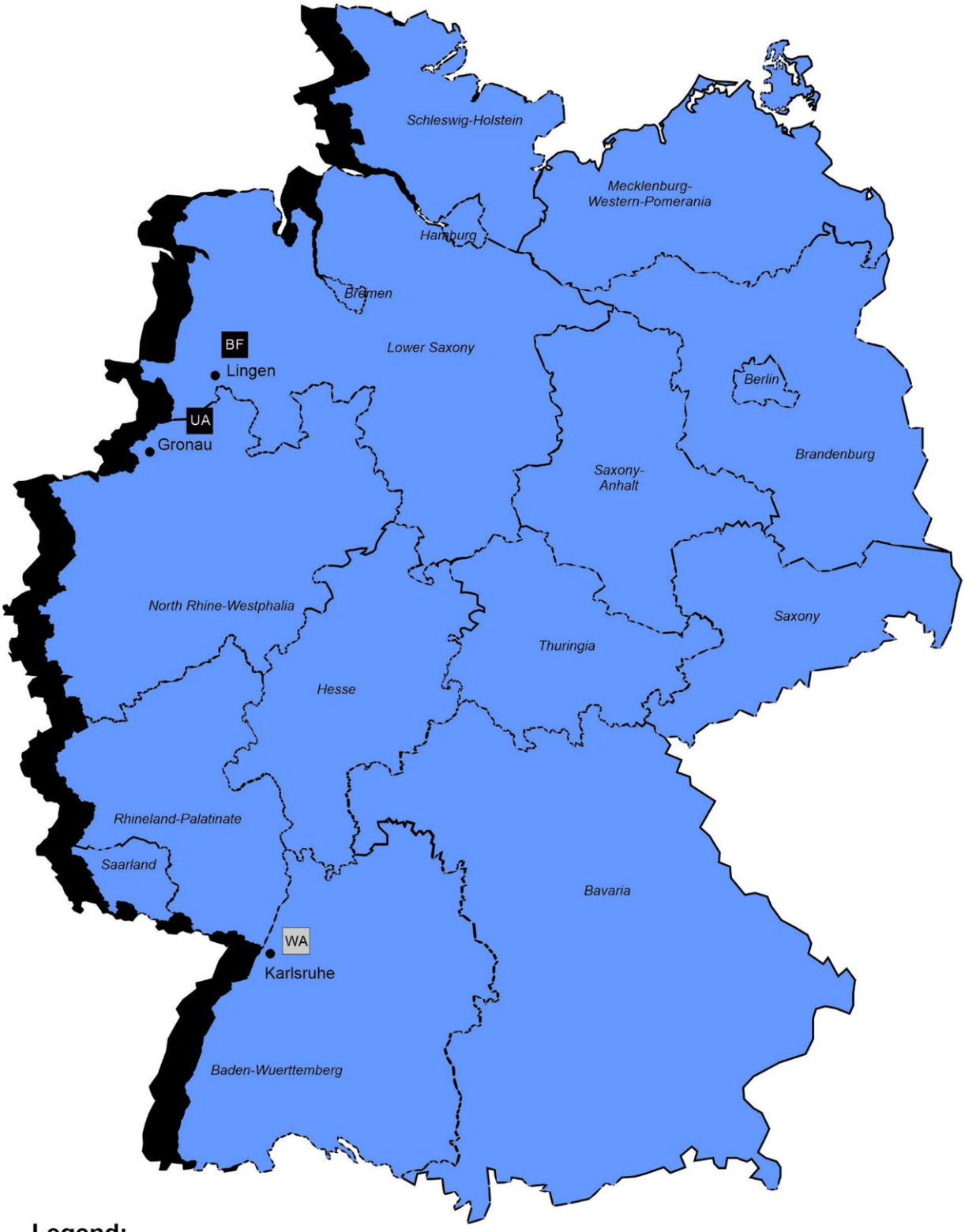
Table III.3: Fuel element factories released from the Atomic Energy Act

No.	Designation of the facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
1	SIEMENS Fuel element plant Karlstein Karlstein (BY)	Production of fuel elements from low-enriched uranium dioxide	Annual throughput of 400 Mg UO_2 with a maximum U-235 content of 4.0 %	Operating licence pursuant to Section 9 AtG dated September 2, 1966 Operating licence according to Section 7 AtG dated December 30, 1977 Licence pursuant to Section 7 of the Atomic Energy Act to dismantle plant components dated August 16, 1994 and March 18, 1996 Release from the Atomic Energy Act: March 1999	Fuel element production has been discontinued; only conventional structural parts are still being manufactured (ANF Karlstein).
2	SIEMENS Fuel element plant Hanau MOX processing division Processing Hanau (HE)	Production of MOX fuel elements primarily for LWRs from plutonium and uranium	Throughput approx. 35 Mg HM/a, Expansion to 120 Mg HM/a was planned	Operating licence pursuant to Section 9 AtG dated August 16, 1968 Last comprehensive licence pursuant to Section 9 AtG dated December 30, 1974 6. partial building licence according to Section 7 AtG dated March 12, 1991 Several partial licences for emptying and dismantling the MOX fuel plant from 1997 to 2005 Release from the Atomic Energy Act: September 2006	In April 1994, the operator decided not to recommission the old plant. The production facilities have been dismantled. State custody has been dissolved. Completion of dismantling work in July 2006.
3	SIEMENS Fuel Element Plant Hanau Operating section Uranium Processing Hanau (HE)	Production of LWR fuel elements from low-enriched uranium	Capacity 1,350 Mg U/a	Operating licence according to Section 9 of the Atomic Energy Act dated July 22, 1969 Operating licence according to Section 7 AtG dated August 31, 1990 Several individual and partial licences for decommissioning and dismantling the plant from 1996 to 2001 Release from the Atomic Energy Act: May 2006	Production of uranium fuel elements discontinued in October 1995. The dismantling work, including site remediation, was completed in January 2006. The facility was released from nuclear regulatory supervision. Groundwater purification (Gen. according to Section 7 StrlSchV) has been completed.

No.	Designation of the facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
4	NUKEM-A fuel element plant Hanau-Wolfgang (HE)	Production of fuel elements from enriched uranium and thorium for research reactors	100 kg U-235 Enrichment up to 20 %; 1,700 kg U-235 enrichment between 20 % and 94 %; 100 Mg natural uranium; 100 Mg depleted uranium; 200 Mg thorium	Operating licence according to Section 9 AtG dated July 30, 1962 Several permits for mining, decommissioning, and remediation of the site from 1988 to 2001 In May 2006, released from the Atomic Energy Act) except for a partial area of 1,000 m² for further groundwater remediation. Completion of radiological groundwater remediation in accordance with Section 19 AtG on July 20, 2015	Operating licence dated January 15, 1988 suspended; all the fuel in the facility had been used by December 31, 1988 The dismantling work and radiological soil remediation have been completed. Nuclear regulatory supervision was concluded with a decision dated July 20, 2015.
5	High Temperature Fuel Element Company (HOBEG) Hanau (HE)	Fabrication of spherical fuel elements for HTR based on uranium (up to 94 % U-235) and thorium	200,000 fuel elements/year 11.7 Mg HM (during operating period)	Operating licence according to Section 9 AtG dated December 30, 1974. Nine licences for dismantling and decommissioning between December 5, 1988, and April 7, 1995. Released from supervision under the Atomic Energy Act on December 18, 1995.	The facility was temporarily taken out of service on January 15, 1988, then decommissioned. Process engineering components were dismantled. Decontamination of the site and building structures has been completed. The site and buildings are used by Nuclear Cargo & Service GmbH.

Table III. 4: Reprocessing plant

No	Name of facility and location	Purpose of the plant	Capacity as per licence	Approval	Comments
1	Karlsruhe Reprocessing Plant (WAK) Eggenstein-Leopoldshafen, BW	Pilot plant for reprocessing and technology development	0.175 Mg of HM/day; approx. 40 Mg UO_2/a	WAK operation: 1th Partial operating licence according to Section 7 AtG dated January 2, 1967 VEK operation 1th operating licence for VEK dated December 20, 2005 2nd Partial operating licence for VEK dated February 24, 2009 (nuclear [hot] commissioning) Decommissioning WAK: 1st Decommissioning licence, March 1993 23rd Decommissioning licence dated December 14, 2011, for the dismantling of the LAVA high-activity laboratory and the LAVA (hot) cells 26th Decommissioning licence for the remote dismantling of the VEK process technology dated July 6, 2018 27th Decommissioning licence dated March 4, 2021 (partial dismantling of a pipe bridge between the process building and the HWL) 28th Decommissioning licence dated June 1, 2021 (dismantling of a shielding wall of the process building 29th Decommissioning licence dated October 14, 2021 (removal of the water basin in the process building) 30th Decommissioning licence dated January 16, 2024 (dismantling of remaining HWL equipment)	The plant was in operation from 1971 to 1990. During this period, approximately 200 Mg of nuclear fuel from experimental and power reactors was reprocessed. Decommissioning and dismantling with the aim *of returning the site to its original condition* are well advanced. The facilities in the process building have been largely removed. A vitrification facility (VEK) for 60 m^3 HAWC was built and operated until November 2010. The HAWC was completely vitrified. This produced 140 waste glass molds (56 Mg), which were placed in five CASTOR®HAW 20/28 transport and storage casks. The CASTOR®casks have been stored at EWN's Storage Facility North since February 2011.



Legend:

UA Uranium enrichment plant
BF Fuel element farbrication plant
WA Reprocessing plant

In operation

Under decommissioning

As of 31 December 2024

Fig. III.1 : Nuclear supply locations

Annex IV – Nuclear waste disposal facilities

Status: December 31, 2024

Table IV.1: Storage facilities for fuel elements[1]

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
1	Neckarwestheim Storage Facility for Fuel Elements (BZN) Gemmrigheim, BW	Storage of irradiated fuel elements from units GKN1 and GKN 2 of the Neckar joint nuclear power plant	1,600 Mg of heavy metal in up to 151 transport and storage containers with up to $8.3 \cdot 10^{19}$ Bq activity and 3.5 MW heat release	In accordance with Section 6 dated September 22, 2003 1st Amendment dated March 22, 2006 2nd Amendment dated September 28, 2006 1st Supplement dated September 03, 2007 2nd Supplement dated February 18, 2010 3rd Amendment dated May 11, 2010 4th Amendment dated December 13, 2013 5th Amendment dated April 16, 2014 6th Amendment dated August 9, 2016 7th Amendment dated April 26, 2017 8th Amendment dated August 24, 2017 9th Amendment dated December 17, 2018 10th Amendment dated July 5, 2022	Start of construction: November 17, 2003 First cask emplacement: December 06, 2006 At the end of 2024, there were 99 casks in the storage facility.

[1] With their transfer to BGZ, all BGZ-owned storage facilities for the storage of nuclear fuels (both central and on-site storage facilities) have been given new, uniform designations.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
2	Philippsburg Storage Facility for Fuel Elements (BZP) BW	Storage of irradiated fuel elements from units 1 and 2 of the Philippsburg nuclear power plant	1,600 Mg of heavy metal in up to 152 transport and storage casks with up to $1.5 \cdot 10^{20}$ Bq activity and 6.0 MW heat release	In accordance with Section 6 AtG December 19, 2003 1st Amendment dated October 05, 2006 2nd Amendment dated December 21, 2006 3rd Amendment dated June 13, 2014 4th Amendment dated December 18, 2014 5th Amendment dated February 24, 2016 6th Amendment dated March 19, 2020 7th Amendment dated October 1, 2020 8th Amendment dated October 27, 2020 9th Amendment dated December 8, 2021 10th Amendment dated July 25, 2023	Start of construction: May 17, 2004 First cask emplacement: March 19, 2007 At the end of 2024, there were 106 casks in storage.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
3	Grafenrheinfeld Storage Facility for Fuel Elements (BZR) BY	Storage of irradiated fuel elements from the Grafenrheinfeld nuclear power plant	800 Mg of heavy metal in up to 88 transport and storage casks with up to $5 \cdot 10^{19}$ Bq activity and 3.5 MW heat release	In accordance with Section 6 AtG dated February 12,2003 Order for immediate enforcement on September 10,2003 1st Amendment dated July 31, 2007 2nd Amendment dated October 6, 2011 3rd Amendment dated November 3, 2011 4th Amendment dated April 26, 2018 5th Amendment dated November 15, 2018 6th Amendment dated December 16, 2019	Start of construction: September 22, 2003 First cask emplacement: February 27, 2006 At the end of 2024, there were 54 casks were in storage.
4	Gundremmingen Storage Facility for Fuel Elements (BZM) BY	Storage of irradiated fuel elements from units B and C of the Gundremmingen nuclear power plant	1,850 Mg of heavy metal in up to 192 transport and storage casks with up to $2.4 \cdot 10^{20}$ Bq activity and 6.0 MW heat release	In accordance with Section 6 AtG dated December 19, 2003 Order for immediate enforcement on July 28, 2004 1st Amendment dated June 2, 2006 2nd Amendment dated January 7, 2014 3rd Amendment dated February 27, 2015 4th Amendment dated October 27, 2015 5th Amendment dated December 14, 2017 6th Amendment dated October 1, 2020	Start of construction: August 23, 2004 First cask emplacement: August 25, 2006 At the end of 2024, there were 137 casks were in storage

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
5	Isar Storage Facility for Fuel Elements (BZI) Niederaichbach BY	Storage of irradiated fuel elements from the Isar 1 and Isar 2 nuclear power plants	1,500 Mg of heavy metal in up to 152 transport and storage casks with up to $1.5 \cdot 10^{20}$ Bq activity and 6.0 MW heat release	In accordance with Section 6 AtG dated September 22, 2003 Order for immediate enforcement on May 28, 2004 1st Amendment dated January 11, 2007 2nd Amendment dated February 29, 2008 3rd Amendment dated November 16, 2011 4th Amendment dated February 7, 2012 5th Amendment dated June 20, 2016 6th Amendment dated July 28, 2016 7th Amendment dated August 9, 2017 8th Amendment dated December 22, 2021 9th Amendment dated April 12, 2023	Start of construction: June 14, 2004 first cask emplacement: March 12, 2007 At the end of 2024, there were 88 casks in the storage facility.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
6	Biblis Storage Facility for Fuel Elements (BZB) HE	Storage of irradiated fuel elements from units A and B of the Biblis nuclear power plant Storage of HAW glass molds from Sellafield in up to seven CASTOR®HAW28M casks	1,400 Mg of heavy metal in up to 135 transport and storage casks with up to $8.5 \cdot 10^{19}$ Bq activity and 5.3 MW heat release	In accordance with Section 6 AtG dated September 22, 20031st Amendment dated October 20, 2005 1st Supplement dated March 20, 2006 2nd Amendment dated March 27,2006 3rd Amendment dated June 16, 2014 4th Amendment dated July 22, 2014 5th Amendment dated September 22, 2015 6th Amendment dated April 7, 2016 7th Amendment dated December 14, 2017 8th Amendment dated June 14, 2018 9th Amendment dated December 19, 2019	Start of construction: March 01,2004 First cask emplacement: May 18, 2006 At the end of 2024, there were 108 casks in storage.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
7	Grohnde Storage Facility for Spent Fuel Elements (BZD) NI	Storage of irradiated fuel elements from the Grohnde nuclear power plant	1,000 Mg of heavy metal in up to 100 transport and storage containers with up to $5.5 \cdot 10^{19}$ Bq activity and 3.75 MW heat release	In accordance with Section 6 AtG dated December 20, 2022 Order for immediate enforcement on September 19, 2005 1st Amendment dated April 17, 2007 2nd Amendment dated May 23, 2012 3rd Amendment dated June 25, 2012 4th Amendment dated July 15, 2020 5th Amendment dated August 17, 2023 6th amendment dated April 25, 2024	Start of construction: November 10, 2003 First cask emplacement: April 27, 2004 At the end of 2024, there were 68 casks storage.
8	Lingen Storage Facility for Fuel Elements (BZL) Bramsche NI	Storage of irradiated fuel elements from the Emsland nuclear power plant	1,250 Mg of heavy metal in up to 125 transport and storage casks with up to $6.9 \cdot 10^{19}$ Bq activity and 4.7 MW heat release	In accordance with Section 6 AtG dated November 06, 2002 with order of immediate enforcement 1st supplement dated July 31, 2007 1st Amendment dated December 01, 2008 2nd Amendment dated December 19, 2014 3rd Amendment dated August 7, 2015 4th Amendment dated June 4, 2020	Start of construction: October 18, 2000 First cask emplacement: December 10, 2002 At the end of 2024, there were 47 casks in storage.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
9	Unterweser Storage Facility for Fuel Elements (BZU) Rodenkirchen NI	Storage of irradiated fuel elements from the Unterweser nuclear power plant	800 Mg of heavy metal in up to 80 transport and storage casks with up to $4.4 \cdot 10^{19}$ Bq activity and 3.0 MW heat release	In accordance with Section 6 AtG dated September 22, 2003Order for immediate enforcement on February 05, 2007 1st Amendment dated May 27, 2008 2nd Amendment dated January 5, 2012 3rd Amendment dated December 18, 2012 4th Amendment dated August 11, 2016 5th Amendment dated November 2, 2017 6th Amendment dated July 26, 2018	Start of construction: January 19, 2004 First cask emplacement: June 18, 2007 At the end of 2024, there were 40 casks in storage.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
10	Krümmel Storage Facility for Fuel Elements (BZK) SH	Storage of irradiated fuel elements from the Krümmel nuclear power plant	775 Mg of heavy metal in up to 65 transport and storage casks with up to $9.6 \cdot 10^{19}$ Bq activity and 2.28 MW heat release With the 4th amendment, the number of storage spaces was reduced from 80 to 65 and the thermal output from 3.0 to 2.28 MW.	In accordance with Section 6 AtG dated December 19, 2003 1st amendment on November 16, 2005 Order of immediate enforcement on April 28, 2006 2nd Amendment dated October 17, 2007 3rd Amendment dated July 9, 2014 4th Amendment dated April 18, 2016 5th Amendment dated July 4, 2016 6th Amendment dated December 18, 2018	Start of construction: April 23, 2004 First cask emplacement: November 14, 2006 At the end of 2024, there were 42 casks in storage.
11	Brokdorf Storage Facility for Fuel Elements (BZF) SH	Storage of irradiated fuel elements from the Brokdorf nuclear power plant	1000 Mg of heavy metal in up to 100 transport and storage casks with up to $5.5 \cdot 10^{19}$ Bq activity and 3.75 MW heat release	In accordance with Section 6 AtG dated November 28, 20031st Amendment dated May 24, 2007 2nd Amendment dated July 19, 2012 3rd Amendment dated August 29, 2012 4th Amendment dated July 7, 2022 5th Amendment dated December 7, 2022 6th Amendment dated December 19, 2023 7th Amendment dated March 27, 2024	Start of construction: April 05, 2004 First cask emplacement: March 05, 2007 At the end of 2024, there were 61 casks in storage.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
12	Brunsbüttel Storage Facility SH	Storage of irradiated fuel elements from the Brunsbüttel nuclear power plant	450 Mg of heavy metal in up to 80 transport and storage casks with up to $6.0 \cdot 10^{19}$ Bq activity and 2.0 MW heat release	In accordance with Section 6 AtG dated November 28, 2003 order for immediate enforcement on October 28, 2005 1st Amendment dated March 14, 2008 2nd Amendment dated July 21, 2014 The permit for storage was revoked by a ruling of the Schleswig Higher Administrative Court on June 13, 2013, and a decision of the Federal Administrative Court on January 8, 2015. On November 16, 2015, Kernkraftwerk Brunsbüttel GmbH & Co. oHG submitted an application for a new licence.	Start of construction: October 07, 2003 First cask emplacement: February 05, 2006 Since the end of 2017, 20 casks have been in temporary storage. Nine containers were stored until 2013 on the basis of the storage licence. Eleven further casks were emplaced until 2017 on the basis of a supervisory order. On January 17, 2020, the nuclear regulatory order was extended without a specific time limit.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
13	Ahaus Storage Facility for Fuel Elements (BZA) (formerly Ahaus Transport Cask Storage Facility (TBL-A)) NW	Storage of spent fuel elements in transport and storage casks of the type CASTOR® (dry storage)	420 casks storage spaces (LWR), total capacity up to max. 3,960 Mg HM Max. storable activity $2 \cdot 10^{20}$ Bq	In accordance with Section 6 AtG dated April 10, 1987 Permission of increased amount of heavy metal and approval of further cask types 1st Amendment dated May 17, 2000 2nd Amendment dated April 24, 2001 3rd Amendment dated March 30, 2004 4th Amendment dated July 04, 2008 5th Amendment dated December 22, 2008 6. Amendment dated May 26, 2010 7th Amendment dated February 8, 2016 8th Amendment dated July 21, 2016 9th Amendment dated August 1, 2017	In April 1995, the storage of 305 CASTOR®THTR/AVR casks with fuel elements from the THTR-300 was completed. On March 20, 1998, an additional - 2 CASTOR® V/19 - 1 CASTOR® V/19 SN06 and - 3 CASTOR® V/52 casks with LWR fuel elements were transferred to the TBL-A. In 2005, 18 casks CASTOR® MTR 2 containers were stored, which had been transported from Rossendorf to Ahaus.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
14	Gorleben Storage Facility for Fuel Elements (BZG) (formerly Gorleben Transport Cask Storage Facility (TBL-G)) NI	Storage of spent fuel elements in transport and storage casks, as well as solidified HAW fission product solutions and other radioactive substances (dry storage)	3,800 Mg HM or 420 casks storage spaces; Max. storable activity $2 \cdot 10^{20}$ Bq	In accordance with Section 6 AtG dated September 05, 1983 Order for immediate enforcement on September 06, 1988 Renewal of the storage licence dated June 02, 1995 for irradiated fuel elements and vitrified fission product solutions 1st Amendment dated December 01, 2000 2nd Amendment dated January 18, .2002 3rd Amendment dated May 23, 2007 4th Amendment dated January 29, 2010 5th Amendment dated August 1, 2017 6th Amendment dated June 21, 2018	Since 2011, a total of 113 casks have been located in the TBL-G, of which - 5 casks with spent fuel elements, of which - 1 CASTOR® Ic - 1 CASTOR® IIa, - 3 CASTOR® V/19 and 108 casks with HAW glass molds, of which - 1 TS 28 V, - 74 CASTOR® HAW 20/28 CG, - 21 CASTOR® HAW28M - 12 TN85.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
15	Transport Cask Storage Facility at the Storage Facility North (ZLN) Rubenow (near Greifswald), MV	Storage of spent fuel elements from the Rheinsberg and Greifswald reactors in transport and storage casks (dry storage)	585.4 Mg HM in max. 80 storage casks Maximum storable activity: $7.5 \cdot 10^{18}$ Bq	In accordance with Section 6 AtG dated November 05, 1999 1st Amendment dated March 14, 2001 2nd Amendment dated July 7, 2003 3rd Amendment dated December 19, 2005 4th Amendment dated February 17, 2006 5th Amendment dated December 17, 2008 6th Amendment dated February 24,2009 7th amendment dated April 30,2010	Since 2011, there have been 74 casks in the ZLN, of which: - 62 CASTOR®440/84 - 3 CASTOR®KRB-MOX - 4 CASTOR®KNK - 5 CASTOR®HAW 20/28 CG SN 16.
16	AVR Cask Storage Facility at FZJ Jülich NW	Storage of spent AVR fuel elements in CASTOR®transport and storage casks	Up to 300,000 AVR fuel elements in a maximum of 158 CASTOR® THTR/AVR casks	In accordance with Section 6 AtG dated June 17, 1993 1st Amendment dated April 27, 1995 2nd Amendment dated July 7, 2005 The storage licence expired on June 30, 2013.	Since 2009, 152 CASTOR®THTR/AVR casks have been in the storage facility. Storage is currently taking place on the basis of a nuclear regulatory order.
17	Storage facility at the Obrigheim nuclear power plant BW	Storage of spent fuel elements and core components from the Obrigheim nuclear power plant (wet storage)	980 fuel elements (approx. 286 Mg HM)	Dated October 26, 1998 in accordance with Section 7 AtG	Between June and December 2017, a total of 342 stored fuel elements were transferred to the SZL Neckarwestheim (now: Neckarwestheim Fuel Element Storage Facility). The dismantling of the external fuel element storage pool was the subject of the second decommissioning and dismantling licence for the Obrigheim nuclear power plant dated October 24, 2011.

Table IV. 2a: Central storage facilities for radioactive waste[1]

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
1	Gorleben Waste Storage Facility (AZG) NI	Storage of radioactive waste with negligible heat generation from nuclear power plants, medicine, research, and industry	200-liter and 400-liter drums, type III concrete casks, type I-II cast casks, type I-IV casks with a total activity of up to $5 \cdot 10^{18}$ Bq 15,000 m^3	Handling licences in accordance with Section 3 StrlSchV[2] dated October 27, 1983, October 13, 1987, and September 13, 1995	In operation since October 1984. Operator: BGZ
2	Ahaus Storage Facility (AZA) NW	Storage of radioactive waste from nuclear power plants	Konrad casks, 20' casks, and plant components, total activity limit for storage area I of $1 \cdot 10^{17}$ Bq	Handling licences in accordance with Section 7 StrlSchV[3] dated November 9, 2009, latest handling licence in accordance with Section 12 StrlSchG dated July 17, 2020, valid until December 31, 2057.	In operation since July 2010. Operator: BGZ
3	Unterweser 1 Waste Storage Facility (AZU 1) NI	Storage of low-level radioactive waste from the Unterweser and Stade nuclear power plants	200-liter and 400-liter drums, concrete containers, sheet steel containers, concrete containers, cast iron containers with a total activity of up to $1.85 \cdot 10^{15}$ Bq	Handling licences in accordance with Section 3 StrlSchV[2] dated June 24, 1981, November 29, 1991, and November 6, 1998	In operation since fall 1981. Operator: BGZ

[1] With their transfer to BGZ, all BGZ-owned storage facilities for radioactive waste have been given new, uniform designations.

[2] In the version dated October 13, 1976, and June 30, 1989, respectively.

[3] In the version of 2001

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
4	Unterweser 2 Waste Storage Facility (AZU 2) NI	Storage of radioactive waste from the Unterweser nuclear power plant and other nuclear power plants belonging to PreußenElektra GmbH, as well as AZU 1 and BZU	Storage of waste containers conditioned for the Konrad final repository; as well as transport preparation or buffer storage of individual components or waste in 20-foot containers or in transport packaging with a total activity of up to $2 \cdot 10^{17}$ Bq	Handling licence in accordance with Section 7 StrlSchV[1] dated December 5, 2018	In operation since July 2020. Operator: BGZ
5	Storage Facility of EVU Mitterteich BY	Storage of waste with negligible heat generation from Bavarian nuclear facilities	40,000 waste containers (200-liter, 400-liter, or cast-iron containers)	Handling licences in accordance with Section 3 StrlSchV (German Radiation Protection Ordinance)[2] from July 07, 1982	In operation since July 1987. Operator: Bavarian Collection Point for Radioactive Materials GmbH (GRB)
6	Storage Facility North (ZLN) Rubenow MV	Storage of operational and decommissioning waste and residual materials from the Greifswald and Rheinsberg nuclear power plants, including storage of dismantled large components; storage of residual materials and waste conditioned for third parties.	165,000 m	Handling licence in accordance with Section 3 StrlSchV[3] dated February 20, 1998	In operation since March 1998. Operator: EWN

[1] Licenses pursuant to Section 7 StrlSchV refer to StrlSchV 2001 and continue to apply pursuant to Section 197 StrlSchG.

[2] In the version dated October 13, 1976, and June 30, 1989.

[3] In the version dated October 13, 1976, and June 30, 1989

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence	Comments
7	Main Department for Decontamination Operations (HDB), now Waste Management Operations (EB) Karlsruhe BW	Storage of non-heat-generating waste from FZK, WAK, ITU, BW state collection point and, to a limited extent or for buffering purposes, also from third parties	Handling (conditioning and interim storage) of radioactive residues and nuclear fuel-containing waste up to a total activity of $4.5 \cdot 10^{17}$ Bq	Handling licence in accordance with Section 9 AtG of November 25, 1983, 36th amendment notice of April 7, 2017, in accordance with Section 7 (1) and (2) StrSchV and Section 2 (1) and (3) AtG in storage building L566	In operation since December 1964. The L563 storage bunker for MAW waste operated by KTE is being expanded to include building L566. MAW waste products and raw waste are to be made available for post-conditioning suitable for final storage, and the waste products conditioned for final storage are to be stored temporarily for the long term. Operator: KTE GmbH

Table IV. 2b: BGZ's own decentralized storage facilities for radioactive waste

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence[1]	Comments
1	Biblis 1 Waste Storage Facility (AZB 1) HE	Storage facility for radioactive waste from the operation and decommissioning of the nuclear power plant	2,100 m^3	Section 7 AtG, Section 7 StrlSchV (2001)	In operation since 1982 Operator: BGZ
2	Biblis 2 Waste Storage Facility (AZB 2) HE	Storage facility for radioactive waste from the operation and decommissioning of the nuclear power plant	5,500 m^3, Activity: max. $2 \cdot 10^{17}$ Bq	Section 7 StrlSchV	In operation since 2018. Operator: BGZ
3	Grafenrheinfeld Waste Storage Facility (AZR) BY	Storage of radioactive waste from the operation and decommissioning of the nuclear power plant	6,000 m^3	Section 7 StrlSchV	In operation since 2021, Operator: BGZ
4	Neckarwestheim Waste Storage Facility (AZN) BW	Storage of radioactive waste from the operation and decommissioning of the nuclear power plant	12,000 m^3, Permissible total activity max. $2 \cdot 10^{17}$ Bq	Approval granted on December 17, 2018, in accordance with Section 7 StrlSchV.	In operation since December 2020. Operator: BGZ
5	Philippsburg Storage Facility (AZP) BW	Storage of radioactive waste from the operation and decommissioning of the nuclear power plant	15,000 m^3, Permissible total activity max. $2 \cdot 10^{17}$ Bq	Approval granted on December 17, 2018, in accordance with Section 7 StrlSchV.	In operation since April 2020. Operator: BGZ
6	Obrigheim Storage Facility (AZO) BW	Storage of radioactive waste from the operation and decommissioning of the nuclear power plant	5,000 m^3, total activity max. $1 \cdot 10^{17}$ Bq	Amendment approval pursuant to Section 12 StrlSchG granted on October 8, 2019, concerning the operating regulations.	In operation since 2008. Operator: BGZ

[1] Licences granted under Section 7 StrlSchV refer to StrlSchV 2001 and continue to apply under Section 197 StrlSchG.

No	Name of facility and location	Purpose of the facility	Capacity as per licence	Licence[1]	Comments
7	Stade Waste Storage Facility (AZS) NI	Storage of radioactive waste from the decommissioning of the nuclear power plant	5,000 m^3, total activity max. $1 \cdot 10^{17}$ Bq	Section 7 StrlSchV, Section 12 StrlSchG	In operation since August 1, 2007. Operator: BGZ
8	Würgassen Waste Storage Facility (AZW) NW	Storage of low- and intermediate-level radioactive waste and residual materials from the operation and decommissioning of the nuclear power plant		Approval in accordance with Section 7 (StrlSchV)	In operation since 2007. Operator: BGZ

Table IV.3: Conditioning facilities for fuel elements

No	Name of facility and location	Purpose of the plant	Capacity as per licence	Permit	Comments
1	Pilot conditioning plant (PKA) Gorleben, NI	Repair of damaged containers, conditioning of radioactive residues and waste (including spent fuel elements, fuel rods, and fuel element components) for interim and final storage	Heavy metal applied for: 35 Mg/a Capacity of operational buffer storage: 12 Mg HM	According to Section 7 AtG: 1st Partial licence dated January 30, 1990 2nd Partial licence dated July 21, 1994 (subsequent obligation dated December 18, 2001) 3rd Partial licence dated December 19, 2000 (contains the operating licence) Modification licence dated August 1, 2017 (change of licence holder)	According to 3rd partial licence, usage of the facility is initially restricted to repairing damaged storage casks. A subsequent obligation under the 2nd partial licence guarantees the readiness to accept a damaged cask at any time. As soon as an alternative concept is available, the operator intends to dismantle the PKA.

Table IV.4: Final storage and decommissioning projects

No.	Name of facility and location	Purpose of the facility	Quantity disposed/activity	Licence	Comments
1	Konrad final repository Salzgitter, NI	Final storage of radioactive waste with negligible heat generation		Application according to Section 9b of the Atomic Energy Act in 1982 (planning approval application) Withdrawal of the application for immediate enforcement in a letter from the BfS dated July, 17, 2000. The planning approval decision was granted on May 22,2022. Once normal appeal procedures against the planning approval decision had been exhausted, it was legally binding from March 27, 2007 and could be implemented. Pending constitutional appeals have not been admitted or accepted for a ruling. On January 15, 2008, the main operating plan was approved by the responsible mining authority.	The geological host formation is coral oolite (iron ore) below an water-impermeable barrier from the Cretaceous period.

No.	Name of facility and location	Purpose of the facility	Quantity disposed/activity	Licence	Comments
2	ASSE II mine Remlingen, NI	Initially: Research and d velopment work for dis posing of radioactive a chemically toxic waste, disposing of low- and intermediate-level radioactive waste <u>Now:</u> Decommissioning after prior retrieval of radioactive waste in accordance with Section 57b of the Atomic Energy Act.	Between 1967 and 1978, approximately 125,000 canisters of low- and intermediate-level radioactive waste were stored	Licences pursuant to Section 3 StrlSchV (old) in the version dated October 15, 1965. Storage licences for nuclear fuels in accordance with Section 6 AtG. Licence according to Section 7 of the Radiation Protection Ordinance issued on July 8, 2010 to handle other radioactive substances outside the storage chambers up to 100 times the exemption limit. Licence according to Section 9 AtG to handle nuclear fuels and other radioactive substances as a part of fact-finding mission stage 1 dated April 21, 2011. Further licences according to Section 7 of the Radiation Protection Ordinance dated September 20, 2011 to handle enclosed and open radioactive substances (radiation protection laboratory).	The geological host formation is rock salt. The BfS became the operator of the Asse II mine on January 1, 2009 replaced by the BGE on April 25, 2017. Since the *LEX Asse* came into force in April 2013 (Section 57b AtG.), the radioactive waste is to be retrieved prior the prompt decommissioning, if this is technical feasible from a safety point of view.

No.	Name of facility and location	Purpose of the facility	Quantity disposed/activity	Licence	Comments
3	Morsleben disposal site for radioactive waste (ERAM) ST	Initially: to dispose of low- and intermediate-level radioactive waste, most of which has short-lived radionuclides Now: Decommissioning with waste underground	Disposal of approx. 36,752 m^3 low- and intermediate-level radioactive waste	April 22, 1986: Granting of the permanent operating licence. This was valid until June 30, 2005, according to Section 57a of the Atomic Energy Act; when the act was amended in 2002, the permanent licence continued without any restrictions with the exception of the regulations for accommodating further radioactive waste or storing it for the purpose of disposal as planning approval decision. BfS declaration to forego accepting any further radioactive disposal on April 12, 2001.	The geology of the disposal areas largely consists of potash and rock salt formations. Putting items into storage was halted on September 25, 1998. An application to convert and keep open the facility was made on July 10, 2014. Decommissioning was applied for on May 9, 1997. Following a public hearing in October 2012, BGE is currently performing extensive work to supplement the planning approval documents in line with the recommendations of the German Nuclear Waste Management Commission dated March 31, 2013 and the demands of the experts of the current Ministry of Science, Energy, Climate Protection and the Environment of Saxony-Anhalt.

Legend:

PKA	Pilot conditioning plant
VEK	Karlsruhe Vitrification Facility
ZL	Interim storage facility for high-level radioactive waste
EL	Radioacitive waste repository
EP	Repository project
■	In operation/under construction
□	Under decommissioning/decommissioning applied for

As of 31 December 2024

1) As soon as an altervative concept is available, the operator intends to dismantle the PKA.

Figure IV.1: Nuclear waste disposal facilities