Operating results 2020

In 2020 the six (6) German nuclear power plants generated 75.10 billion kilowatt hours (kWh) of electricity gross. No plant ceased operation in 2020. At the end of 2019 the Philippsburg 2 nuclear power plant ceased commercial operation due to the revision of the German Atomic Energy Act in the political aftermath of the accidents in Fukushima, Japan, in 2011. Six nuclear power plants with an electric gross output of 8,545 MWe were in operation during the year 2020.

Three nuclear power plants in operation in 2020 achieved results with a gross production greater than 11 billion kilowatt hours, two power plants produced more than 10 billion kilowatt hours.

Additionally the Isar 2 unit achieved one of the world's ten best production results in 2020 ("Top Ten", sixth place). At the end of 2020, 442 reactor units were in operation in 33 countries worldwide and 54 were under construction in 16 countries. The share of nuclear power in world electricity production was around 11 %. German nuclear power plants have been occupying top spots in electricity production for decades thus providing an impressive demonstration of their efficiency, availability and reliability.

The Taishan-2 nuclear power plant in China (capacity: 1,750 MWe gross, 1,660 MWe net, reactor type: EPR, the most powerful nuclear power plant worldwide and the most powerful single power plant worldwide) achieved the world record in electricity production in 2020 with appr. 13.1 billion kilowatt hours.

Worldwide, 43 nuclear power plant units achieved production results of more than 10 billion kilowatt hours net in the year 2020.

Additionally German nuclear power plants are leading with their lifetime electricity production. The Brokdorf, Emsland, Grohnde, Gundremmingen C, Isar 2, Neckarwestheim II and Philipsburg 2 nuclear power plant have produced more than 350 billion kilowatt hours since their first criticality.

Operating results of nuclear power plants in Germany 2019 and 2020
* At the end of 2019 the Philippsburg 2 nuclear power plant ceased commercial operation due to the revision of the German Atomic Energy Act

Nuclear power plant	Rated power in 2020		Gross electricity generation in MWh		Availability factor* in %		Energy availability factor** in %	
	gross in MWe	net in MWe	2019	2020	2019	2020	2019	2020
Brokdorf KBR	1,480	1,410	10,153,213	10,552,306	87.69	90.72	82.34	80.86
Emsland KKE	1,406	1,335	10,781,232	11,410,500	89.20	93.84	89.12	93.76
Grohnde KWG	1,430	1,360	10,700,632	10,485,503	90.06	94.80	89.82	94.50
Gundremmingen KRB C	1,344	1,288	10,381,798	9,154,214	89.15	79.40	88.54	77.70
Isar KKI 2	1,485	1,410	12,036,656	11,666,574	95.95	93.16	95.68	92.99
Neckarwestheim GKN II	1,400	1,310	10,411,410	11,113,300	94.03	92.68	87.18	92.62
Philippsburg KKP 2*	*(1,468)*	*(1,402)*	10,606,307	–	89.63	–	89.31	–
Total (in 2019 and 2020)	8,545	8,113	75,071,247	64,382,397	90.82	90.61	88.86	88.63

* Availability factor (time availability factor) kt = tN/tV: The time availability factor kt is the quotient of available time of a plant (tV) and the reference period (tN). The time availability factor is a degree for the deployability of a power plant.

** Energy availability factor kW = WV/WN: The energy availability factor kW is the quotient of available energy of a plant (WV) and the nominal energy (WN). The nominal energy WN is the product of nominal capacity and reference period. This variable is used as a reference variable (100 % value) for availability considerations. The available energy WV is the energy which can be generated in the reference period due to the technical and operational condition of the plant. Energy availability factors in excess of 100 % are thus impossible, as opposed to energy utilisation.

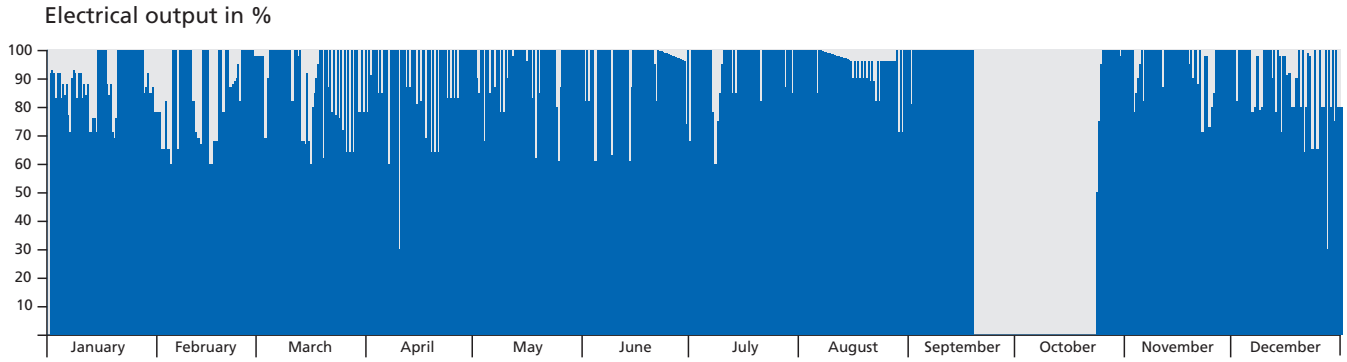
*** Inclusive of round up/down, rated power in 2020.

**** The Philippsburg KKP 2 nuclear power plant was permanently shutdown on 31 December 2019 due to the revision of the German Atomic Energy Act in 2011.

All data in this report as of 31 March 2021

Brokdorf

Operating sequence in 2020



The Brokdorf nuclear power plant (KBR) was online for a total of 7,969 operating hours in 2020 with a working availability of 86.3 %. Gross generation for the year under review was 10,552 GWh.

Until the 2020 plant revision, the thermal reactor power was limited to a maximum of 95 % with a 3 K reduction in coolant temperature due to the provisions of ME 02/2017 "Increased oxide layer thickness on fuel rod cladding tubes of fuel assemblies".

On 5 April 2020, a control valve malfunction occurred on the oil cooler of the main coolant pump YD30 D001 from the steady-state partial load condition, at approx. 915 MW. Due to increased bearing temperatures, the main coolant pump was switched off manually. The system stabilised in 3-pump operation.

On 29 December 2020, the main coolant pump YD20 D001 was switched off from the steady-state full-load condition due to the failure of an oil level sensor on the electric motor. The electrical power was reduced to approx. 570 MW via the reactor and generator power limitations. The plant stabilised in 3-pump operation.

Planned shutdowns

On 19 September 2020, the plant was shut down for the 32nd refuelling and plant revision:
The revision included the following priorities:

- Reactor — Full core discharge; Load of 72 fresh fuel assemblies; Inspection of fuel assemblies, control elements, throttle bodies.
- Main coolant pump — Mechanical seal replacement YD20, Special inspection of support pins MCP.
- Main steam safety and relief sation — Internal inspections.
- Coolant — Work in the pump antechambers of the VE10/20 and 30/40 auxiliary cooling water systems. Work in the main cooling water ducts VA10-30 Repair of the baffle ZN.5.
- Turbine/Generator — Standard service. Repair generator stator.
- Accident instrumentation — Replacement of four YA/TL measuring transducers
- Transformers — Exchange, CS41, CS32, CT11, CS11 and CS31

Grid synchronisation took place on 23 October 2020 at 04:55 after 34 revision days. Compared to the planning, the start-up date was delayed by 11.4 days. The delay was caused by additional unplanned work due to findings on the generator.
In the 33rd operating cycle, Westinghouse fuel assemblies (WSE-BE) are mainly used. Fuel elements with M5 cladding tubes are no longer in use. This means that the maximum permissible reactor power of 3,900 MW_{th} can be used again. The core of the 33rd operating cycle is designed for a natural cycle length of 405 full-load days and a subsequent stretch operation of 15 full-load days.

Unplanned shutdowns and reactor/turbine trip

None.

Power reductions above 10 % and longer than for 24 h

In the period from 11 to 14 June 2020, the fine screens in the VA40/50/60 N002 cooling water purification plant failed due to overload. The cause was increased sediment accumulation in front of the screens, which was due to sedimentation and smoothing work in the Elbe. The output was reduced to 810 MW.
Load reductions were carried out to implement the grid-supporting power control as well as redispatch as specified by the operations control centre.

Delivery of fuel elements

During the reporting year 64 fuel elements were delivered.

Waste management status

By the end of the year 2020 35 loaded CASTOR© cask were located at the on-site intermediate storage Brokdorf.

Operating data

Review period 2020

Plant operator: PreussenElektra GmbH
Shareholder/Owner: PreussenElektra GmbH (80 %),
Vattenfall Europe Nuclear Energy GmbH (20 %)
Plant name: Kernkraftwerk Brokdorf (KBR)
Address: PreussenElektra GmbH, Kernkraftwerk Brokdorf,
25576 Brokdorf, Germany
Phone: 04829 752560, Telefax: 04829 511
Web: www.preussenelektra.de

First synchronisation:	10-14-1986
Date of commercial operation:	12-22-1986
Design electrical rating (gross):	1,480 MW
Design electrical rating (net):	1,410 MW
Reactor type:	PWR
Supplier:	Siemens/KWU

The following operating results were achieved:

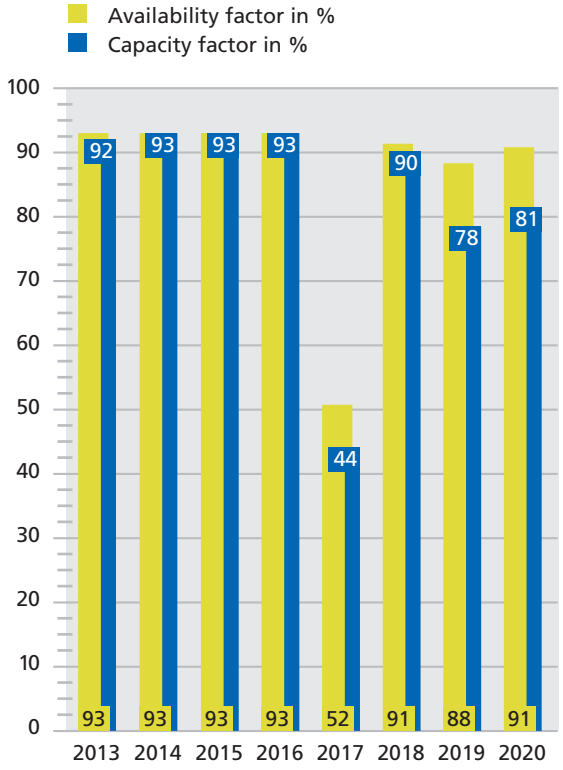
Operating period, reactor:	7,969 h
Gross electrical energy generated in 2020:	10,552,306 MWh
Net electrical energy generated in 2020:	10,015,110 MWh
Gross electrical energy generated since first synchronisation until 12-31-2020:	371,273,327 MWh
Net electrical energy generated since first synchronisation until 12-31-2020:	352,900,075 MWh
Availability factor in 2020:	90.72 %
Availability factor since date of commercial operation:	89.80 %
Capacity factor 2020:	80.86 %
Capacity factor since date of commercial operation:	85.78 %
Downtime (schedule and forced) in 2020:	9.28 %
Number of reactor scrams 2020:	0

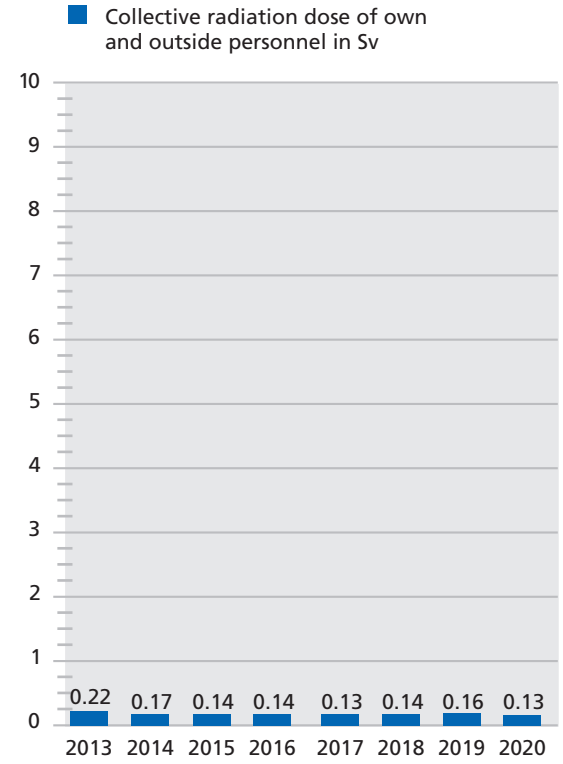
Licensed annual emission limits in 2020:

Emission of noble gases with plant exhaust air:	$1.0 \cdot 10^{15}$ Bq
Emission of iodine-131 with plant exhaust air:	$6.0 \cdot 10^{9}$ Bq
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	$5.55 \cdot 10^{10}$ Bq

Proportion of licensed annual emission limits for radioactive materials in 2020 for:

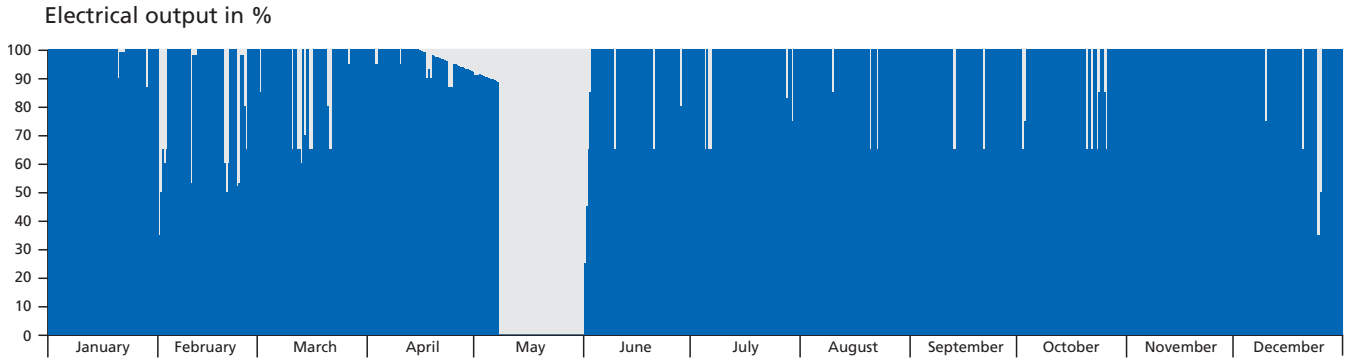
Emission of noble gases with plant exhaust air:	0.131 %
Emission of iodine-131 with plant exhaust air:	0.006 %
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	0.0000 %
Collective dose:	0.130 Sv





Emsland

Operating sequence in 2020



Apart from the 22,5 days refueling outage the Emsland nuclear power plant had been operating uninterrupted and mainly at full load during the review period 2020. Producing a gross power generation of 11,410,500 MWh with a capacity factor of 93.76 % the power plant achieved a very good operating result.

Planned shutdowns

33rd Refueling and 32rd overall maintenance outage:
The annual outage was scheduled for the period 8 to 31 May 2020. The outage took 22.5 days from breaker to breaker. In addition to the replacement of 44 fuel elements the following major maintenance and inspection activities were carried out:

- Inspection of core and reactor pressure vessel internals
- Inspection of pressurizer valves
- Ultrasonic testing of the reactor pressure vessel
- Eddy current test on steam generator tubes
- Pressure test on different coolers and tanks
- Inspection on main condensate pump
- Maintenance works on different transformers
- Different automatic nondestructive examinations

Unplanned shutdowns and reactor/turbine trip

Turbine scram due to increased turbine vibrations after the end of the outage.

Power reductions above 10 % and longer than for 24 h

22 April to 8 May: Stretch-out operation.

Delivery of fuel elements

64 Uranium-fuel elements were delivered.

Waste management status

No CASTOR© cask loading was carried out during the review period 2020.
At the end of the year 47 loaded casks were stored in the local interim storage facility, operated by BGZ.

General points

In the year 2020, the surveillance audit of the quality management system (ISO 9001) and the recertification of the environmental management system (ISO 14001) were successfully carried out.

Operating data

Review period 2020

Plant operator: Kernkraftwerke Lippe-Ems GmbH
Shareholder/Owner: RWE Power AG (87,5 %), PreussenElektra GmbH (12,5 %)
Plant name: Kernkraftwerk Emsland (KKE)
Address: Kernkraftwerk Emsland,
Am Hilgenberg , 49811 Lingen, Germany
Phone: 0591 806-1612
Web: www.rwe.com

First synchronisation:	04-19-1988
Date of commercial operation:	06-20-1988
Design electrical rating (gross):	1,406 MW
Design electrical rating (net):	1,335 MW
Reactor type:	PWR
Supplier:	Siemens/KWU

The following operating results were achieved:

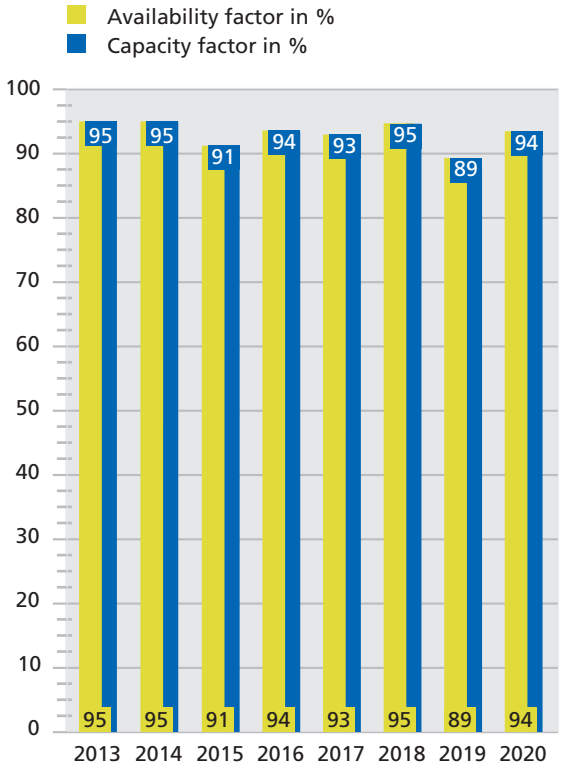
Operating period, reactor:	8,250 h
Gross electrical energy generated in 2020:	11,410,500 MWh
Net electrical energy generated in 2020:	10,836,453 MWh
Gross electrical energy generated since first synchronisation until 12-31-2020:	369,010,701 MWh
Net electrical energy generated since first synchronisation until 12-31-2020:	349,903,450 MWh
Availability factor in 2020:	93.84 %
Availability factor since date of commercial operation:	93.91 %
Capacity factor 2020:	93.76 %
Capacity factor since date of commercial operation:	93.77 %
Downtime (schedule and forced) in 2020:	6.16 %
Number of reactor scrams 2020:	0

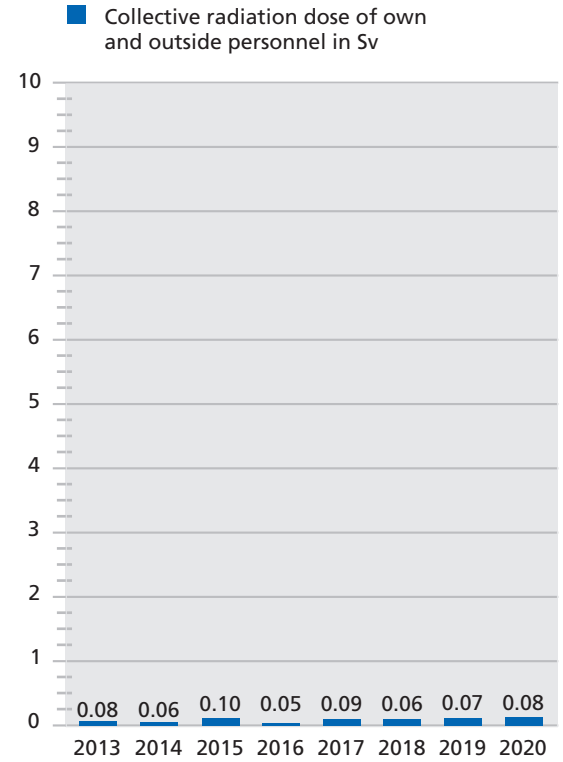
Licensed annual emission limits in 2020:

Emission of noble gases with plant exhaust air:	1.0 · 10^{15} Bq
Emission of iodine-131 with plant exhaust air: (incl. H-3 and C-14)	5.0 · 10^{9} Bq
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	3.7 · 10^{10} Bq

Proportion of licensed annual emission limits for radioactive materials in 2020 for:

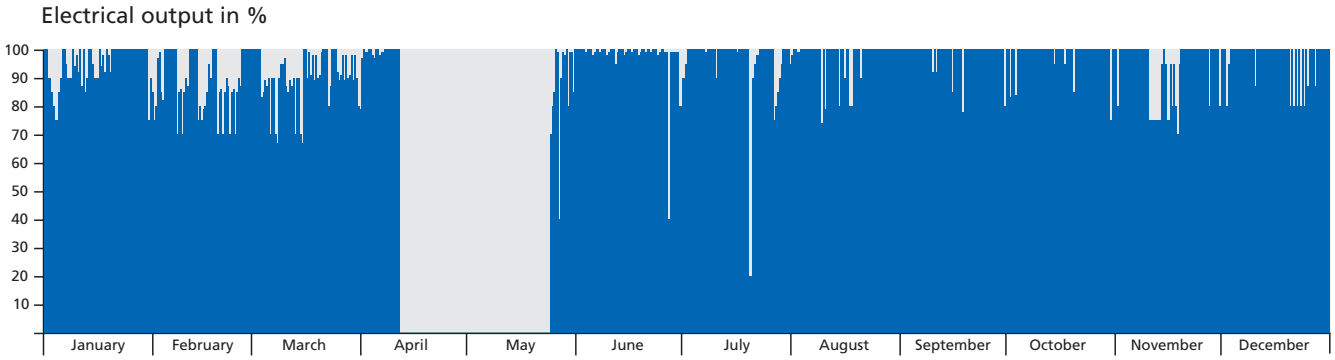
Emission of noble gases with plant exhaust air:	0.09 %
Emission of iodine-131 with plant exhaust air: (incl. H-3 and C-14)	0.0 %
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	0.00 %
Collective dose:	0.075 Sv





Grohnde

Operating sequence in 2020



The Grohnde nuclear power plant was off the grid for a 42-day overhaul with refuelling in the 2020 reporting year and achieved a time availability of 94.8 %. Gross generation amounted to 10,485,502.7 MWh.

Due to concerns about infection control because of the Corona pandemic, the overhaul had initially been prohibited in its original planning by the Lower Saxony Ministry for Social Affairs, Health and Equality and the Lower Saxony Ministry for the Environment, Energy, Construction and Climate Protection. Therefore, the revision had to be rescheduled at short notice and stretched over a significantly longer period of time, so that the revision lasted a total of 42 days instead of the originally planned 19 days.

According to the specifications of the load dispatcher, 14 load reductions took place in 2020 for a total of 179 hours, as well as 150 grid and 95 primary controls for a total of 4,684 hours.

Planned shutdowns

12 April to 24 May 2020: 37th Refuelling and major annual revision:
Nuclear power plant Grohnde was shut down as scheduled.
The main planned works during this year's revision were:

- Unloading and loading with the replacement of 32 fresh fuel elements.
- Full inspection of 19 fuel elements.
- Eddy current test of 32 control elements.
- Visual inspection of 15 flow restrictor assemblies.
- Start-up inspection of the BE centring pins of the UKG and OKG
- Main coolant pump YD10 D001 Motor exchange for reserve motor
- Auxiliary borating pump TW20 D001 Pump inspection
- Three-way valve TH14 S001 Replacement of the threaded bushing of the three-way valve
- VL83 + VL93 Exchange/modification of Taprogge screens
- Work and tests in the redundancies with the focus on the activities in the main redundancy 3/7 (maintenance work on valves and actuators as well as tests on containers, batteries and electrotechnical branches).

Unplanned shutdowns and reactor/turbine trip

None.

Power reductions above 10 % and longer than for 24 h

In the months of January, February, March, November and December, load-following operation due to requirements of the load of the load dispatcher.

Delivery of fuel elements

In February 2020 28 U-/U-Gd-fuel elements were delivered.

Waste management status

Between September and November 2020, a total of three CASTOR©-V/19 containers were dispatched to the ZL-KWG.

General points/management systems

In September 2020, the monitoring audit of the quality management system (ISO 9001) and the recertification of the environmental management system (ISO 14001) and the occupational health and safety management system (OHSAS 18001) were successfully carried out.

Operating data

Review period 2020

Plant operator: Gemeinschaftskernkraftwerk Grohnde GmbH & Co. OHG
Shareholder/Owner: PreussenElektra GmbH (83,3 %),
Stadtwerke Bielefeld (16,7 %)
Plant name: Kernkraftwerk Grohnde (KWG)
Address: Gemeinschaftskernkraftwerk Grohnde GmbH & Co. OHG,
P.O. bx 12 30, 31857 Emmerthal, Germany
Phone: 05155 67-1
E-mail: kwg-kraftwerksleitung@preussenelektra.de
Web: www.preussenelektra.de

First synchronisation:	09-05-1984
Date of commercial operation:	02-01-1985
Design electrical rating (gross):	1,430 MW
Design electrical rating (net):	1,360 MW
Reactor type:	PWR
Supplier:	Siemens/KWU

The following operating results were achieved:

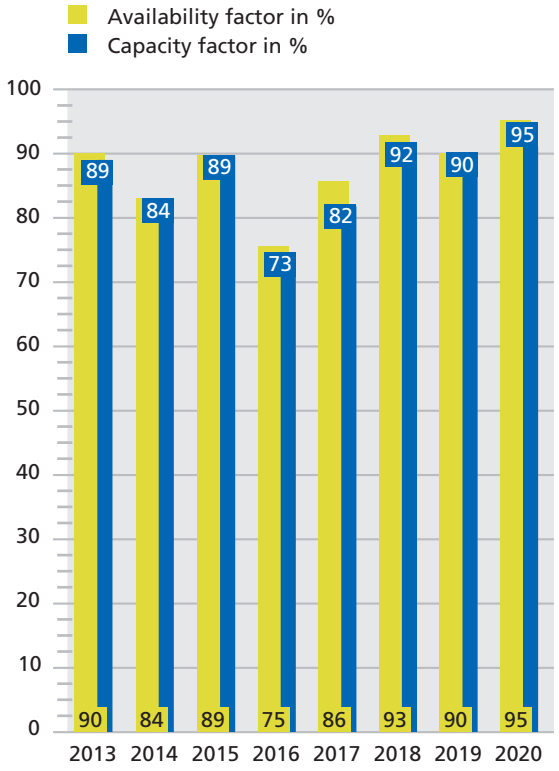
Operating period, reactor:	7,774 h
Gross electrical energy generated in 2020:	10,485,503 MWh
Net electrical energy generated in 2020:	9,909,597 MWh
Gross electrical energy generated since first synchronisation until 12-31-2020:	398,760,338 MWh
Net electrical energy generated since first synchronisation until 12-31-2020:	376,992,203 MWh
Availability factor in 2020:	94.80 %
Availability factor since date of commercial operation:	91.80 %
Capacity factor 2020:	94.50 %
Capacity factor since date of commercial operation:	91.40 %
Downtime (schedule and forced) in 2020:	11.50 %
Number of reactor scrams 2020:	0

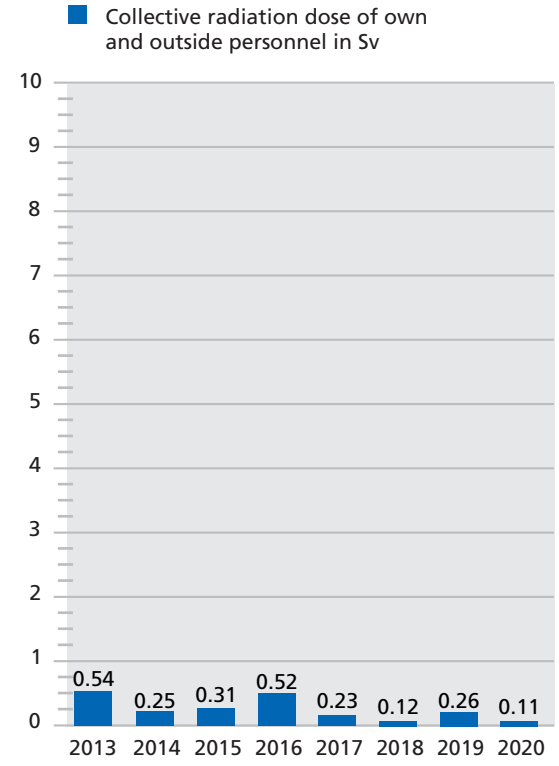
Licensed annual emission limits in 2020:

Emission of noble gases with plant exhaust air:	$9.0 \cdot 10^{14}$ Bq
Emission of iodine-131 with plant exhaust air:	$7.5 \cdot 10^{9}$ Bq
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	$5.55 \cdot 10^{10}$ Bq

Proportion of licensed annual emission limits for radioactive materials in 2020 for:

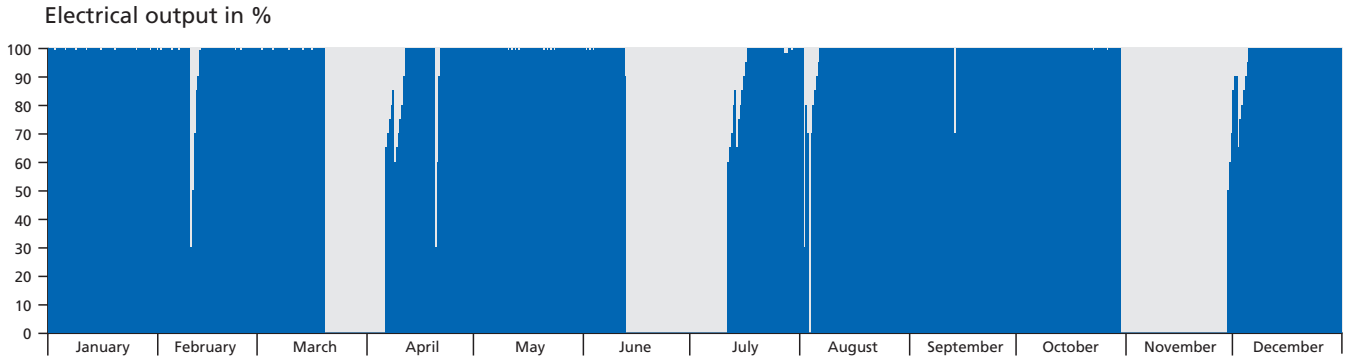
Emission of noble gases with plant exhaust air:	0.017 %
Emission of iodine-131 with plant exhaust air:	0.000 %
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	0.000 %
Collective dose:	0.108 Sv





Gundremmingen C

Operating sequence in 2020



In the review year 2020, unit C of Gundremmingen nuclear power plant was operated at full load except for two outages for refuelling and one special shutdown to replace a defective fuel element.

In March/April the plant was providently taken off the grid due to one defective fuel element. The changing of 25 fuel elements based on a plan that was checked and released by the controlling authority.

During the 34th refueling outage in June/July a total of 159 fuel elements were unloaded and replaced with 100 fresh and 59 (4 MOX) partially spent fuel elements.

The 35th refueling outage with the 22nd overall maintenance inspection, planned for the year 2021, was due to one defective fuel element providently brought forward in autumn 2020. On the occasion a total of 101 fuel elements were unloaded and replaced with 36 fresh and 65 partially spent fuel elements.

During the outages all safety relevant workings were monitored by the relevant nuclear controlling authority, the Bavarian State Ministry of the Environment and Consumer Protection (StMUV), and consulted authorized experts. The inspection of the technical systems with regard to safety and reliability confirmed the excellent condition of the plant.

On December 17, the plant achieved 350 billion kWh of gross generation since the initial startup in the year 1984.

A gross total of 9,154,214 MWh of electricity was produced in 2020.

Planned shutdowns

13 June to 11 July 2020: 34th refuelling outage (28.2 d).
The following major activities were carried out:

- Refuelling and sipping of all fuel elements inside the core; result: no defective fuel element
- Exchange of filter cartridge in reactor water cleanup system
- Preventive measures on valves of emergency cooling and residual heat removal system
- Precautionary replacement of 10 kV power cables
- Eight annual inspection of emergency power bus bars in redundancy 3
- Maintenance work on pilot valves and lines of safety and relief valves
- Maintenance work on systems of feed water, condensate and auxiliary steam

30 October to 29 November 2020: 35th refuelling outage and 22nd overall maintenance inspection (30.1 d)
The following major activities were carried out:

- Refuelling and sipping of all fuel elements inside the core; result: one defective fuel element
- Maintenance work in all redundancies
- Exchange of pumps of reactor water cleanup system
- Maintenance work on main steam and safety and relief valves system
- Maintenance work on main transformers
- Exchange of one auxiliary transformer
- Maintenance work on standby grid bus bars and transformers

Unplanned shutdowns and reactor/turbine trip

20 March – 6 April 2020: special shutdown due to one defective fuel element (16.8 d)
3 August 2020: Turbine trip due to troubleshooting at turbine protection system (1.6 h)

Power reductions above 10 % and longer than for 24 h

9 – 11 February 2020: Period tests and maintenance work (50 h)
16 – 18 April 2020: Maintenance work (46.1 h)
2 – 3 August 2020: Maintenance work (31.8 h)

Peer Reviews

Between 17 and 21 February, a WANO Peer Review Follow Up took place at Gundremmingen NPP. The following focus areas were focused: Nuclear Organisation Stucture and Traits, Human Performance, Operational Priorities, Chemistry Fundamentals, Engineering Fundamentals, Radiological Safety.

Delivery of fuel elements

In 2020, no fresh fuel elements were delivered.

Waste management status

In 2020, a total of 11 CASTOR© casks were loaded. Thus, at the end of 2020, 80 CASTOR© casks with each 52 spent fuel elements out of units B and C are stored in the local interim storage.

General points

In October 2020, a surveillance audit to confirm certification of the environmental management system (ISO 14001) and energy management system (ISO 50001) was successfully carried out.

Operating data

Review period 2020

Plant operator: Kernkraftwerk Gundremmingen GmbH
Shareholder/Owner: RWE Power AG (75 %),
PreussenElektra GmbH (25 %)
Plant name: Kernkraftwerk Gundremmingen C (KRB C)
Address: Kernkraftwerk Gundremmingen GmbH,
Dr.-August-Weckesser-Straße 1, 89355 Gundremmingen, Germany
Phone: 08224 78-1, Telefax: 08224 78-2900
E-mail: kontakt@kkw-gundremmingen.de
Web: www.kkw-gundremmingen.de

First synchronisation:	11-02-1984
Date of commercial operation:	01-18-1985
Design electrical rating (gross):	1,344 MW
Design electrical rating (net):	1,288 MW
Reactor type:	BWR
Supplier:	Siemens/KWU, Hochtief

The following operating results were achieved:

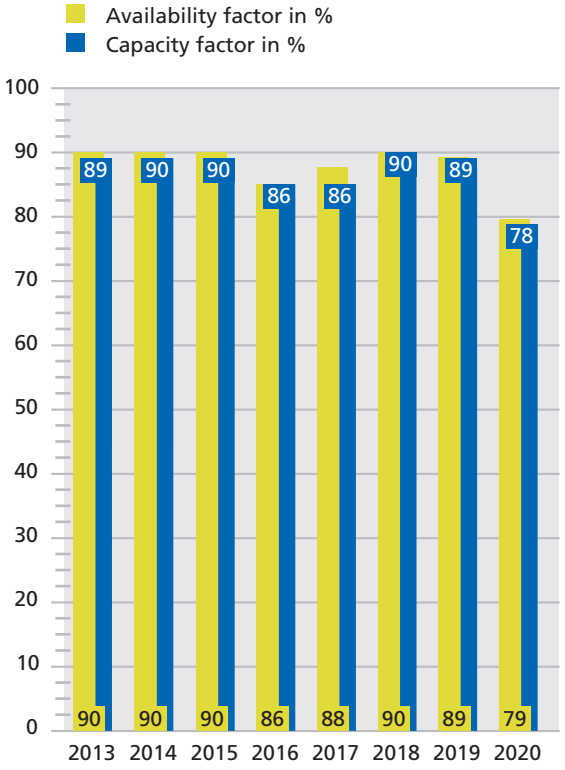
Operating period, reactor:	6,973 h	
Gross electrical energy generated in 2020:	9,154,214	MWh
Net electrical energy generated in 2020:	8,710,127	MWh
Gross electrical energy generated since first synchronisation until 12-31-2020:	350,477,766	MWh
Net electrical energy generated since first synchronisation until 12-31-2020:	333,792,429	MWh
Availability factor in 2020:	79.40 %	
Availability factor since date of commercial operation:	89.90 %	
Capacity factor 2020:	77.70 %	
Capacity factor since date of commercial operation:	87.30 %	
Downtime (schedule and forced) in 2020:	20.60 %	
Number of reactor scrams 2020:	0	

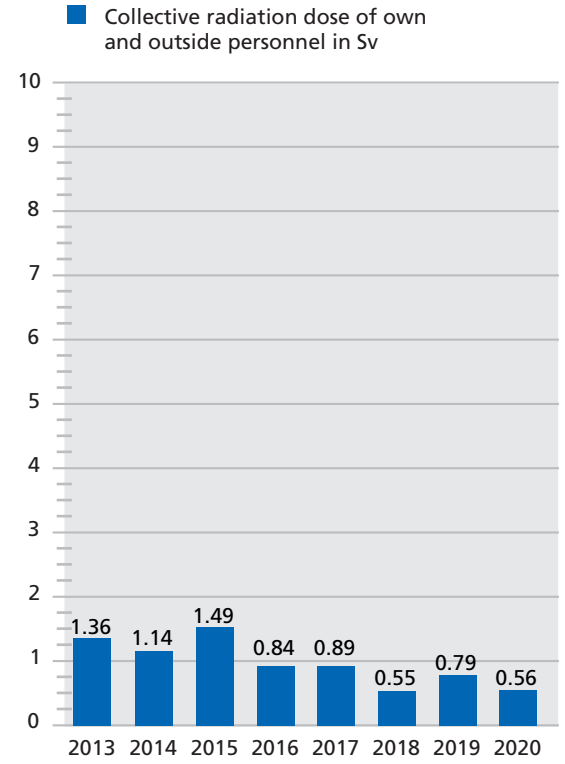
Licensed annual emission limits in 2020 (values added up for Units B and C, site emission):

Emission of noble gases with plant exhaust air:	$1.85 \cdot 10^{15}$ Bq
Emission of iodine-131 with plant exhaust air:	$2.20 \cdot 10^{10}$ Bq
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	$1.10 \cdot 10^{11}$ Bq

Proportion of licensed annual emission limits for radioactive materials in 2020 for (values added up for Units B and C):

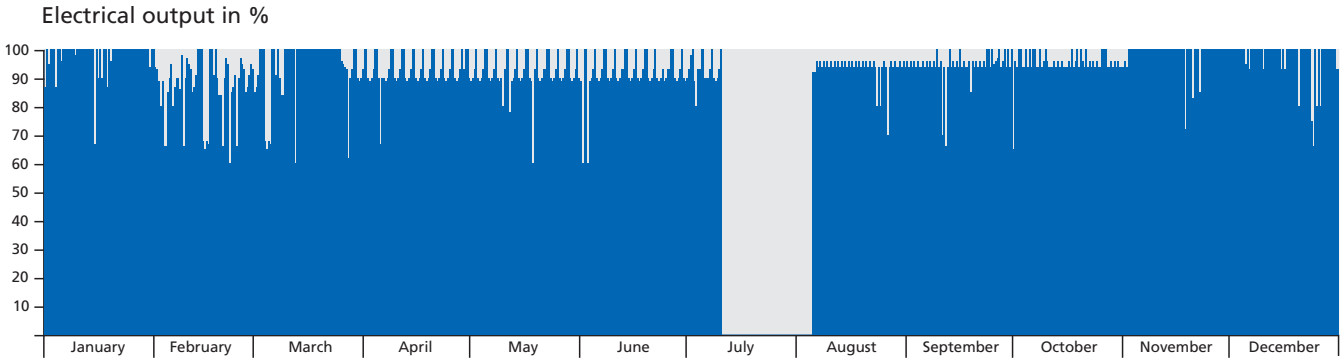
Emission of noble gases with plant exhaust air:	0.35 %
Emission of iodine-131 with plant exhaust air:	0.57 %
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	0.09 %
Collective dose:	0.56 Sv





Isar 2

Operating sequence in 2020



With a gross electricity generation of 11.667 TWh and a work capacity factor of 92.99 %, unit Isar 2 achieved an excellent operating result in 2020. Due to the increased load-following and control operation, the unit also made an important contribution to grid stability, which, however, reduced the net work that could be generated by 476.574 GWh, corresponding to 14.08 full-load days. The highest generator capacity was reached on 22 January 2020 and amounted to 1,509 MW.

Planned shutdowns

The refuelling with plant revision took place from 11 July 2020 to 5 August 2020 with a duration of 25.0 days. During the revision, 56 new fuel assemblies were used.

Unplanned shutdowns and reactor/turbine trip

None.

Power reductions above 10 % and longer than for 24 h

None.

Safety Reviews

28 - 29 January 2020: Process review waste disposal
12 - 14 February 2020: WANO Pre-Visit. Management review KKI.
31 March and 2 April 2020
15 April 2020: 1st operational review
4 and 19 May 2020: Internal audit at KKI
"Transport and storage of new fuel elements"
18 May 2020 to 16 October 2020: Surveillance audit by DNV GL, Business Assurance Zertifizierung und Umweltgutachter GmbH according to ISO 9001/14001 and EMAS, additionally transition audit for the conversion from BS OHSAS 18001 to the new standard ISO 45001. Due to the Corona pandemic, this audit was carried out in several stages.
18 - 19 May 2020: Inspection in accordance with §16 of the Major Accidents Ordinance – fire protection and immission control
30 June - 2 July 2020: Internal audit "Procurement" at KKI
20 May – 2 July 2020, 27 July – 5 August 2020
and 18 – 25 September 2020: Management system audit – P
art 2 at KKI, accompanying Legal Compliance Audit (EMAS)
5 November 2020: 2nd company review
10 – 12 November 2020: E.ON Corporate Audit

WANO Review/Technical Support Mission

A WANO pre-visit took place at the KKI 2 plant from 12 to 14 February 2020.

Delivery of fuel elements

In the reporting year 48 uranium fuel elements from Westinghouse were delivered. 8 uranium fuel elements are in stock at the dry storage.

Waste management status

In 2020, 45 uranium fuel elements and 18 MOX fuel elements were stored in the on-site interim storage facility, operated by BGZ.
Of the storage and transport casks stored in the on-site interim storage facility, the KKI-2 has received 26 CASTOR®V/19 and 10 TN24E can be assigned to the KKI-2.
In addition, a cross transport of fuel rods from KKI-1 into the fuel pool KKI-2 took place in October 2020. A special cask of the type NCS45 was used for this purpose.

General points

In the year under review, the plant was mainly used in secondary control operation and occasionally in primary control operation. There were only two technical malfunctions that led to minor performance restrictions:
On 3 September 2020, the provision of system services (primary and secondary control) was not possible for a short time due to the failure of an AKS 11 assembly in the coolant mass, pressure and temperature gradient limitation.
During the performance of the recurring test "turbine test automation", an unscheduled extension of the planned partial load phase occurred on 29 October 2020 due to a defective limit switch of a turbine control valve.
The deviation from the theoretically maximum possible net nominal energy in the reporting year – based on the net nominal energy – amounted to 10.86 % in the reporting year. The revision accounted for approx. 6.84 %, power reductions at the request of the load dispatcher contributed 3.85 %.
Repairs, malfunctions and operational power reductions, such as the start-up and shut-down process for the revision, only accounted for 0.17 % of this.

Operating data

Review period 2020

Plant operator: PreussenElektra GmbH
Shareholder/Owner: PreussenElektra GmbH (75 %), Stadtwerke München GmbH (25 %)
Plant name: Kernkraftwerk Isar 2 (KKI 2)
Address: PreussenElektra GmbH, Kernkraftwerk Isar, Postfach 11 26, 84049 Essenbach, Germany
Phone: 08702 38-2465, Telefax: 08702 38-2466
Web: www.preussenelektra.de

First synchronisation:	01-22-1988
Date of commercial operation:	04-09-1988
Design electrical rating (gross):	1,485 MW
Design electrical rating (net):	1,410 MW
Reactor type:	PWR
Supplier:	Siemens/KWU

The following operating results were achieved:

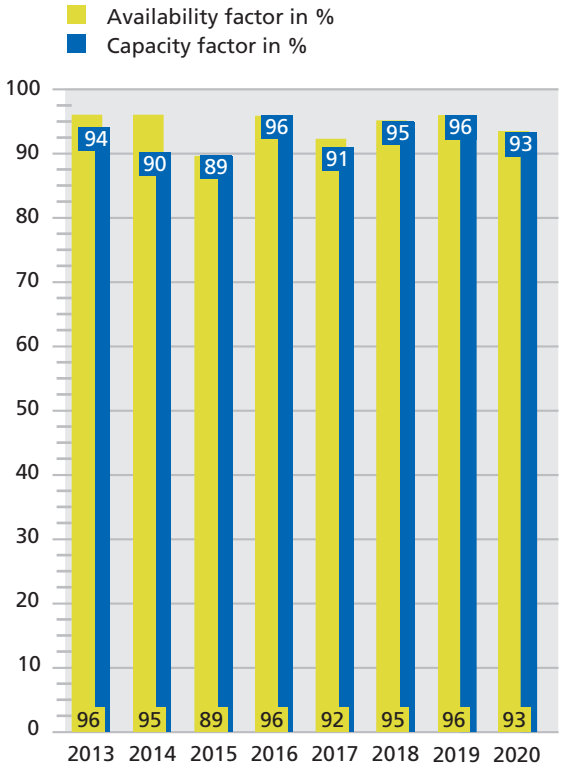
Operating period, reactor:	8,183 h
Gross electrical energy generated in 2020:	11,666,574 MWh
Net electrical energy generated in 2020:	11,019,155 MWh
Gross electrical energy generated since first synchronisation until 12-31-2020:	377,429,043 MWh
Net electrical energy generated since first synchronisation until 12-31-2020:	356,371,249 MWh
Availability factor in 2020:	93.16 %
Availability factor since date of commercial operation:	93.36 %
Capacity factor 2020:	92.99 %
Capacity factor since date of commercial operation:	92.50 %
Downtime (schedule and forced) in 2020:	6.84 %
Number of reactor scrams 2020:	0

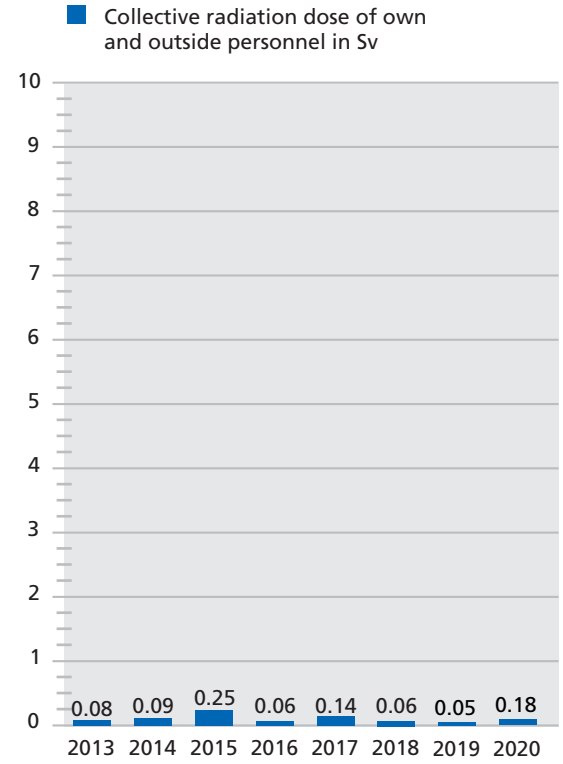
Licensed annual emission limits in 2020:

Emission of noble gases with plant exhaust air:	1.1 · 10^{15} Bq
Emission of iodine-131 with plant exhaust air:	1.1 · 10^{10} Bq
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	5.5 · 10^{10} Bq

Proportion of licensed annual emission limits for radioactive materials in 2020 for:

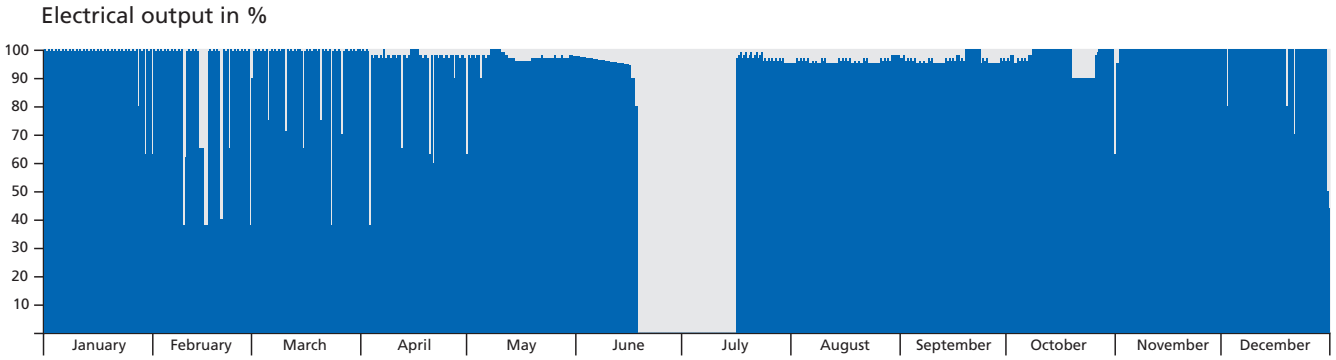
Emission of noble gases with plant exhaust air:	0.100 %
Emission of iodine-131 with plant exhaust air:	< limit of detection
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	< limit of detection
Collective dose:	0.179 Sv





Neckarwestheim II

Operating sequence in 2020



During the reporting year 2020 the Neckarwestheim II nuclear power plant (GKN II) generated gross energy of 11,113,300 MWh. The net electrical generation was 10,415,986 MWh, of which 10,113,715 MWh went into the public three-phase grid and 999,585 MWh to the static converter plant of Deutsche Bahn AG. The plant was on the grid for 8,140.8 hours. This results in a time utilisation of 92.68 %.
Since the commissioning of the three-phase-machine machine, 351,354,884 MWh gross and 328,590,462 MWh net have been generated.

Planned shutdowns

19 June to 16 July: 37rd fuel reloading and annual major inspection:

- Refuelling with exchange of 44 new fuel elements.
- Eddy current tests of the heating tubes of all 4 steam generators.
- Partial general overhaul of the feedwater pump LAC10
- Partial overhaul of main condensate pump LCB20
- Major overhaul of generator circuit breaker BAC01
- Partial general overhaul of reserve power transformer BCT01
- Major overhaul of main valves at FSA stations 20/30
- Major overhaul of the purge air GBA KLA30/40
- Inspection work on the high-pressure preheaters LAD61/62

Unplanned shutdowns and reactor/turbine trip

None.

Power reductions above 10 % and longer than for 24 h

26 May to 19 June 2020: Stretch-out operation.
January to May 2020: Load sequence operation.

Integrated management system (IMS) EnKK (NPP P, GKN, KWO)

The integrated management system (IMS) of the EnBW Kernkraft GmbH (EnKK) with its partial system for

- nuclear safety (SMS),
- quality management (QMS/QSÜ)
- Occupational Safety Management (AMS) as well as
- environmental and energy management (UMS, EnMS, Umwelt- und Energiemanagementsystem)

were also in 2020 continuously further developed. Scope and content of each process descriptions were gradually adapted to the different internal requirements and related approval criteria. The completeness and effectiveness (conformity) of the process-oriented IMS, including the quality management measures (QM), were confirmed by corresponding internal and external audits as well as by an inspection by the assessor (ESN) and the supervisory authority over several days at the GKN and KKP sites.
EnKK's energy management system was converted to the 50001: 2018 standard and successfully certified from 5 – 7 May 2020.
The IMS was adapted to the site-specific requirements in operation/residual operation in accordance with KTA1402. Dismantling-specific adaptations (project handling, disposal) have been made and are still being developed.

Waste management status

In 2020, 3 CASTOR© V/19 casks were loaded with 36 GKN I and 3 GKN II fuel assemblies and transported to the Neckarwestheim interim fuel storage facility (BZN). At the end of 2020, there were 749 GKN II fuel assemblies (dry storage, wet storage and reactor) and 13 GKN I fuel assemblies (wet storage) in the GKN II plant.

Operating data

Review period 2020

Plant operator: EnBW Kernkraft GmbH (EnKK)
Shareholder/Owner: EnBW Erneuerbare und Konventionelle Erzeugung AG (98,45 %), ZEAG Energie AG, Deutsche Bahn AG, Kernkraftwerk Obrigheim GmbH
Plant name: Kernkraftwerk Neckarwestheim II (GKN II)
Address: EnBW Kernkraft GmbH, Kernkraftwerk Neckarwestheim, Im Steinbruch, 74382 Neckarwestheim, Germany
Phone: 07133 13-0, Telefax: 07133 17645
E-mail: poststelle-gkn@kk.enbw.com
Web: www.enbw.com

First synchronisation:	01-03-1989
Date of commercial operation:	04-15-1989
Design electrical rating (gross):	1,400 MW
Design electrical rating (net):	1,310 MW
Reactor type:	PWR
Supplier:	Siemens/KWU

The following operating results were achieved:

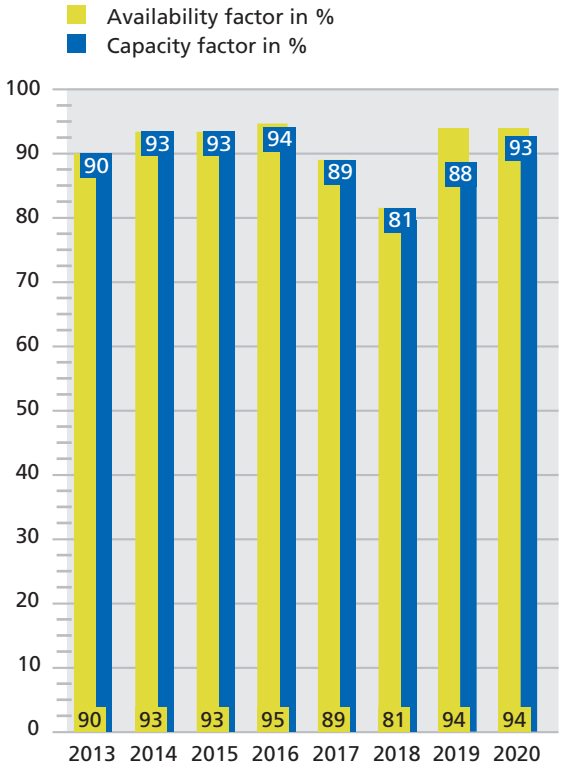
Operating period, reactor:	8,149 h
Gross electrical energy generated in 2020:	11,113,300 MWh
Net electrical energy generated in 2020:	10,415,986 MWh
Gross electrical energy generated since first synchronisation until 12-31-2020:	351,354,884 MWh
Net electrical energy generated since first synchronisation until 12-31-2020:	328,590,462 MWh
Availability factor in 2020:	92.68 %
Availability factor since date of commercial operation:	92.92 %
Capacity factor 2020:	92.62 %
Capacity factor since date of commercial operation:	92.56 %
Downtime (schedule and forced) in 2020:	7.32 %
Number of reactor scrams 2020:	0

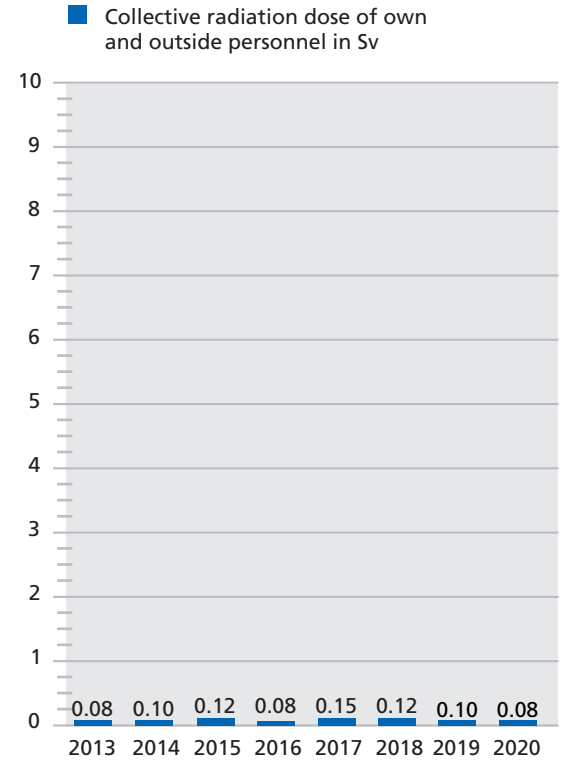
Licensed annual emission limits in 2020:

Emission of noble gases with plant exhaust air:	1.0 · 10^{15} Bq
Emission of iodine-131 with plant exhaust air:	1.1 · 10^{10} Bq
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	6.0 · 10^{10} Bq

Proportion of licensed annual emission limits for radioactive materials in 2020 for:

Emission of noble gases with plant exhaust air:	0.0142 %
Emission of iodine-131 with plant exhaust air:	< limit of detection
Emission of nuclear fission and activation products with plant waste water (excluding tritium):	< limit of detection
Collective dose:	0.071 Sv





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