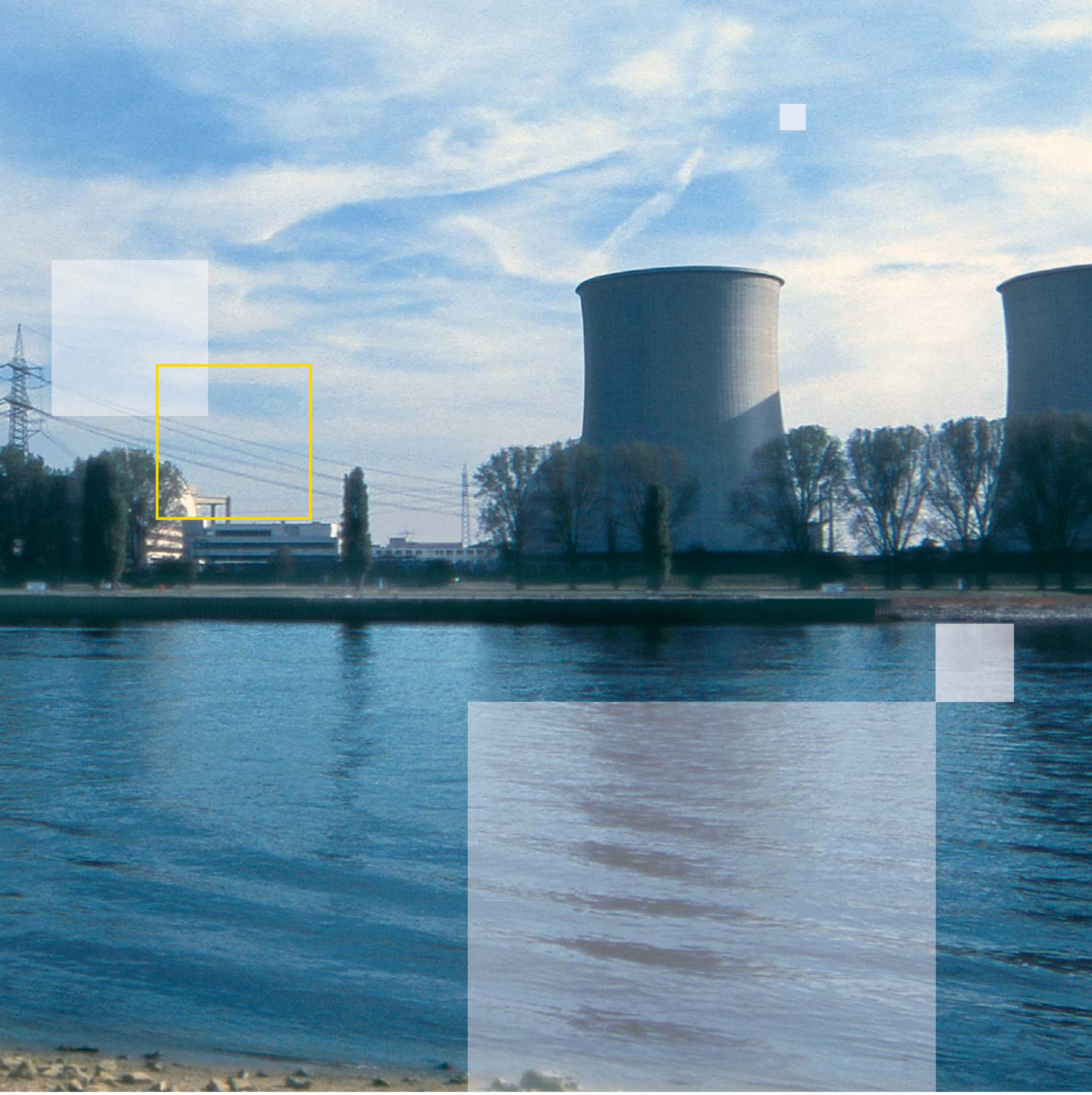


Biblis power plant

A brief portrait

RWE Power

RWE Power – All the power

RWE Power is Germany's largest power generator and a leading producer of energy resources. The core business comprises the cost-effective, reliable and environment-friendly generation of power and heat as well as the extraction of fossil fuels.

We rely on a broad primary energy mix of lignite and hard coal, nuclear power, gas and renewable energies from which we produce power to meet base-load, mid-merit and peak-load demand.

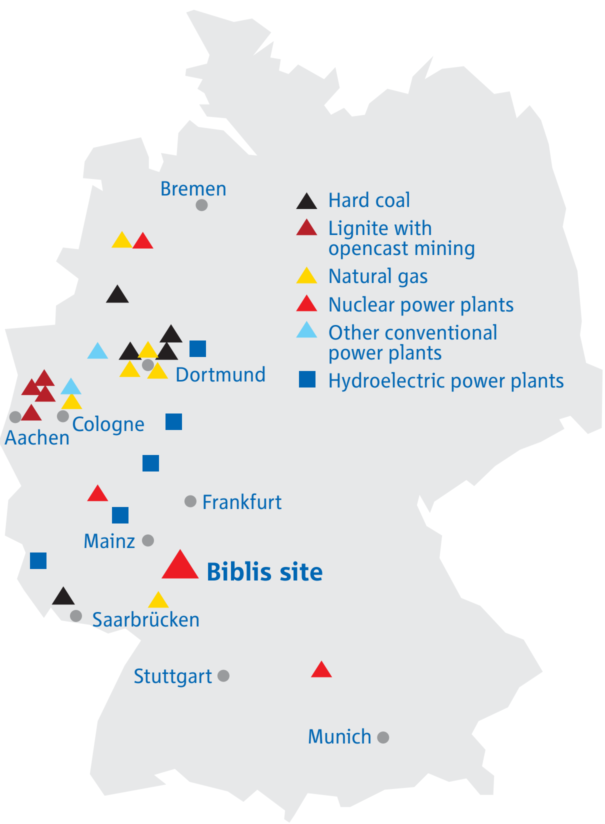
RWE Power operates in a highly competitive market. We aim to remain best in class among the leading national power generators and to expand our international market position. We want to play a major part in shaping the future of energy supply.

Our successful performance is based on a strategy focused on this aim and supported by efficient cost management. We never lose sight of one important aspect of our corporate philosophy: The protection of the environment. Respect for nature and its resources is more than mere lip service at RWE Power.

Our sound economic base is underpinned by the expert and committed support of some 15,000 employees together with approx. 5,000 more at our subsidiaries, and allows us to make consistent use of the opportunities afforded by the deregulated energy market.

Our operations are embedded in a corporate culture based on team spirit and transparency both within the Company and outside.

Pooling all generation activities under one umbrella has made us number one in Germany with a 30 % share of power generation output and number three in Europe with 9 %. And that's what we are working for – with all the power.



Safe and reliable – Our nuclear power plants

RWE Power has been operating nuclear power plants since the early sixties. This involves the plants at Gundremmingen in Bavaria, Emsland nuclear power plant in Lingen, Biblis in Hesse and the decommissioned plant at Mülheim-Kärlich.

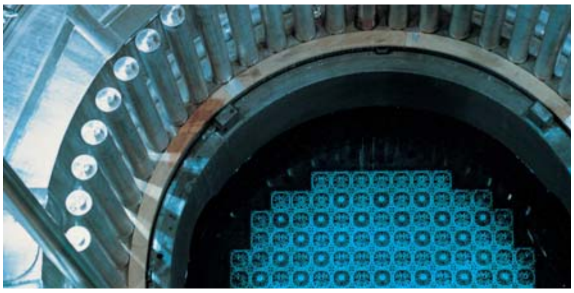
Their combined gross capacity totals 6,600 MW. In Germany nuclear energy accounts for about 30 % of power supplies. With its high safety standards and extremely well trained staff, the German plants are regarded internationally as exemplary.

The Biblis power plant is situated 13 km north of the city of Worms on the Hessian side of the river Rhine. The plant consists of two units, so-called pressurized water reactors, with a total electrical capacity of about 2,500 MW. About 650 highly qualified and committed employees have ensured safe and reliable plant operation for about 30 years.

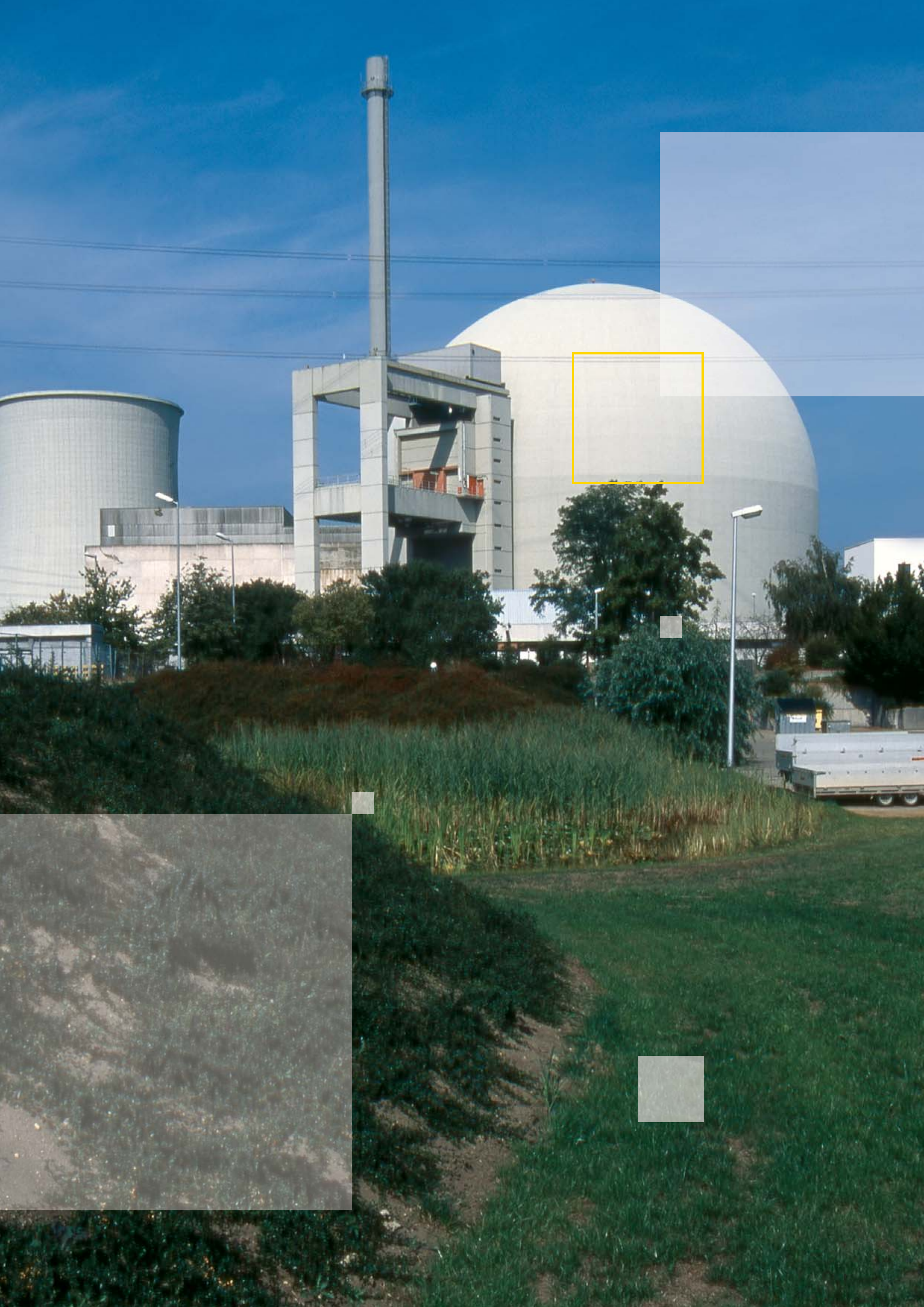
At full output, the two power plant units at Biblis generate enough electricity per year to meet the demand of five million residential households in Germany. At the same time, the power plants prevent emissions of about 15 million tons of carbon dioxide per year versus power generation from fossil fuels.

The German Atomic Energy Act sets a limit for the use of nuclear energy. While we accept the primacy of politics, we firmly believe that the decision to phase out nuclear energy is wrong. The electricity output limited for the individual plants by the current legislation will allow Biblis to continue generating power from nuclear energy until about 2012.

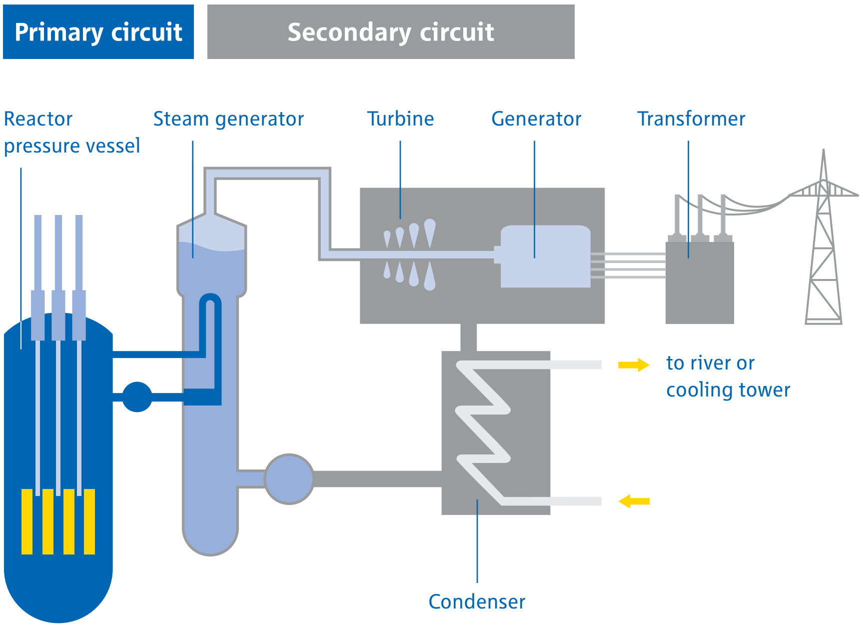
The electricity is transmitted from the Biblis power plant through high-voltage lines to nearby substations from where it is distributed across the interconnected system.



193 fuel assemblies make up the reactor core in which the chain reaction takes place. The open reactor vessel shows the arrangement of the fuel assemblies resembling a chessboard.



Functional schematic of a nuclear power plant with pressurized-water reactor



Mode of operation of Biblis nuclear power plant
Nuclear power plants are thermal power stations using nuclear fission to produce the required heat. Nuclear fission takes place in the reactor core comprising the fuel assemblies. Each unit at Biblis has 193 fuel assemblies with altogether about 45,000 fuel rods and about 100 tons of uranium dioxide.

In the reactor core, rod-shaped control elements (control rods) control the neutron flux and hence the reactor output by lifting and lowering of these rods. Nuclear fission is interrupted when they are inserted. The reactor operates with maximum output when the rods are withdrawn.

A characteristic design feature of pressurized-water reactors are two water circuits separated from each other: The primary and secondary circuit. In the primary circuit, the water transports the heat produced by nuclear fission. Despite a temperature of 300° Celsius, the water in this circuit remains liquid because it is pressurized at 155 bar.

In the steam generator, which constitutes the interface between primary and secondary circuit, the heat is transferred to the secondary circuit. Steam is produced because, at 55 bar, the pressure is much lower in the secondary circuit. This non-radioactive main steam drives the turbine, which is connected to the generator producing the electricity.

The condenser is located below the steam turbine; here, the steam is cooled by cooling water until it returns to a liquid state (condensation).
The condensate arising is pumped back to the steam generator. In normal operation, the heated cooling water is directly discharged back into the river Rhine. The cooling towers are used, for instance, when the water in the river Rhine has very high temperatures or the water level in the river is very low.

In the early seventies, the reactor units at Biblis represented milestones setting standards worldwide for their capacity range. Since that time, their power generation has always ranked them among the leading pressurized-water reactors by international standards.

Closely intertwined – The safety systems

The safe operation of our nuclear facilities has absolute priority – any time and everywhere.

Nuclear energy is a branch of industry governed by a closely knit system of regulations and controls. This ranges from the power plant, through provincial and federal supervisory authorities, the Reactor Safety Commission and independent experts on to European and international organizations. High safety standards and a sophisticated safety culture are at the heart of this system.

In Germany, the planning, construction and operation of nuclear power plants are strictly monitored by the relevant authorities in charge. This oversight also includes detailed inspection and maintenance programs to identify and correct any irregularities on plant components early on.

The safety systems

The safety engineering in nuclear power plants first and foremost aims to retain radioactive substances produced by nuclear fission in the reactor core. A number of engineering principles are already applied during the design of a plant in order to achieve this aim.

The design principles

Extreme precautions are taken when designing nuclear power plants in that always the coincidence of unfavorable conditions and adverse events is assumed. For this reason, the design principles of redundancy, diversity, physical separation and the fail-safe principle are applied when designing and constructing nuclear power plants.

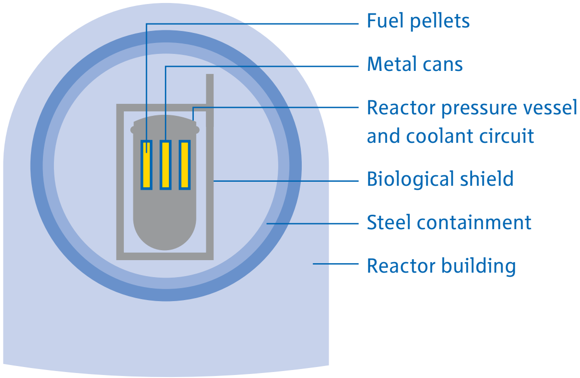
- Redundancy means that important safety-related systems are installed several times.
- Diversity means that several systems fulfill an identical safety engineering function in a different way.
- The physical separation of the redundant systems of diverse design ensures that several systems cannot fail due to a common cause at the same time.
- The fail-safe principle means that the safety-related function is maintained or activated in the event of off-site power supply failing.

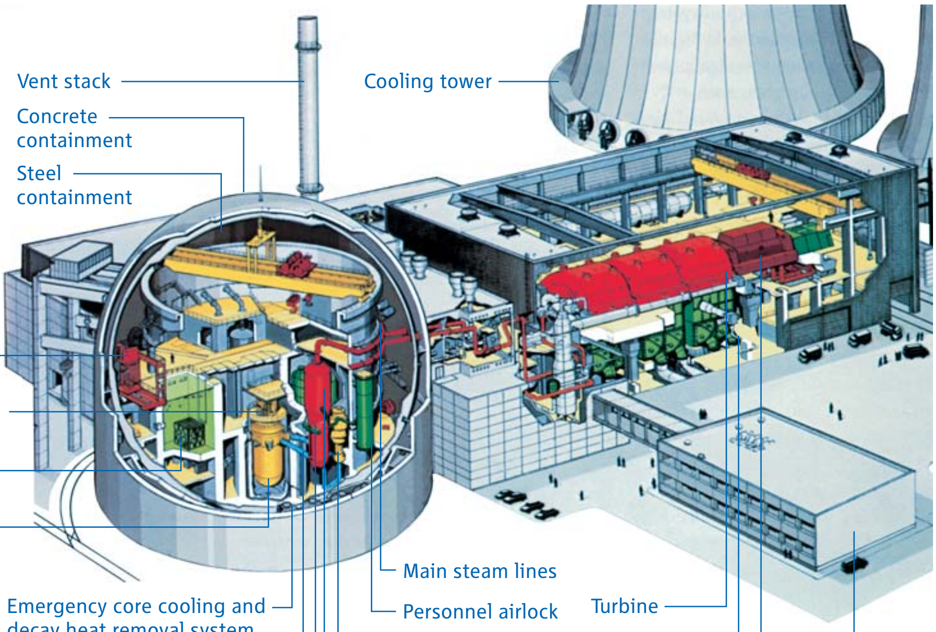
All the power plant systems and processes are controlled and monitored from the central control rooms of the two units A and B.

The retention barriers

The retention barriers are part of the passive safety systems and constitute essential structural components of our safety engineering:

- The crystal lattice of the ceramic fuel pellets retaining most of the fission products;
- The metal cans around the fuel pellets;
- The reactor pressure vessel with closed coolant circuit;
- The concrete shield of the reactor (also called biological shield);
- The containment of steel several centimeters thick;
- The reactor building of thick steel-reinforced concrete.





The reactor protection system

In addition, every nuclear power plant is equipped with a reactor protection system. During operation, it permanently monitors all important measured values, compares them with the specified design requirements and corrects any identified abnormal operating conditions. When certain limits, which are exactly defined in advance, are reached, the reactor protection system automatically triggers active safety responses. These include:

- The reactor scram: The power supply to the electromagnetic drive mechanisms of the control rods is interrupted. By gravity, they drop between the fuel assemblies in the reactor core and stop the chain reaction.
- The tight closure of building parts: This prevents the release of radioactive substances from the primary circuit to the outside.
- The decay heat removal system: It is activated automatically when the reactor is shut down or when an event occurs involving loss of coolant from the primary circuit. It does not only remove the decay heat of the shut-down reactor, but also replaces any loss of coolant.
- The emergency power supply system: It ensures the power supply of all safety-related systems if the normal power supply of the plant has been disrupted or lost.

The operability of the active safety systems is checked systematically by an established program of in-service inspections. The testing program for the passive safety systems aims to furnish proof of their intended status.

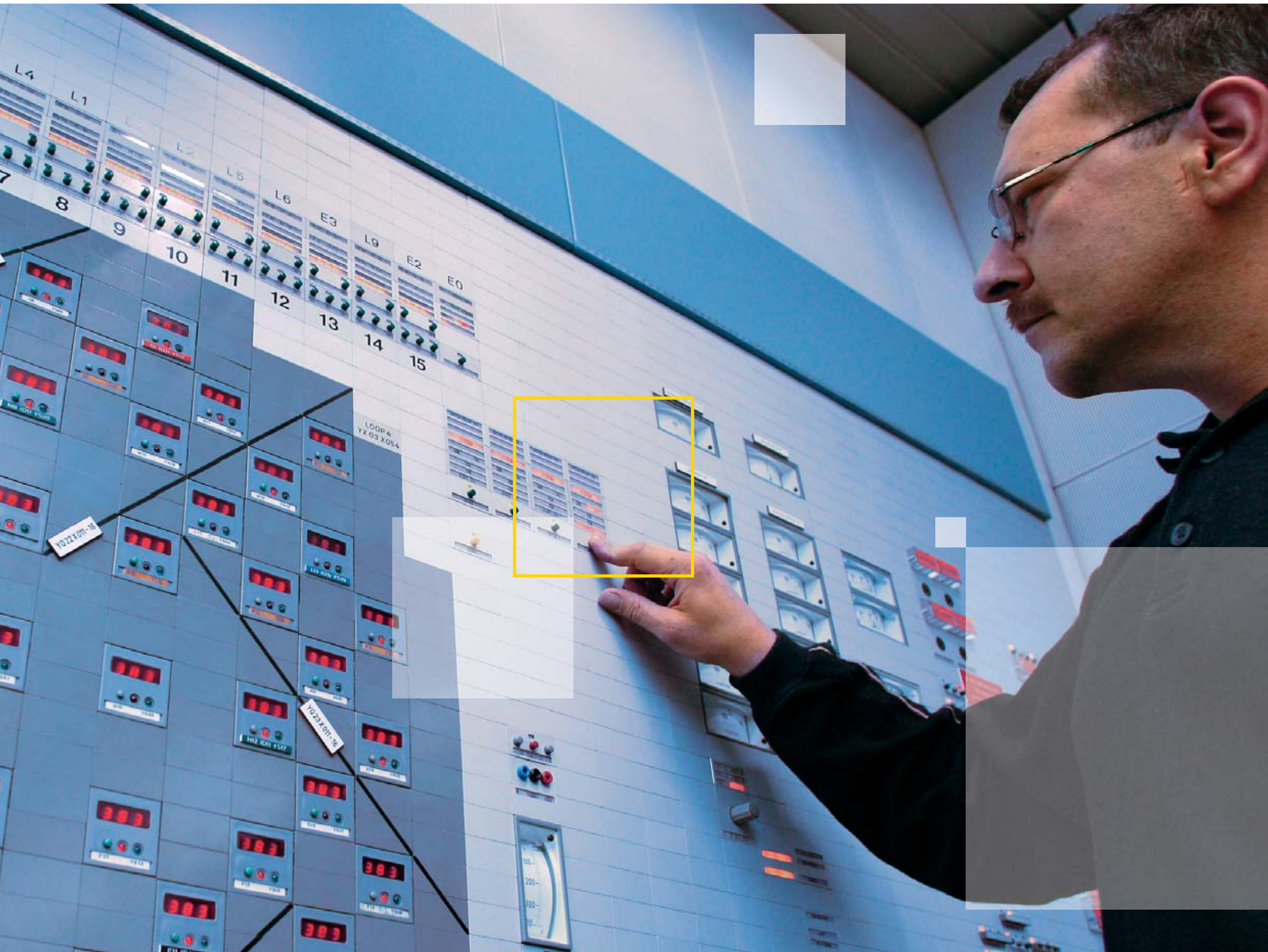
An important element – The safety culture

The safety culture is an integral part of the corporate culture of RWE Power.

Electricity generation in the nuclear plants of RWE Power is based on three objectives: safety, environmental compatibility and economic efficiency. The high level of technical safety is maintained and advanced by suitable monitoring and maintenance activities.

It goes without saying that we do not solely rely on engineering systems when it comes to safety: Our staff, too, plays an important part in this.

The technical skills and qualifications of the operating crews make an essential contribution to safe plant operation. Their specific training, acquired know-how, consistent further training and their deeply rooted safety awareness practiced every day are of great importance in this context. Thus, they constitute a crucial cornerstone of our safety culture.

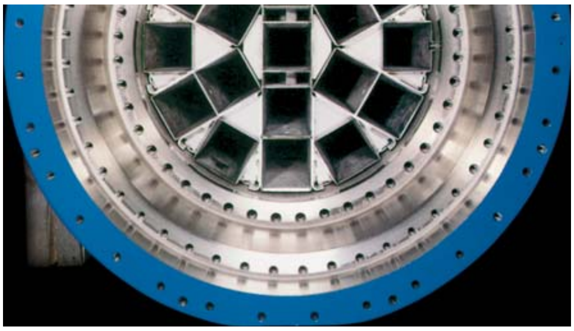


Safety first – The nuclear waste management concept

Of major importance to us is not only the operation of our nuclear power plants, but also the disposal of radioactive waste.

According to the waste management concept for nuclear power plants, radioactive waste from nuclear engineering facilities has to be safely enclosed and contained indefinitely in ultimate repositories.

The German federal government has undertaken to provide such ultimate repositories no later than by 2030. Until then, spent fuel assemblies have to be stored in intermediate facilities. This purpose is served by an intermediate repository on the site of the Biblis nuclear power plant to accommodate the fuel assemblies from the nuclear power plant until they are shipped to the ultimate repository.

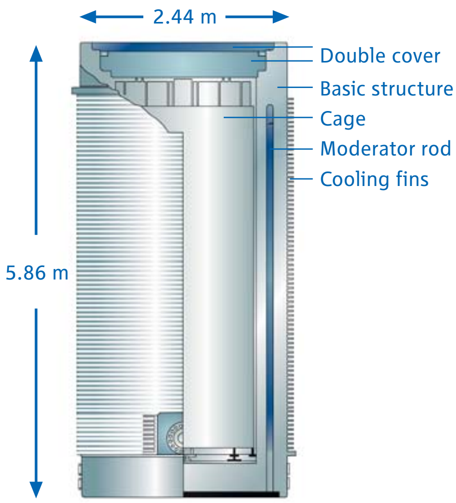


Look inside a CASTOR: The type of flask used in Biblis can accommodate 19 spent fuel assemblies.

The fuel assemblies are kept in intermediate storage in CASTOR flasks, like here in the on-site interim repository at Lingen, before they are shipped to an ultimate repository.

At the heart of the safety concept of the on-site intermediate repository is the CASTOR V/19® (pictured on the bottom right). The CASTOR is a special flask to safely accommodate and store 19 fuel assemblies of a pressurized-water reactor. It shields off the radiation of the spent fuel assemblies so effectively that you can stand in the immediate vicinity of the CASTOR without any risk of exposure.

The repository will be situated on the power plant site to the side of the reactor building in front of the cooling towers of unit B. The interim repository accommodates 137 CASTOR flasks with depleted fuel assemblies. It will be 92 m long, 38 m wide and 18 m high. The building will look like a normal industrial hall. The 85 cm thick external walls and the 55 cm thick concrete roof will reduce the radiation to such an extent that the levels permitted along the power plant perimeter are safely met.



Important economic factor – Secure jobs

Our power plant at Biblis is an important economic factor in the region.

The Biblis nuclear power plant safeguards the jobs of about 650 own employees and many more at numerous suppliers and service providers. The volume of orders awarded to companies in the region totals about € 100 million per year.

Our power plant also offers attractive apprenticeships for young people.

The visitors of the Biblis information center also receive valuable information about energy supply in countries nearby and far away.

Information on the site –
Open to dialogue

As power plant operator and major employer, we are part of the South Hessian region. A trusting partnership with the local population and an open dialogue with everyone involved are an essential concern to us.

The information center of the Biblis power plant serves as a communication platform. Our qualified, committed employees do not only answer technical questions. The wide-ranging discussions also cover various issues relating to the energy industry.

Why not pay us a visit!

RWE Power
Aktiengesellschaft

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Specifications

Overall plant	Unit A	Unit B
Power plant net capacity (transformer upper voltage) MW	1,146	1,240
Generator continuous rating MW	1,225	1,300
Steam generator max. thermal output MW	3,540	3,752
Power plant efficiency related to net capacity %	32.7	33.2
Cooling water flow m^3/h	198,000	218,000

Nuclear steam generation system	Unit A	Unit B
Reactor coolant flow t/h	72,000	72,000
Mean coolant temperature °C	298	303.5
Coolant pressure bar*	154	154
Main steam flow t/h	6,680	7,160
Main steam pressure bar*	50	53

Reactor core	Unit A	Unit B
Mean heat transfer per heating surface unit W/cm^2	57	61
Mean U 235 concentration of the initial core % by wt.	2,56	2,48
Mean U 235 concentration of reloadings % by wt.	up to 4.0	up to 4.0
Uranium weight t	102.7	102.7
Number of fuel assemblies	193	193
Number of control rods	69	61

Reactor pressure vessel	Unit A	Unit B
Internal diameter mm	5,000	5,000
Wall thickness and plating mm	235 + 7	243 + 7
Overall height mm	13,250	13,250
Weight t	550	550

Steam generators	Unit A	Unit B
Heating surface m^2	4 x 4,510	4 x 4,335
Tube diameter x wall thickness mm	22 x 1.2	22 x 1.2
External diameter mm	3,600/4,750	3,400/4,955
Overall height mm	18,750	18,750
Weight t	298	280

Reactor coolant pumps	Unit A	Unit B
Mass flow t/h	4x18,000	4x18,000
Head bar*	6.5	6.7
Motor rating kW	8,550	8,550

Steel containment	Unit A	Block B
Sphere diameter m	56	56
Design pressure bar*	4.7	4.7
Wall thickness mm	30	30

Steam power plant	Unit A	Unit B
Turbine housing	1 x HP double-flow 3 x LP double-flow	
Speed rpm	1,500	1,500
Steam pressure at turbine throttle bar*	49.7	51.8
Temperature at LP section inlet °C	220	226
Condenser pressure bar*	-0.96	-0.96
External diameter of the last blade wheel m	5.6	5.6
Length of final blading mm	1,364	1,364
Generator apparent power MVA	1,500	1,530
Generator terminal voltage kV	27	27
Length of turbine set m	65	65
Power rating of generator transformers MVA	2 x 725	1 x 725 1 x 1,000
Idling transformation ratio	27/420 kV +11 %	27/420 kV 27/245 kV +11 %

Cooling towers	Unit A	Unit B
Fan-type cooling towers with forced draft fans Number	2	2
Height m	80	80
Base diameter m	68	69
Fans per cooling tower	24	24

* Pressure specifications in bar related to atmospheric pressure.

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