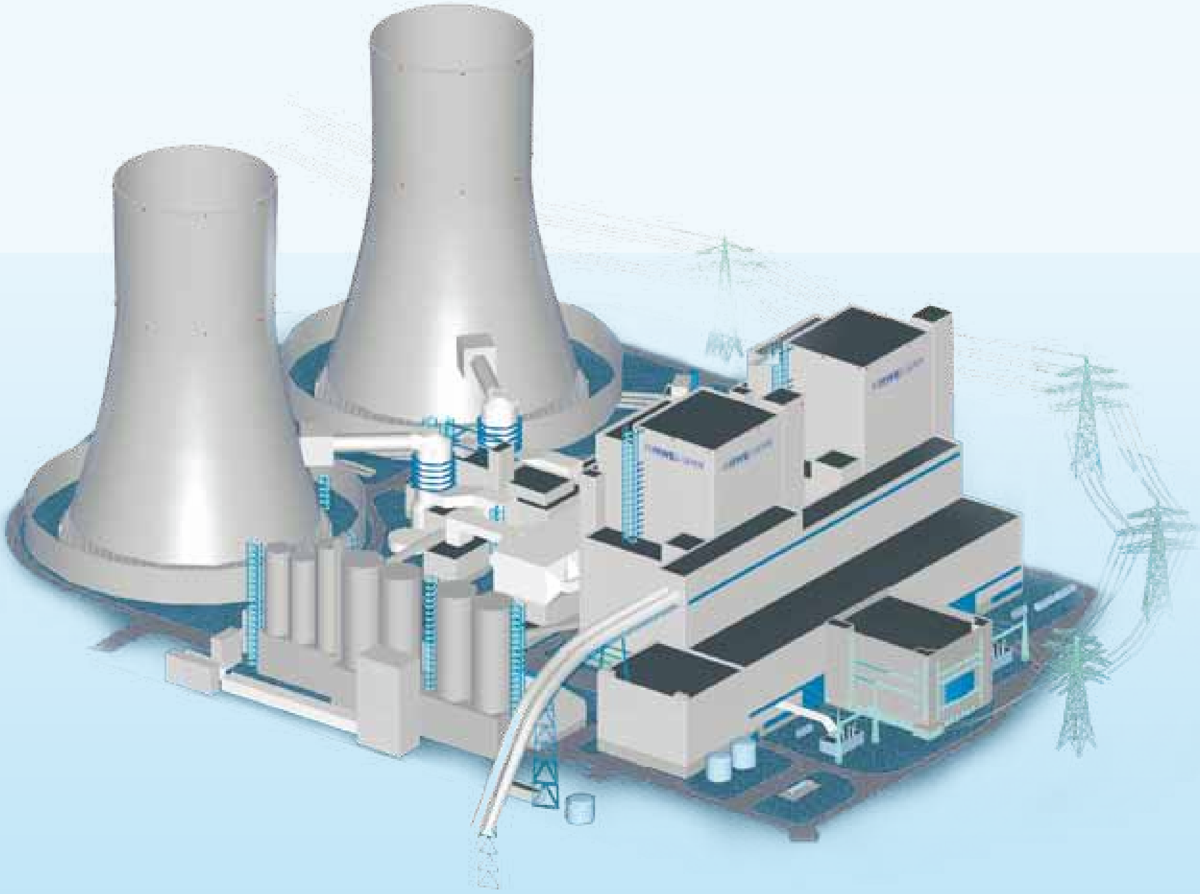
RWE Power

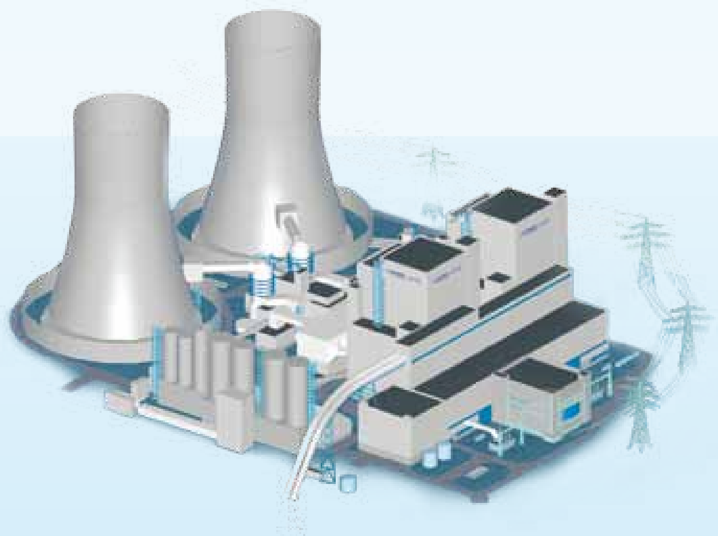
WESTFALEN POWER PLANT

New-build project: units D and E.



RWE
The energy to lead

NEW-BUILD PROJECT: UNITS D AND E



RWE POWER – ALL THE POWER

RWE Power is Germany's biggest power producer and a leading player in the extraction of energy raw materials. Our core business consists of low-cost, environmentally sound, safe and reliable generation of electricity and heat as well as fossil fuel extraction.

In our business, we rely on a diversified primary energy mix of lignite and hard coal, nuclear power, gas and renewable sources to produce electricity in the base, intermediate and peak load ranges.

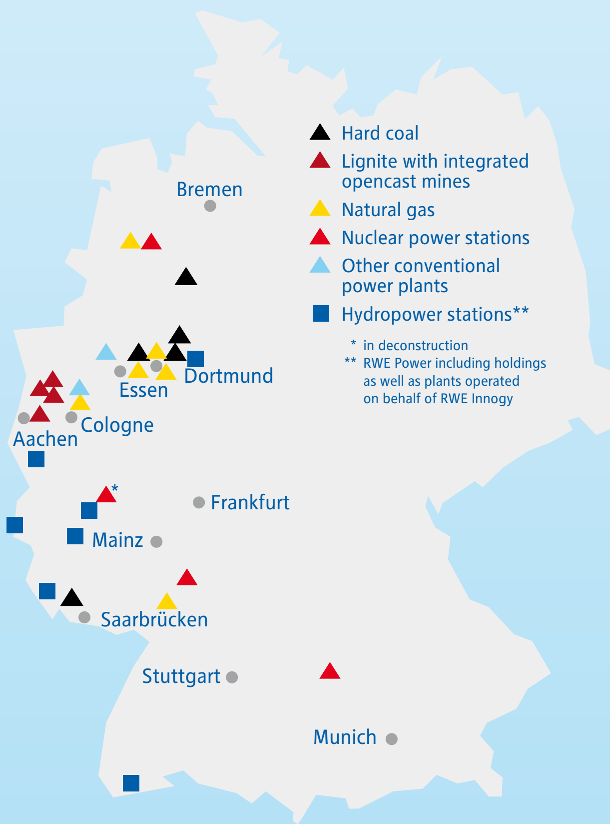
RWE Power operates in a market characterized by fierce competition. Our aim is to remain a leading national power producer and expand our international position, making a crucial contribution toward shaping future energy supplies.

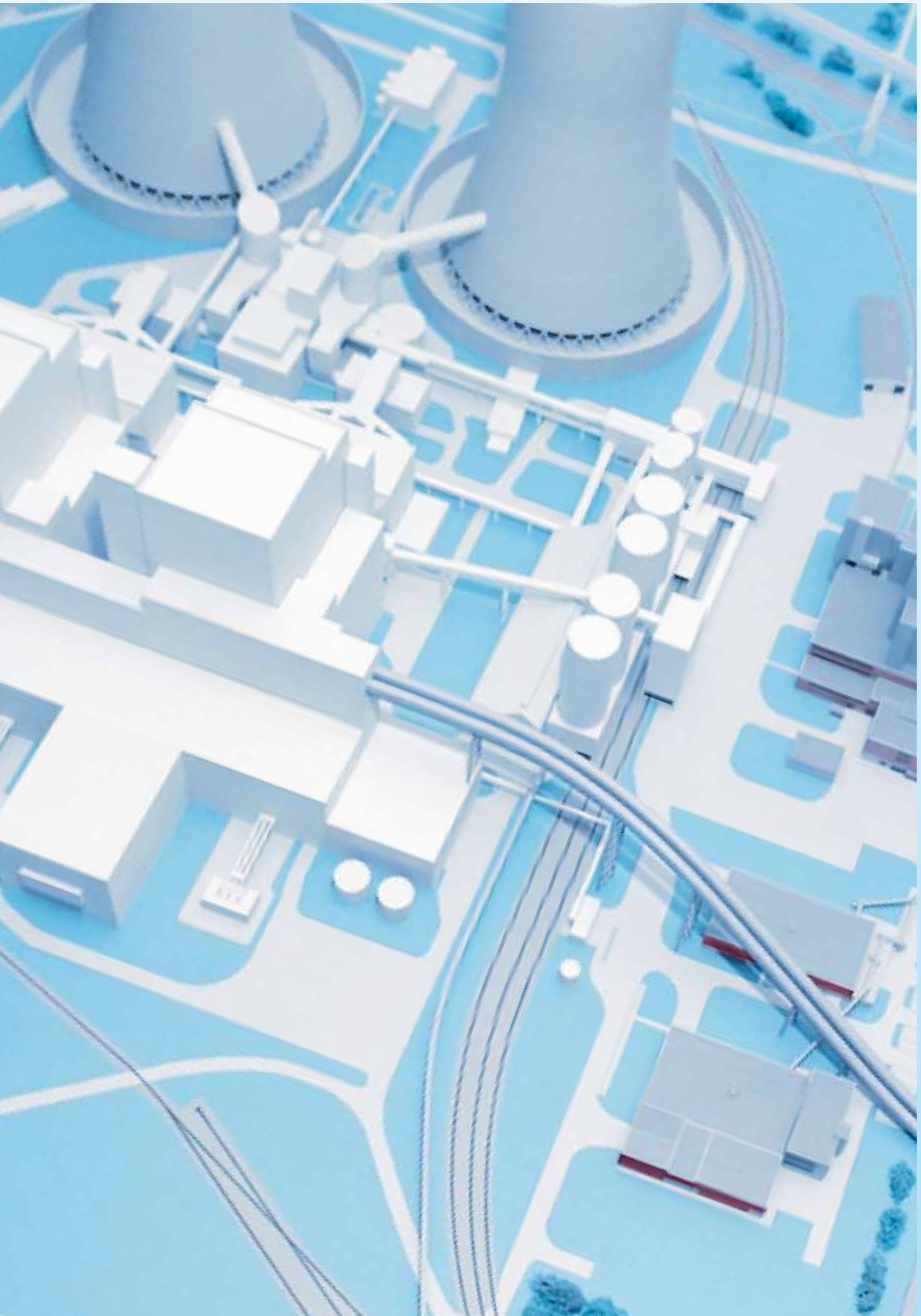
A strategy with this focus, underpinned by efficient cost management, is essential for our success. All the same, we never lose sight of one important aspect of our corporate philosophy: environmental protection. At RWE Power, the responsible use of nature and its resources is more than mere lip service.

Our healthy financial base, plus the competent and committed support of some 17,000 employees under the umbrella of RWE Power enable us to systematically exploit the opportunities offered by a liberalized energy market.

In this respect, our business activities are embedded in a corporate culture that is marked by team spirit and by internal and external transparency.

Bundling all generation activities at RWE Power has made us no. 1 in Germany, with a 30 per cent share in electricity generation, and no. 3 in Europe, with a 9 per cent share. We wish to retain this position in future as well. That is what we are working for – with all our power.





THE PROJECT

As part of its power-plant renewal programme costing € 6 billion, RWE Power AG proposes to build a hard coal-fired twin unit at its Westfalen location.

RWE Power in mid-February filed an application with the Arnsberg regional government for the construction and operation of this power station. This is a first step to create a basis in approval law that provides the flexibility needed to implement the power plant by 2011, and is not yet associated with any final construction and investment decision. Such a decision requires that the project can also be assessed from an energy-policy angle. The application records are currently being scrutinized by the authority. The Arnsberg regional government is in charge of the approval procedure.

The two 800-MW power-plant units are to be operated with hard coal and petroleum coke, a coal-like residue from mineral-oil processing. They are to go on stream as units D and E in mid- and end-2011. At that point in time, the two old units A and B will already have been shut down.

Thanks to progressive technology, the new power station will be among the most modern of its type worldwide. The plant is to be operated initially in the base load, although it can also be used in the intermediate and partial load at any time, i.e. in times of increased or decreased electricity needs.

The power-plant concept is marked by the aim of high net efficiency in generating electricity from the fuel and, associated with this, lower specific emissions, high plant availability, dependability as well as economic efficiency. The plant engineering deployed to achieve these conditions requires the highest steam parameters, optimized power-plant processes and optimized plant engineering, in addition to advanced technical concepts. Associated with this is the use of high-quality, new materials, specifically for the water-steam cycle. Moreover, the plant can later be retrofitted with a CO_2 flue-gas scrubber with which the CO_2 can be captured after combustion and stored as soon as this technology is ready for deployment at power stations.

The new power-plant units are largely designed for fully automatic operation. Monitoring of operations is from a central control room.

The construction period for the units, which will be built successively, amounts to about four years. RWE Power is investing some € 2 billion in the location.

HAMM LOCATION

The two power-plant units are to be erected on today's plant premises in the Uentrop part of Hamm, in the Schmehausen communal district.

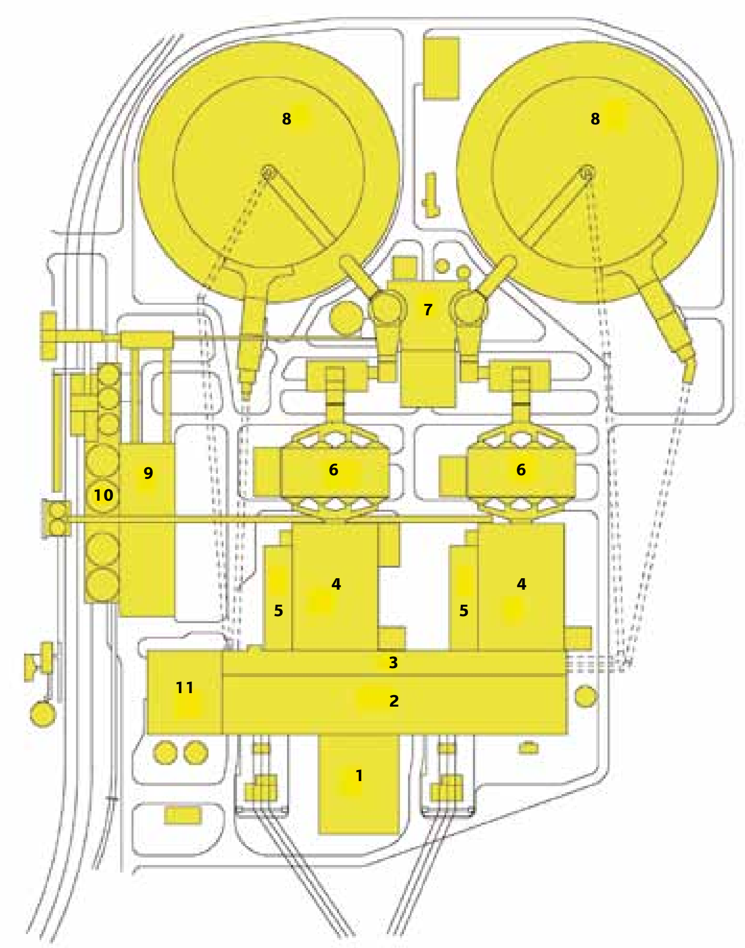
The Hamm power-plant location can look back on a long tradition: in 1962 / 63, the power station Westfalen in the Lippe meadows, east of Uentrop-Schmehausen, entered into service. It went online with the two 160-MW units A and B. In order to meet the constantly growing demand for electricity, above all by industry, the location was extended in 1969 to include unit C with an electrical output of 305 MW.

The three plants – along with the two new units applied for – receive their main fuel, hard coal, via the Datteln-Hamm Canal, at the eastern end of which the power plant is located. For some years now, the power station has been producing up to 15 per cent of its furnace thermal rating not from coal, but using a pyrolysis plant linked to unit C, which carbonizes, e. g., old plastics and sorting residues of high calorific value.

In 1985, the pebble-bed reactor THTR-300 was commissioned on the power-station's grounds. As early as 1989, the plant was shut down again, freed from its essential radioactive components and partially demolished. The remaining parts are safely locked up pending final demolition.

The two new hard coal-fired power-plant units are to emerge south of the old power station and will be integrated completely into the existing location. Outside the power-plant area, no significant additional space is needed.

This location is optimally connected to the traffic network: in addition to its own harbour at the end of the Datteln-Hamm Canal, it has access to the rail network of Ruhr-Lippe-Eisenbahngesellschaft, which inks up to the network of Deutsche Bahn via Hamm's railway station. Autobahn A 2 runs some 650 m northwest of the location.



Layout of main construction site

Key

1 Main switch house
2 Turbine house
3 Turbine house, intermediate building
4 Steam generator
5 Bunker bay
6 Electrostatic precipitator
7 FGD
8 Cooling tower
9 Gypsum-storage facility
10 Bin systems
11 Water centre

THE PLANT AND ITS FUNCTIONAL PRINCIPLE

High efficiency, low specific emissions, exemplary availability and economic efficiency: these goals determine the design of the project.

RWE Power not only wishes to build two new units at the Hamm location. In addition, existing plants and systems are to be re-used and adapted to the requirements of the new hard coal-based units. For this, the plants for materials handling, the intermediate storage facility and the conveyance of the coal must be extended, for instance.

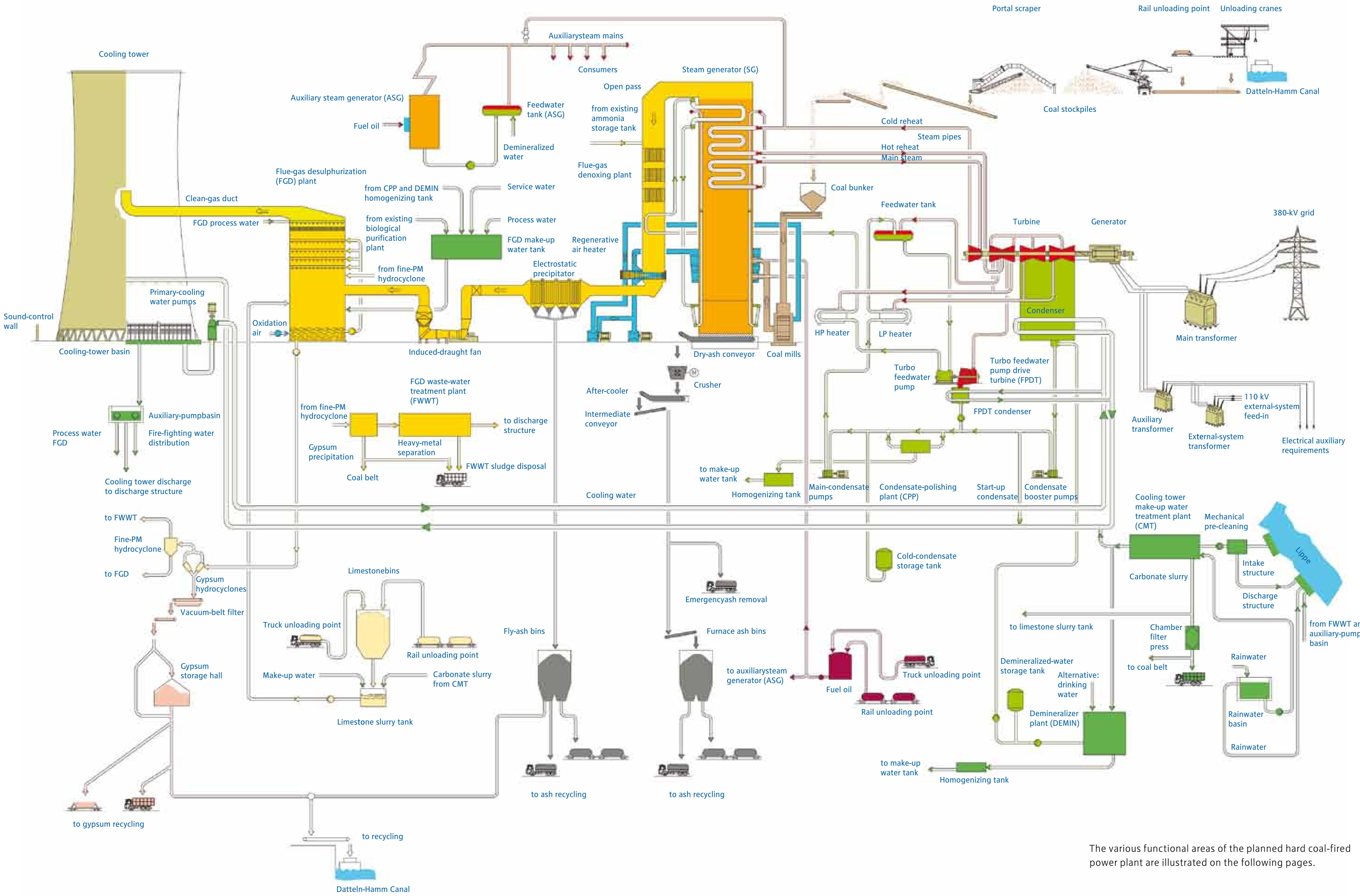
The two new units are designed for fully automatic operation. Staff can monitor operations from a central control room.

Essential data of the new power station
Main technical data at nominal load (approximate figures)

Furnace thermal rating	$MW_{t/h}$	2 x 1635 Main steam generator 1 x 135 Auxiliary steam generator**
Gross electrical capacity	MW	2 x 800
Net electrical capacity	MW	2 x 765
Net efficiency	%	approx. 46
Fuel quantity	t/h	2 x 240
Main steam output	kg/s	2 x 600*
Main steam pressure/ main steam temperature	bar/° C	285*/600*
Hot reheat temperature	° C	610*

* at the steam-generator outlet
** auxiliary steam generator at nominal load not in operation; is available for powering up the plant with a max. furnace thermal rating of 150 MW

The plant and its functional principle



The various functional areas of the planned hard coal-fired power plant are illustrated on the following pages.

DIAGRAM OF A POWER PLANT UNIT

Energy conversion, environmental protection, logistics: a power station is a complex entity combining many different, inter-dependent technical sequences.

In a thermal power plant, chemical energy (from coal) is initially converted into thermal energy by combustion, then in a turbine into kinetic energy and, finally, by generator into electrical energy. But that is not the whole story. Round and about this core process can be found a whole host of activities that mainly serve water and flue-gas treatment and, hence, environmental protection.

Fuels

The two new steam generators are to use hard coal and petroleum coke. Petcoke is a carbon-rich residue from the mineral-oil industry whose high calorific value has been utilized in power plants for decades. For the start-up burners and the auxiliary steam generator, which is only to be used from time to time, fuel oil is envisaged.

The fuels reach the power station mainly via the Datteln-Hamm Canal. An alternative supply possibility can be ensured by railway. Unloading facilities and coal stockpiles will be expanded for the units D and E. From there, the coal is transported by conveyor to the steam generators' coal bunkers.

Steam generator

From the day bin, the fuel reaches the coal mills where it is pulverized. The pulverized coal is blown via a swivel burner into the steam generator's furnace.

The fire, at a temperature of up to 1,250° C hot, evaporates water, which flows through planar superheater tube bundles in the furnace and in the wall of the steam generator. There, the fully desalinated and demineralized water, which a power-plant operative refers to as feedwater, evaporates to make so-called main steam. It leaves the steam generator at a temperature of 600° C and a pressure of 285 bar. Thus charged with energy, it flows into a turbine.

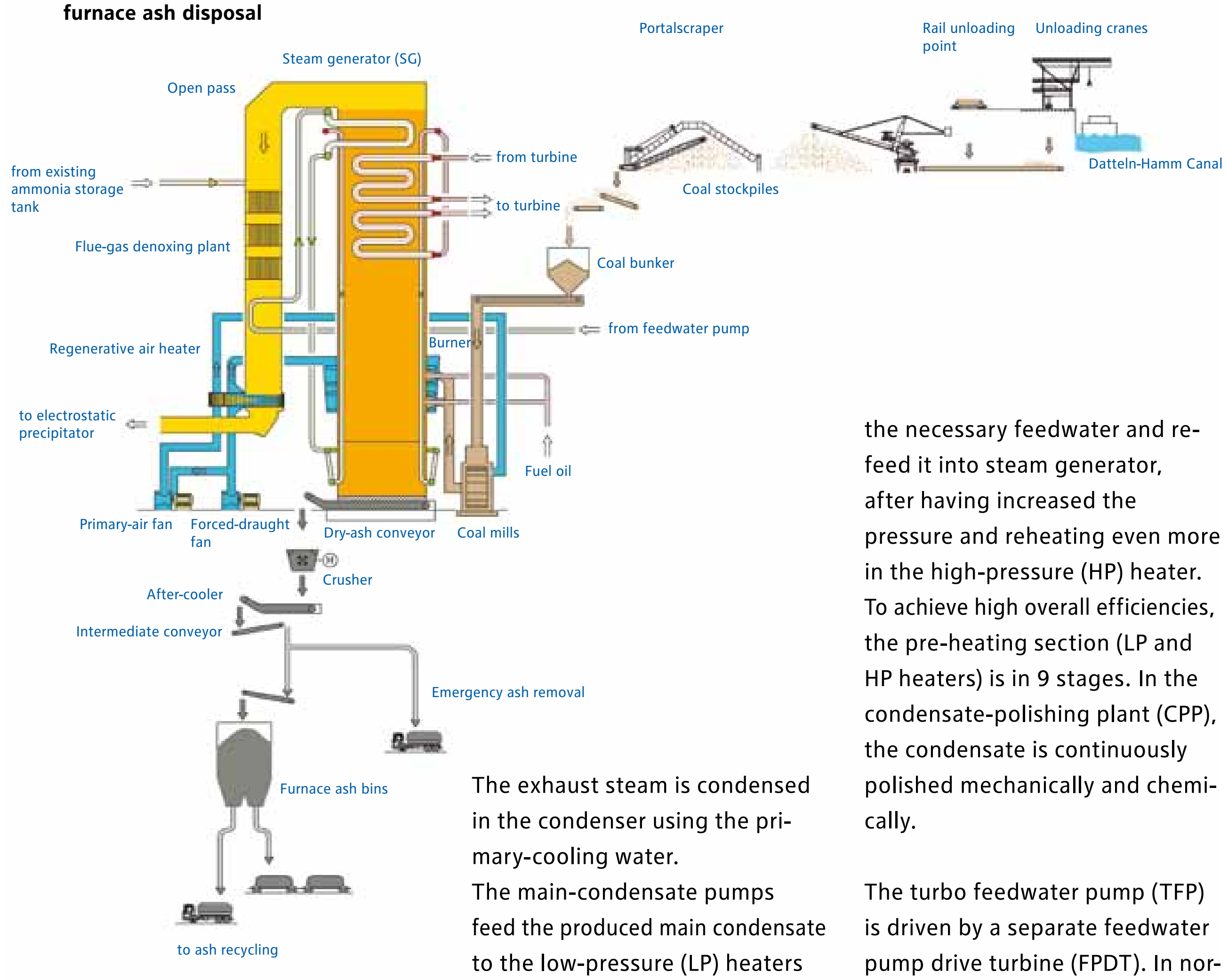
During combustion, ash, too, is produced in addition to thermal energy. It is withdrawn in a dry state from the steam generator's ash hopper, stored in bins and utilized.

Water-steam cycle

The high-pressure steam produced in the steam generator enters the high-pressure section of the steam turbine and does mechanical work there, while expanding and cooling. To achieve a high overall efficiency, the steam, after leaving the high-pressure section, is rerouted into the steam generators and reheated.

The superheated steam is again sent back to the turbine in the double-flow medium-pressure section and does further mechanical work, while expanding and cooling further. After leaving the medium-pressure section, the steam flows into the steam turbine's low-pressure section, each of which are designed double-flow, where further mechanical work is performed, expanding and cooling down to exhaust-steam pressure level.

Steam generator with fuel supply and furnace ash disposal



The exhaust steam is condensed in the condenser using the primary-cooling water.
The main-condensate pumps feed the produced main condensate to the low-pressure (LP) heaters and the feedwater tank and, in the process, reheat it in the various feed-heating stages using extraction steam from the turbine. From the feedwater tank the feedwater pumps withdraw the necessary feedwater and refeed it into steam generator, after having increased the pressure and reheating even more in the high-pressure (HP) heater. To achieve high overall efficiencies, the pre-heating section (LP and HP heaters) is in 9 stages. In the condensate-polishing plant (CPP), the condensate is continuously polished mechanically and chemically.

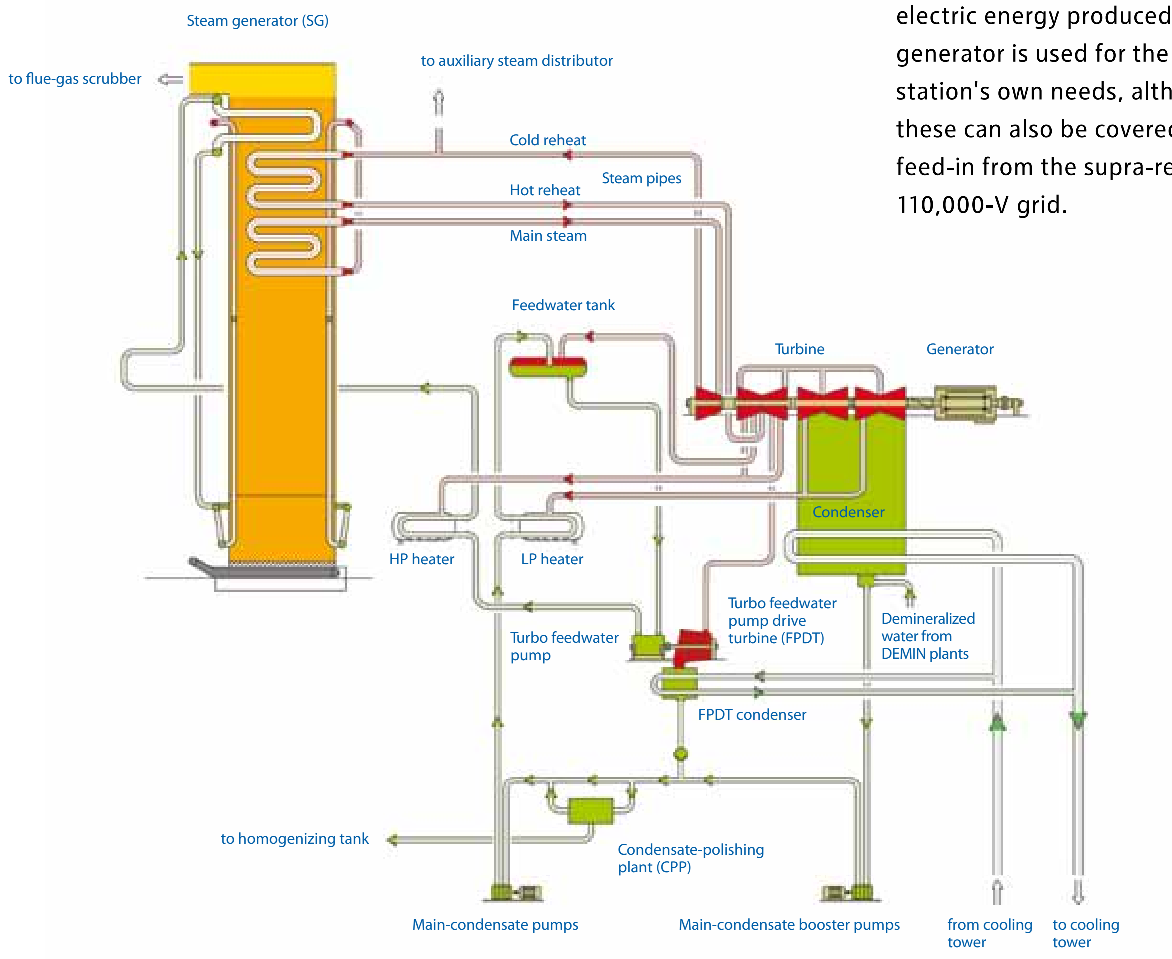
The turbo feedwater pump (TFP) is driven by a separate feedwater pump drive turbine (FPDT). In normal operations, it is supplied with steam by extraction from the main turbine. To supplement the TFP, the plant has a feedwater pump unit driven by electric motor (EFPU).

RWE Power is actively backing the tapping of profitable district-heating and process-steam potentials in the vicinity of the power-plant location: for this, steam extraction in the medium-pressure section of the steam turbine is planned-in for both units. There, the turbine is dimensioned in such a way that retrofitting for steam extraction becomes possible.

Power generation

The generator is linked to the turbine via a shared shaft. It converts its rotary motion into electricity according to the dynamo principle. The electricity has a voltage of 27,000 V. Its voltage has still to be increased by the power plant's main transformer to 380,000 V for feed-in into the supergrid. A small part of the electric energy produced in the generator is used for the power station's own needs, although these can also be covered by feed-in from the supra-regional 110,000-V grid.

Water-steam cycle



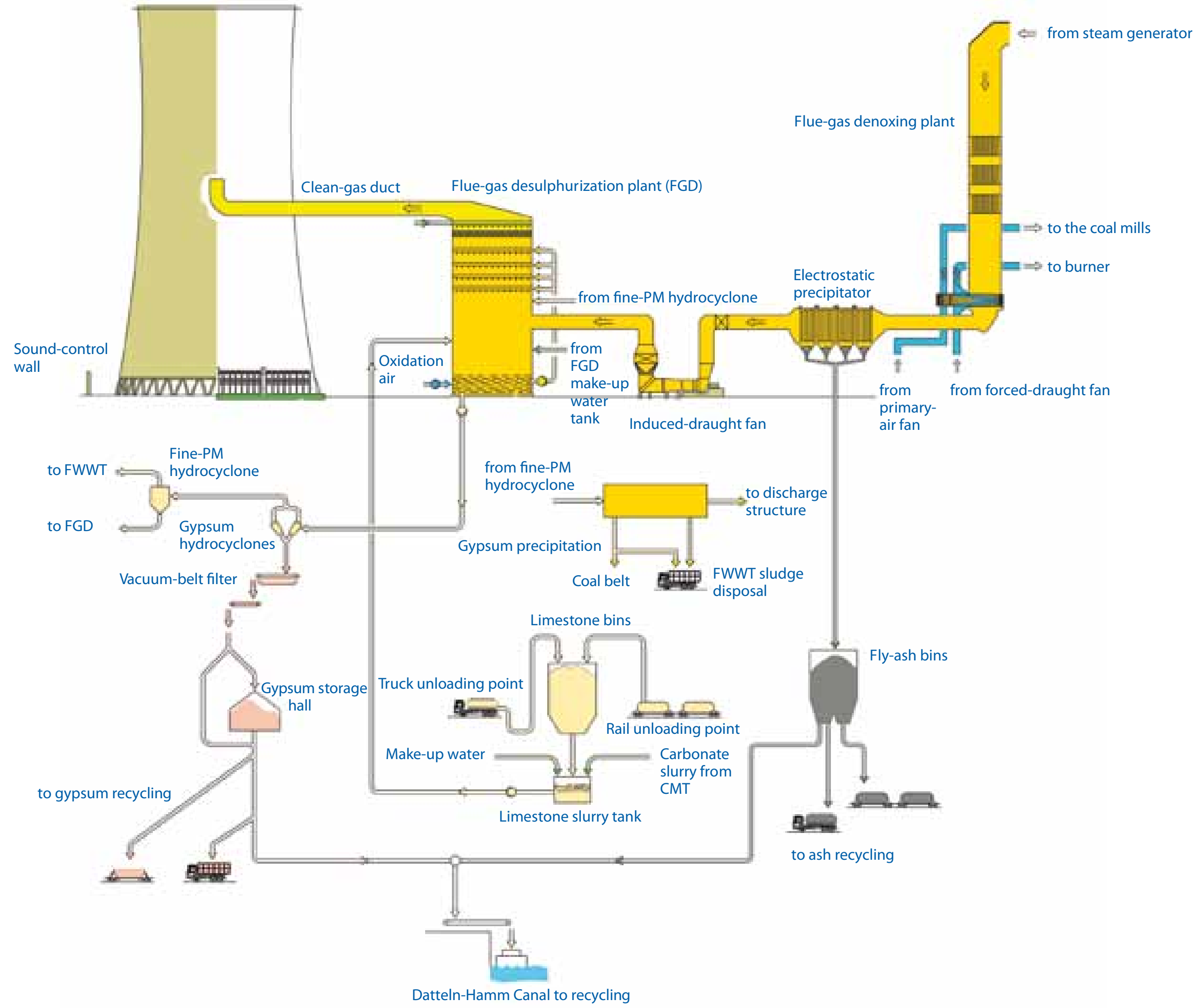
Flue-gas scrubbing

The steam generators are equipped with pulverized-coal burners which are operated with low excess air and optimized airflow. This reduces the emergence of nitrogen oxides in combustion from the word go.

In addition, nitrogen oxides are reduced in a downstream flue-gas denoxing plant. There, the nitrogen oxides react with ammonia using a catalyst to become water and pure nitrogen, the natural components of air.

After that, the flue gases flow through electrostatic precipitators: they separate 99.9 per cent of the dust by electrostatically charging it via discharge electrodes and drawing it to oppositely charged surfaces. In a next step, the sulphur dioxide contained in the flue gas is converted in the atomized spray of a limestone slurry into calcium carbonate, i.e. gypsum, which can be used in the construction-material industry. The scrubbed flue gases are discharged via the cooling tower.

Flue-gas path and flue-gas scrubbing



Emissions

Germany's 13th Ordinance on Air Pollution Control and Noise Abatement (BImSchV) applies to the input of hard coal and petroleum coke in the new units. The emission thresholds are reliably observed. As evidence, the concentrations of dust, sulphur dioxide, carbon monoxide and nitrogen oxides in the flue-gas duct are continuously measured and analysed. All relevant emissions are transmitted to the supervisory authority using an officially recognized measuring and monitoring system by online data transmission.

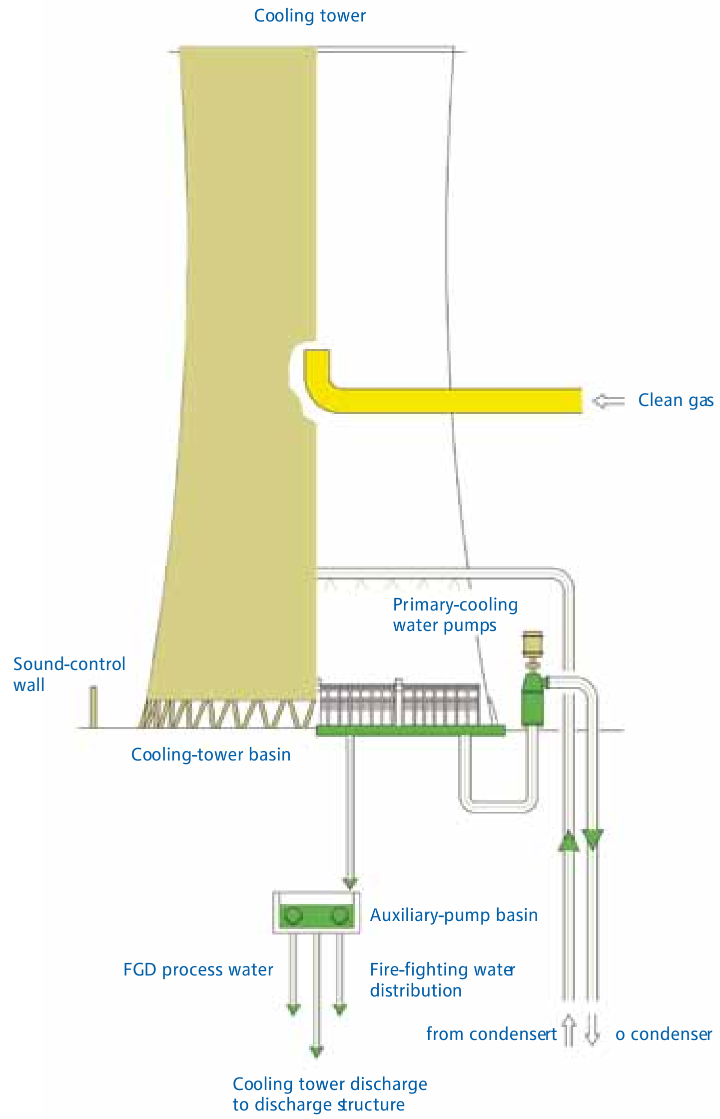
The noise-emission threshold under the Technical Instructions on Noise (TA Lärm), too, are observed. This is ensured, inter alia, by the planned sound-control walls at the base of the cooling towers, and by insulating plant parts, like the induced-draught fan. This was established by an independent expert with a detailed forecast for six measurement points in the plant's environs. The total emissions to be expected were established and assessed by an independent expert, taking account of the initial pollution level within the scope of a detailed noise-emission forecast in the run-up.

Substance	Daily average value pursuant to 13th BImSchV mg/m³ STP, dry	Half-hourly values pursuant to 13th BImSchV mg/m³ STP, dry
Total dust	20	40
SO_2	200	400
Degree of sulphur separation	> 85 %	> 85 %
NO_2	200	400
Hg bei 6 % O_2	0.03	0.05
CO bei 6 % O_2	200	400
	Mittelwert über die Probenahmezeit (i. N.,tr. 6 % O_2)	Mittelwert über die Probenahmezeit (i. N.,tr. 6 % O_2)
Cd, TI	0.05 mg/m³	0.05 mg/m³
Sb, As, Pb, Cr, Co,	0.5 mg/m³	0.5 mg/m³
Cu, Mn, Ni, V, Sn		
As, Cd, Co, Cr, benzo(a)pyrene	0.05 mg/m³	0.05 mg/m³
Dioxins and furans	0.1 ng/m³	0.1 ng/m³

Cooling tower

Powerful pumps transport the cooling water, at about 27° C, from the condenser to the cooling tower. There, it falls as rain at a height of some 15 m. In the upwind of the cooling tower (stack effect), it cools down to about 17° C.
In the process, a small part of the cooling water evaporates and must be replaced. A much larger share is collected in the so-called cooling-tower basin and pumped back to the condenser. So that the cooling towers can adhere to the noise thresholds, a sound-control wall is built around its base.

Cooling tower and cooling-water cycle



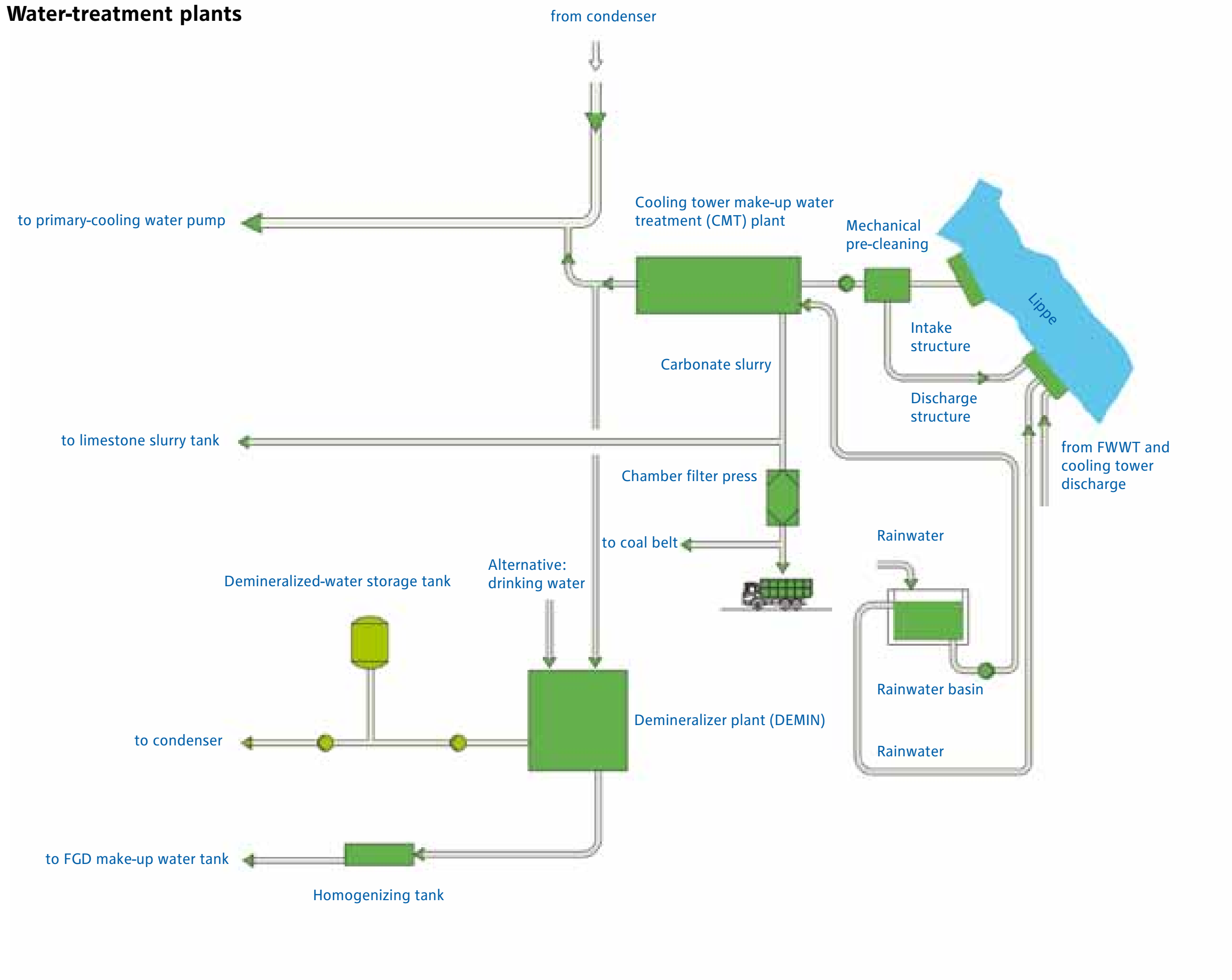
Water treatment

Power plants have two major water cycles: the water-steam cycle between steam generator, turbine and condenser, and the cooling-water cycle between condenser and cooling tower. The two cycles are not completely closed, but depend on additions of water, although the required water quantities must be expensively treated before being used. In the evaporation in the cooling tower, the extraneous, dissolved minerals stemming from the Lippe river remain in the cooling water and would impair its quality with growing concentration. This being so, a sub-stream of the cooling water is separated and re-used in the power-plant process as far as possible. Any unusable amounts are sent back to the Lippe.

The water amounts to be replaced are withdrawn from the Lippe as raw water. First, they are mechanically pre-cleaned using racks and screens. The raw water is then brought up to the necessary water quality in a treatment plant and added to the primary-cooling water.

By contrast, the water envisaged for the water-steam cycle must go through one more step: demineralization in a special plant. Alternatively, there is also the option of supplying the demineralizer plant with drinking water.

Water-treatment plants



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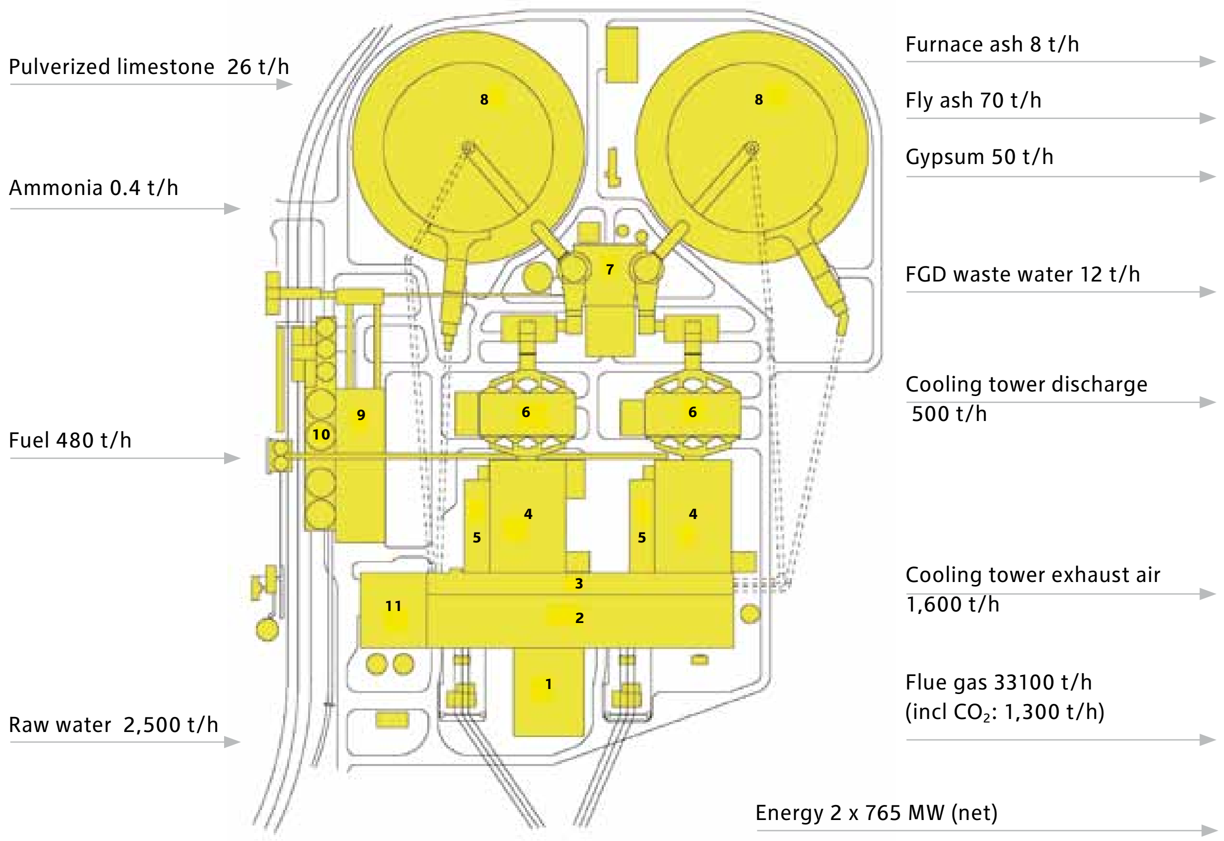
Important mass flux in normal operations (approximate values)



ENVIRONMENTAL COMPATIBILITY

The environmental-protection measures envisaged for the new power-plant units safely adhere to all statutory specifications. All the same, it is necessary to check whether the new units will have any impact on the environment, so that the project's environmental compatibility was investigated and assessed by TÜV NORD Systems GmbH & Co. KG as experts.

Backed by a number of technical expertises and data from the specialist authorities of the state of North Rhine-Westphalia (NRW), the implications for natural assets worthy of protection under the Law on Environmental Compatibility were established, taking account of the various interactions.

Air

To establish the initial pollution level, the data available from measuring stations of the State Office for Nature, the Environment and Consumer Protection NRW were analysed. By way of precaution, the initial pollution level was measured in addition at three locations (vicinity, Lippborg, Beckum). The measurements comprised the parameters dustfall and fine dust, each with an analysis of the heavy-metal concentrations, nitrogen oxides, sulphur dioxide, chlorine, fluorine, dioxins/furans and benzo(a)pyrene.

The analysis of the available data from the measuring network of the state of NRW and the results of the initial pollution level measurements showed that the initial level of all air pollutants is below or largely well below the air-quality thresholds.

Using the calculation methods prescribed by the Technical Instruction on Air-Quality Control (TA Luft), the additional air pollution from the new units was calculated, and the total pollution to be expected established. In addition, and by way of precaution, the extra pollution was established for which the TA Luft lists no air-quality thresholds. The calculated additional pollution refers in each case to the least favourable situation in the investigated area and to the max. permissible emissions from the new units. In normal operations, actual emissions and, hence, the additional pollution, too, are lower.

The bottom line of this observation is that the permissible air-quality thresholds will be undercut in future total levels for all pollutants as well.

Climate

As regards the investigated meteorological parameters clouding, fog formation, humidity, precipitation amount as well as dew, white-frost and ice formation, merely short-term implications for the environs are forecast. Measurable effects in an annual mean are only expected from the shadow cast by the cooling towers and their plumes, and from the associated reduction in the hours of sunshine. The project is not expected to bring any overall, relevant changes to the micro-climate in the environs of the plant location.

Since the emission allowances allocated to the power-plant new-build under Germany's Greenhouse-Gas Emission Trading Law (TEHG) are allocated in line with the total CO_2 emission amounts available, and any difference must be covered by buying in emission rights, it is ensured that the CO_2 emissions from operating the planned hard coal-fired twin units slot into the national climate-protection concept for lowering greenhouse gases.

Prepared for CO_2 capture

RWE Power feels an obligation to meet the energy and climate targets, so that the Company is engaged in vigorous research into zero-CO_2 coal-based power generation. For this, RWE Power is investing well above € 1 billion. From the results, the power station in Westfalen, too, will benefit. The new units are already designed in such a way that they can later be retrofitted with economically defensible CO_2 flue-gas scrubbers.

Soil

The two new power-plant units will be erected on the existing power-station terrain. For the structures and traffic infrastructure, a surface of some 11 ha will be used and permanently concreted. Further surfaces on a scale of 25 ha will be used temporarily during the construction phase. No particularly sensitive or soil worthy of protection is affected by the land use.

Due to the low additional burdens from air pollutants resulting from the operation of the plant, no relevant additional pollution need be expected for the soil in the two units' area of impact owing to the deposition of air pollutants.

Water

Water, as an asset worthy of protection, is divided into groundwater and surface water.

According to the results of the soil analyses, no extensive lowering of the groundwater level is necessary during construction.

The sealing of the surfaces for the structures and traffic infrastructure leads to a lowering of the local rate of groundwater recharge. Owing to the newly concreted surfaces and the groundwater situation, no change to the regional rate of groundwater recharge is expected, however. Since – due to the low additional burdens from air pollutants resulting from the operation of the plant – no relevant additional pollution is to be expected for the soil in the two units' area of impact from the deposition of air pollutants, no relevant additional pollution for the groundwater via the soil > groundwater impact path need be assumed, either.

Among the surface waters, the Lippe river is of special significance, because water is withdrawn from the Lippe to offset the evaporation losses in the heat discharged via the cooling towers, and some of the cooling-tower water is discharged into the Lippe together with the treated FGD waste water.

The Lippe, in the area between Hamm and the confluence with the Rhine, is affected by numerous waste-water discharges and water withdrawals for cooling purposes. Accordingly, it is burdened materially and thermally. The largest quantity of the water discharged by the Westfalen power plant has the quality of concentrated Lippe water without any relevant, chemical additions. Due to the low amount of treated FGD water discharged, relative to the Lippe's flow rate, no relevant changes to the chemical water quality of the Lippe downstream of the discharge point need be expected in the future.

The warming of the Lippe water associated with the discharge of cooling water is restricted under the specifications of Germany's Fish-Water Quality Ordinance (FGQV). The max. warm-up range will amount to 3° K in future. Normally, the warm-up range in the aimed-at operating mode, at values of 0.2-0.3 K, will be well below this.

Overall, no relevant changes to the Lippe's water quality are expected from the water withdrawals and the discharges. This being so, no substantial, adverse implications for the flora and fauna in the Lippe need be feared. For the waters in the power plant's farther environs, just like in the case of soil and groundwater, what applies is that, due to the low additional burdens from air pollutants resulting from the operation of the plant, no relevant additional burden from the deposition of air pollutants is forecast.

Plants, animals, biotopes, landscape

With the erection of the structures and the traffic infrastructure, incl ancillary surfaces, biotopes on an area of some 20 ha will be permanently used up. Furthermore, a surface totalling about 25 ha will be needed during the construction phase for site set-up surfaces, parking spaces and infrastructure facilities. The area affected by the building interference are mainly fallow surfaces on the works' terrain involving wild-growing areas, bushes and young succession-forest surfaces. The biotopes used during the construction phase mainly concern arable land, some fallow arable land as well, grassland and copses. No biotopes specially worthy of protection are used. The project is also associated with impairments to the fauna – especially bird fauna – by the loss of breeding habitats, noise and disruptive effects.

No disadvantageous implications for plants, animals and biotopes from air pollutants need be expected due to the low additional pollutants resulting from operating the plant. This is true of both direct implications from gaseous pollutants and dusts, and of implications via the soil > plants > animals path by any enrichment with pollutants down the food chain.

Overall, the impairments for plants, animals and biotopes must be classified as considerable due to the land use. However, thanks to the envisaged compensation measures, these are offset in their entirety.

The construction of the two units with two cooling towers measuring approx. 165 m as the biggest structures will also cause a considerable impairment of the landscape within a radius of some 10 km. In this respect, it must be taken into account that the power-plant location is already marked by industrial use and, due to the existing power station with its cooling towers, a considerable initial burden exists for the landscape.

The interference with nature and landscape is compensated in line with the specifications of NRW's Landscape Act by taking landscape-management measures. The measures are described in an accompanying landscape conservation plan.

Humans

Relevant impairments for the residents in the power plant's vicinity need be expected neither from air pollutants nor from noise. In both cases, the various air- and noise-pollution thresholds will be safely observed in the future as well.

Any strain on the air from germs constituting a health hazard can likewise be excluded. This is evidenced by measuring the germ pollution in the cooling water and the air at comparable locations.

Overall assessment of environmental compatibility

Overall, the investigations and data analyses showed that the impairments of air, climate, soil and water must be classified as low and, hence, as insignificant. For humans, too, no relevant impairments are expected. Plants, animals and humans are exposed neither directly nor indirectly via interaction to any relevant pollutants. Any impairments for nature and landscape resulting from the use of biotopes during the project and any implications for the landscape are offset by taking landscape-management measures.

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