



Voerde Power Plant



Power and heat for the future

As fifth biggest electricity producer in Germany, with ultramodern power plants in and outside Germany and a variety of services, STEAG GmbH safeguards the energy supply of the future – reliably, efficiently, and with low environmental impact. STEAG blazes the trail for the energy sources biomass, biogas, mine gas, geothermics, wind and solar thermics. The engineers of STEAG Energy Services GmbH develop, build and operate power plants all over the world and are experts for the modernization of existing plants and for made-to-measure energy supply which goes easy on the climate and at the same time is economical.

Power plants at home and abroad

STEAG operates eleven power plants at ten locations in Germany with an installed capacity of about 7,500 MW; nine of these plants use hard coal as primary energy source. At two sites, each of which integrates an industrial power plant, refinery by-products also are used to produce steam, compressed air and electricity. Most of the electricity from hard coal is supplied to industrial and public utilities. The customers include RWE, EnBW and Deutsche Bahn, the German Railways. Where there is a demand for it, cogeneration – the simultaneous production of power and useful heat – is practiced. This heat either is used for heating purposes or is purchased by industrial enterprises in the form of process heat for their production processes. Outside Germany, too, the company contributes to public power supply with three hard-coal-fired power plants, capacity about 1,700 MW, in Turkey, Colombia and the Philippines. The efficient power plants of STEAG make an active contribution to a secure and sustainable supply of energy.



Power plants in double pack

STEAG operates two power plants at the Voerde site: Voerde and West, each with two units. With an installed capacity of 2,234 megawatts (MW), Voerde is STEAG's biggest power plant site. The two units of power plant West are wholly owned by STEAG, while the two units of Voerde belong to Kraftwerk Voerde STEAG-RWE oHG, in which STEAG holds a 75 percent stake. RWE owns the remaining 25 percent. Around 7.5 billion kilowatt-hours (kWh) of electricity annually are generated at the Voerde site. This is enough to supply the electricity needs of 1.9 million single-family households. The coal yard holds 350,000 tons of coal; this capacity permits offsetting fluctuations in delivery and consumption.

The Voerde site has three stacks with heights of 230, 218 and 250 meters (the 250-meter stack has been out of operation since 2005). The 230-meter stack was erected in 2005 in connection with the partial renewal of the flue gas desulfurization plant and is used by the units Voerde A and B. The 218-meter stack belongs to the units West I and West II. A public road leads through the site, Frankfurter Strasse, which connects the town of Voerde with Dinslaken and Duisburg-Walsum.

Optimal location on the Rhine

The location on the Rhine River affords optimal conditions for Voerde: coal can be transported by ship and delivered to the plant by rail, a competitive and environment-friendly procedure. Gypsum, fly ash and granulate in turn leave the power plant by ship. The Rhine ensures the supply of water to the plant.



The power plant process

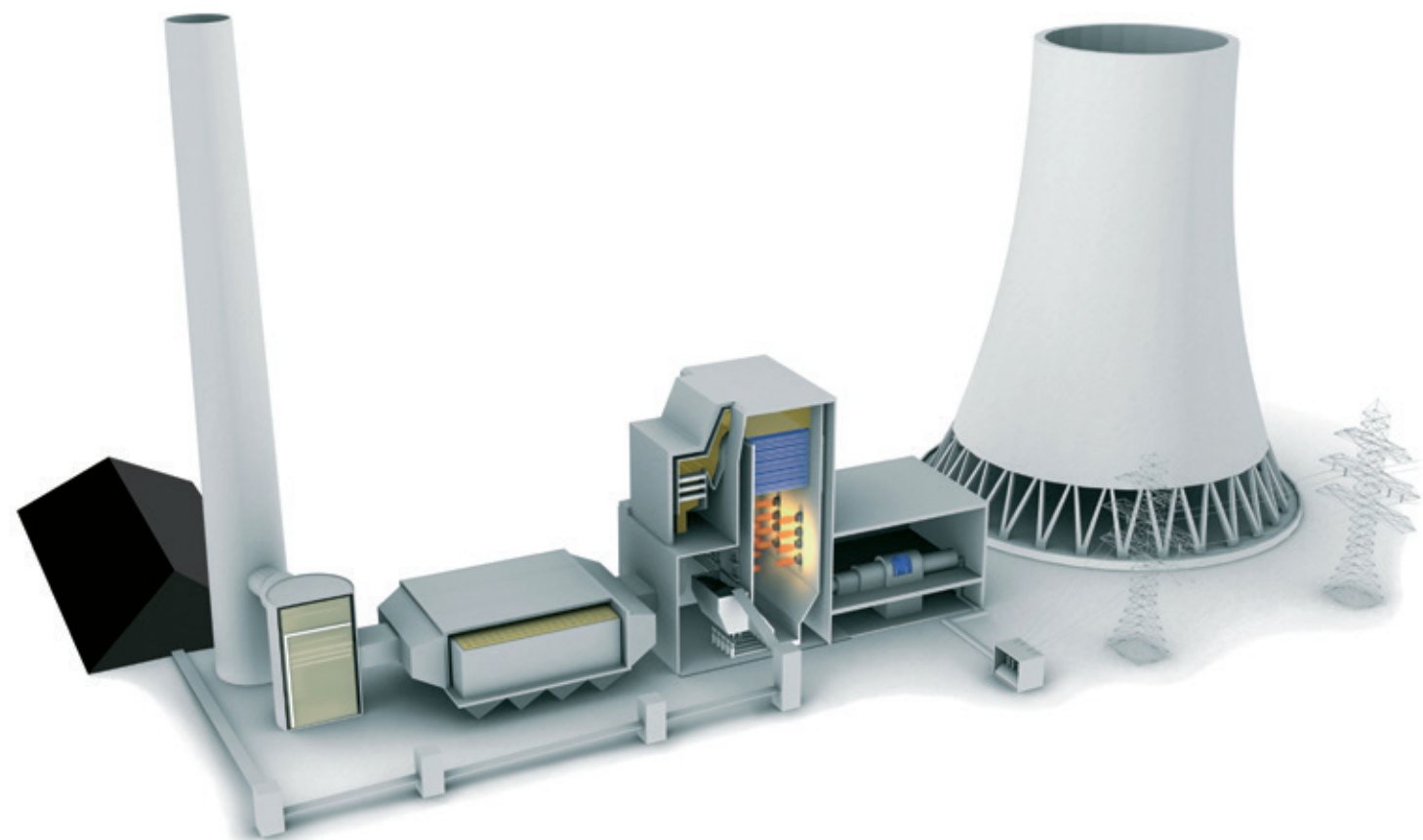
Up to 1,200 tons of hard coal per hour can be transferred from storage to the coal bunker of the Voerde power plant. From there, in the same period of time as much as 72 tons go to each coal mill. The mills pulverize the fuel, which is dried with hot air and then burned in the furnace.

During combustion, hot flue gas is formed. As it passes over kilometers of tubes in the steam generator, the flue gas heats water to make steam. The steam, which reaches a temperature of up to 530 °C and is under high pressure, is conducted into a turbine where it impacts the turbine blades and causes the turbine shaft to rotate.

A connected generator produces electricity from this motion, like a dynamo. Transformers bring the electricity up to the necessary voltage and feed it into the grid.

When the steam has finished its work in the turbine it is conducted into a condenser. This is a large heat exchanger with many tubes in which cooling water circulates. The steam comes in contact with the tubes and forms droplets (condensation), much like humid air on a cold window pane. The condensed water droplets are collected and pumped back into the boiler to complete the cycle.

In the process the cooling water from the condenser heats up from about 20 °C to 30 °C. It is piped into cooling towers where it cascades down and cools off again. A small portion evaporates and is replaced by water from the Rhine River. Only pure water vapor escapes from the cooling towers.



Schematic illustration of the power plant process

From the viewpoint of physics, energy is not produced, but merely transformed. The energy is fixed to the coal in chemical form. The coal is burned in the boiler; the released heat heats up water. This gives rise to hot steam (thermal energy) which drives a turbine (mechanical energy). A connected generator then transforms this mechanical energy into electricity (electrical energy).



Protecting the environment

When coal is fired, flue gases form which contain mainly particles of ash, dust, nitrogen oxides and sulfur dioxide. For many years STEAG has been using highly effective methods to reduce the emissions of these substances. When a power plant is built today, a third of the expenditure goes into environmental protection, most of it into air pollution control. STEAG will make substantial investments in environmental protection in future too. The emissions of the power plant are continuously measured. The company's environmental protection officers monitor and evaluate the measurements. In addition they have independent bodies like the German inspecting authority TÜV make measurements.

Natural diversity around the power plant

In the vicinity of the Voerde plant, STEAG manages the 500 hectare „Rheinaue Walsum“. This river meadow landscape is in a near-natural state and features a great ecological diversity, providing a habitat for a host of rare plant and animal species, including stone martens, dragonflies, peewits, black-tailed godwits and mute swans. Immediately adjoining the plant site are 200 contiguous hectares of mixed woodland, which STEAG also keeps in a near-natural state. An extensive network of bicycle paths and hiking trails provides access to meadows and woodland, which serve as a greenbelt recreation area. Not far from the power plant is the „Scholtenhof“ estate, where STEAG practices organic farming on 300 hectares of land. The products are marketed in the farm's own shop.

Valuable by-products

The STEAG subsidiary STEAG Power Minerals GmbH is responsible for recycling the by-products of all STEAG hard-coal-fired power plants in Germany. Power plant by-products which originate in the firing process are valuable and are marketed: The by-products include fly ash, boiler sand, slag tap granulate and FGD gypsum.

These power plant by-products are environmentally sound and can be used in almost all applications as construction materials without impairing the soil or groundwater. Treatment is only necessary in special cases. In contrast to the natural resources which are becoming increasingly scarce, power plant by-products will be available in the longer term, conserving natural raw materials.



A site with a tradition

At the Voerde site the power plant with two 350 MW units (West I and West II) was erected in 1970/71. In 1982 unit A of Voerde (710 MW) followed, and in 1985 Voerde B, also with 710 MW. Both units were equipped with flue gas de-sulfurization (FGD) systems. In 1987 flue gas desulfurization systems also were installed in the West units.

The installation of nitrogen oxide reduction systems in both power plants then followed in 1989. In December 2005 the two FGD systems of the Voerde units were partially renewed, increasing the capacity of each unit by 51 MW.

Data and facts *

Installed capacity	Total: 2,234 MW Power plant Voerde: 1,522 MW Power plant West: 712 MW
Steam rating per unit	980 to 2,160 t/h
Steam pressure in turbine	180 bar
Steam temperature	530 °C
Useful electricity output	7.5 billion KWh/a
Annual coal consumption	about 2,890,000 t/2,520,000 tce
Components	2 pulverized coal (PC) fired Benson boilers - wet ash removal (980 t/h each) 2 PC-fired Benson boilers – dry ash removal (2,160 t/h) 4 turbine generators (2 x 356 MW, 2 x 761 MW)
Cooling tower	Height 161 meters
Water vapor escaping from cooling tower	2,000 m³/h
Dust removal	Electrostatic precipitator
Flue gas desulfurization (FGD)	Wet scrubbing with lime slurry
NO _x removal (DeNO _x)	Catalytic SCR process
By-products	Granulate, furnace bottom ash, fly ash, gypsum
Initial start-up	West I and II: 1970/71 Voerde A and B: 1982/85
Operator	Power Plant Voerde: STEAG GmbH Power Plant West: STEAG GmbH
Owner	Power Plant Voerde: STEAG GmbH und RWE Power AG Power Plant West: STEAG GmbH

STEAG refers to the gross maximum capacity under nominal conditions as **installed capacity**. This is the continuous output that can be attained under normal conditions. It is limited by the weakest part of the plant (bottleneck), is determined by measurement and converted to normal conditions; stated in MW, calculated as MW electric and equivalent (thermal output).

The **standard coal equivalent or ton of coal equivalent** (tce) is a commonly used unit of measure in Central Europe, though not a statutory unit of measure, to compare the energy content of primary energy sources. 1 ton coal equivalent = 29.3076 gigajoules (GJ) = 8.141 thermal megawatt-hours (MWh_{th}).

* as at December 31, 2011

STEAG GmbH

Rüttenscheider Strasse 1–3
45128 Essen

Germany

Phone +49 201 801-00

Fax +49 201 801-6388

Email info@steag.com

www.steag.com

Voerde Power Plant

Frankfurter Strasse 430

46562 Voerde

Germany

Phone +49 2855 12-2001

Fax +49 2855 12-1091

Email kraftwerk.voerde@steag.com