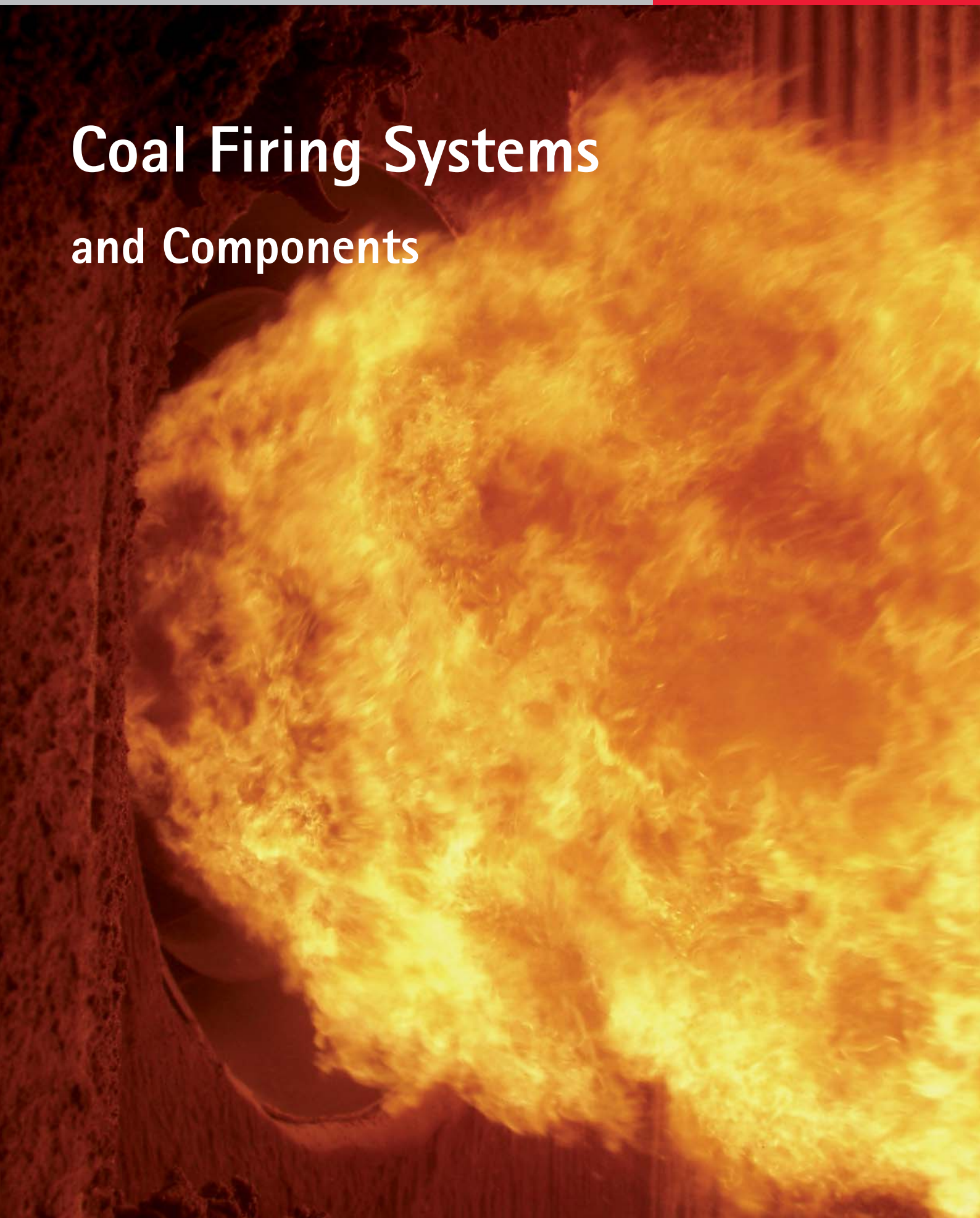
HITACHI
Inspire the Next

Coal Firing Systems

and Components

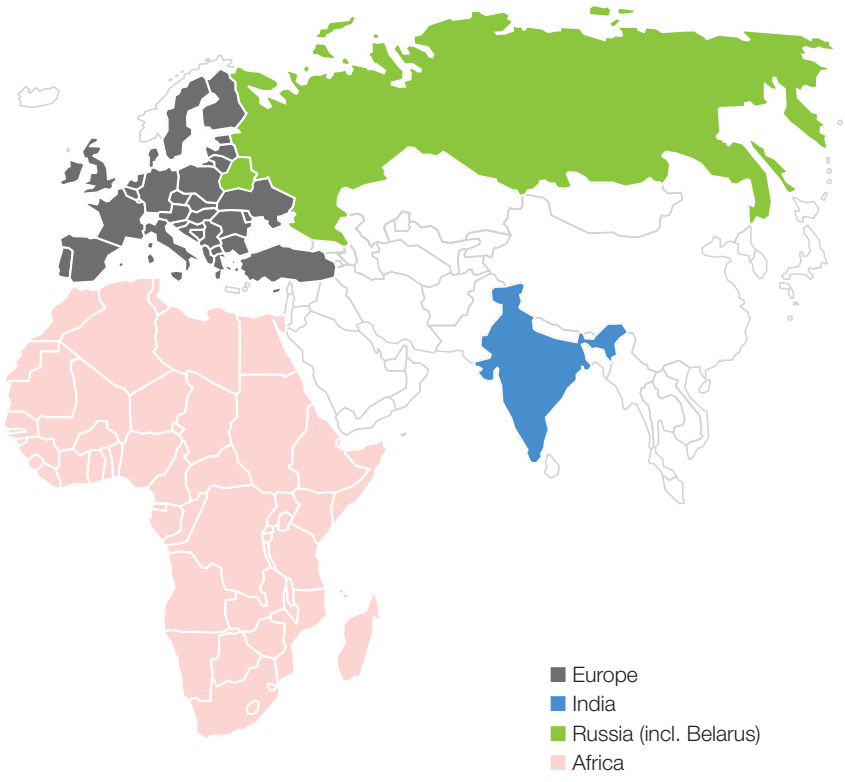


Hitachi Power Europe

Technology leader with excellent references

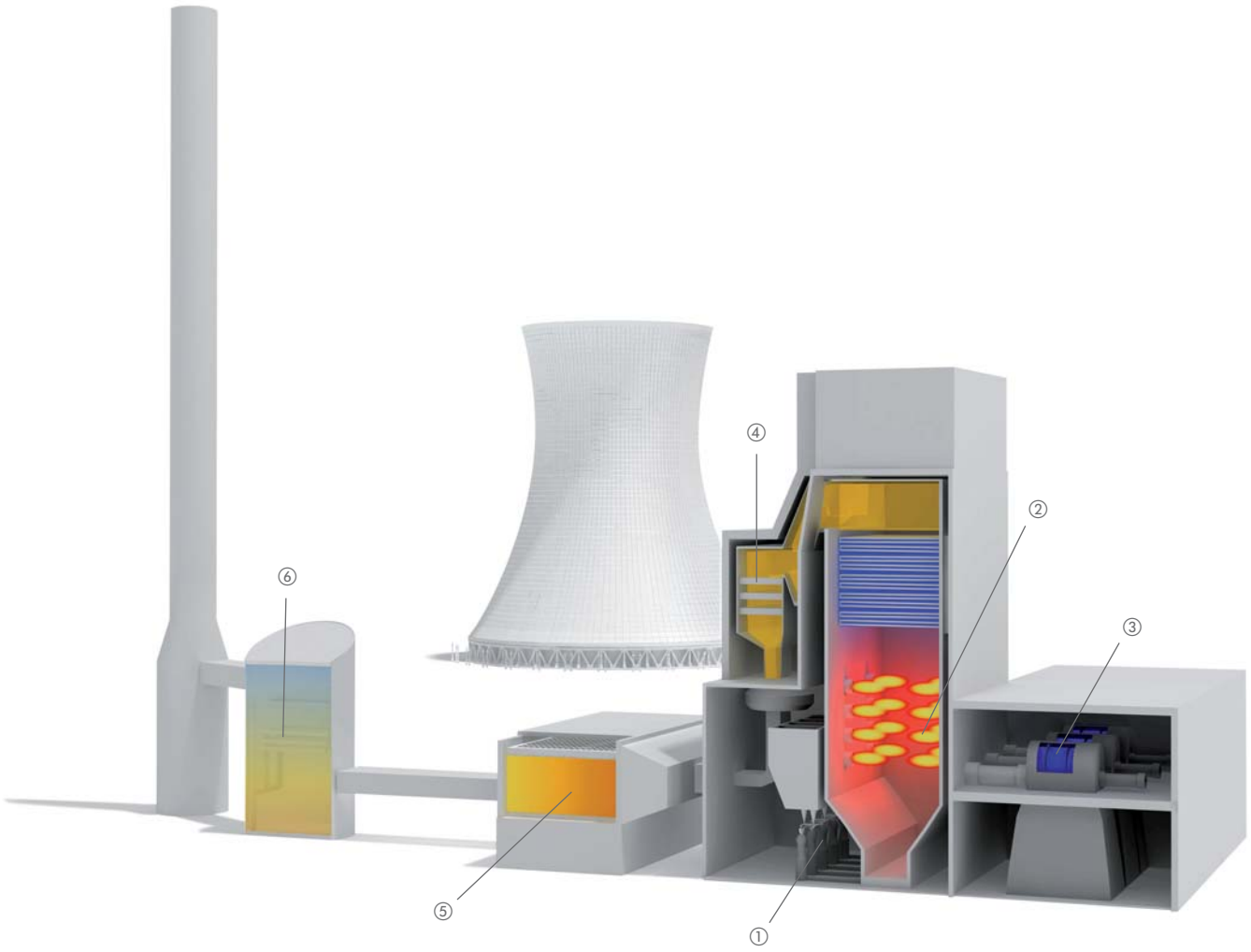
Whether as a plant constructor or as a supplier of key components, Hitachi Power Europe GmbH (HPE) is one of the technology and market leaders in fossil-fired power plants.

The company – a subsidiary of Hitachi, Ltd. – has its head offices in Duisburg. HPE designs and builds not only power plants but also supplies all the key components such as utility steam generators, environmental engineering, turbines and pulverizers. In so doing, HPE can turn back to a track record going back over many years, an extensive list of references and to the outstanding know-how of its workforce. Within the Hitachi Group, HPE is responsible for the markets in Europe, Africa, Russia (incl. Belarus) and India.



Contents

From Coal to Electricity



❶ The raw coal is crushed into fine particles in the coal mills before being injected into the furnace.

❷ Flue gases with a temperature up to 1,450 °C arise from the pulverized fuel being burnt in the steam generator furnace. The liberated heat is used to generate high-pressure and high-temperature steam.

❸ The steam is directed into a turbine; it flows onto the blade wheels and turns the turbine shaft. An attached generator then generates the electrical power.

❹ With the help of catalysts, the nitrogen oxides in the flue gas react in the $DeNO_x$ system to produce nitrogen and water vapor.

❺ Ash particles in the electrostatic precipitator adhere to electrically-loaded surfaces; they are rapped and removed from the flue gas.

❻ In the flue gas desulphurization system (FGD) lime slurry or limestone suspended dust particles bind the sulphur dioxide from the flue gas. The final product is gypsum.

Ensuring economic efficiency, conserving resources

As one of the global cutting-edge companies in power plant design and construction, Hitachi Power Europe provides highly advanced firing systems which can be used in their entirety or as single components for practically all fossil fuel qualities.

Project	Country	Customer	MW	Fuel	Order obtained
Niederaußem	Germany	RWE Energie AG	1 x 1,012	Lignite	1995
Boxberg Q	Germany	VEAG	1 x 907	Lignite	1995
Elbistan B	Turkey	TEAS	4 x 360	Lignite	1998
Dezhou 5/6	China	CNTIC	2 x 660	Anthracite	1998
Hamborn	Germany	RWE Energie AG	1 x 260	Blast Furnace Gas	1999
Iskenderun	Turkey	Siemens/STEAG	2 x 660	Hard Coal	2000
Neurath F&G	Germany	RWE Rheinbraun AG	2 x 1,100	Lignite	2003
Baosteel	China	Baoshan Iron & Steel Co. Ltd	1 x 350	Blast Furnace Gas, Coke Oven Gas, Heavy Fuel Oil	2005
Boxberg R	Germany	Vattenfall Europe	1 x 670	Lignite	2005
Walsum 10	Germany	Evonik	1 x 790	Hard Coal	2006
Moorburg A/B	Germany	Vattenfall Europe	2 x 820	Hard Coal	2006
Datteln	Germany	E.ON Kraftwerke	1 x 1,100	Hard Coal	2006
Gent	Belgium	Electrabel	1 x 300	Blast Furnace Gas	2006
Medupi	South Africa	Eskom	6 x 790	Hard Coal	2007
Maasvlakte	Netherlands	E.ON Kraftwerke	1 x 1,100	Hard Coal	2008
Wilhelmshaven	Germany	Electrabel	1 x 750	Hard Coal	2008
Kusile	South Africa	Eskom	6 x 790	Hard Coal	2008

Selection of steam generator orders since 1995

HPE develops solutions, which are just as flexible as our customers' requirements, for energy suppliers and industry alike. This can be seen most clearly from the large number of different types of references (see table) available.

A high degree of operational efficiency and conservation of resources/environment is looked upon as an obligation and challenge by HPE in designing and manufacturing new utility steam generators.

This also applies to the modernization and enhancement of existing power plants and their components, such as pulverizers and burners.

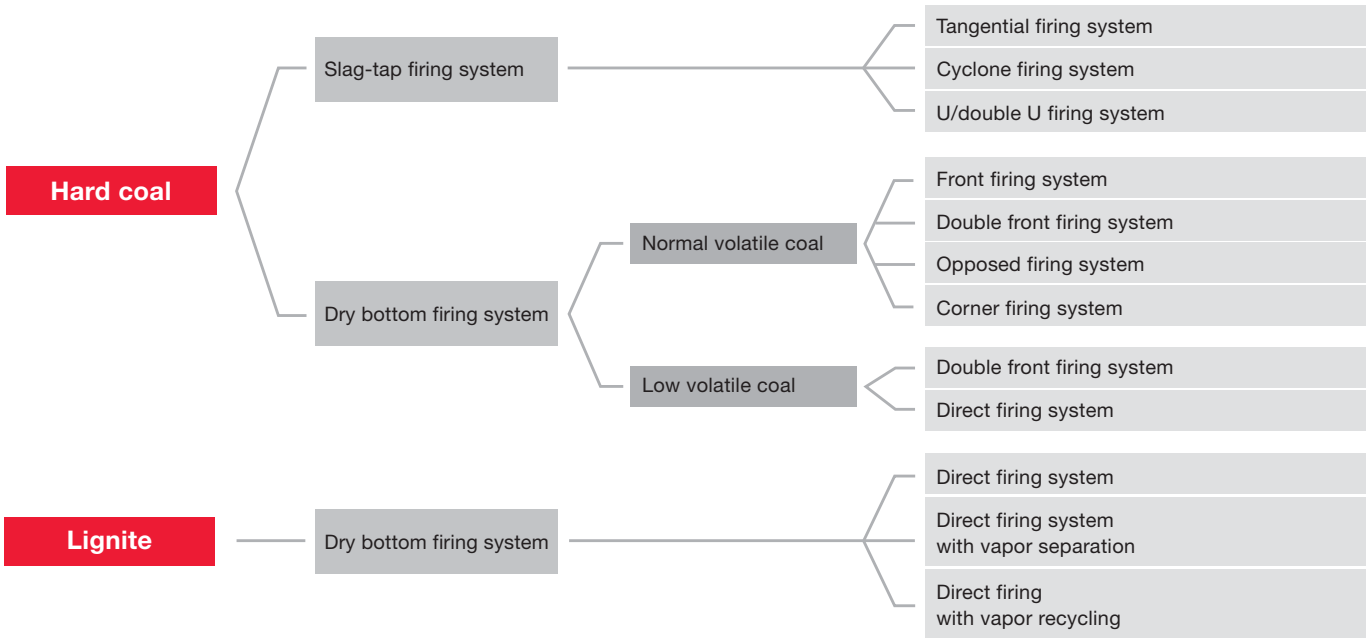
It goes without saying that HPE as a certificated DIN ISO 9001 company always orientates itself to the best possible quality.

What counts is the choice

The planning and design of firing systems is primarily dependent on the fuel used and must be individually tailored – something requiring above-average achievements on the part of our designers.

Whilst there is no secret about up-to-date firing systems, one still needs considerable know-how and a long track record in plant concepts and specific sequences. Playing a prime role here are the fuel properties themselves, such as calorific value, moisture and ash content, volatiles and coal grindability.

Advanced firing systems with a staged combustion sequence lower emissions and require substantial design and material selection outlay on the basis of the standards and legislation in force. This applies equally to the selection and construction of the firing components.



Pulverized hard coal firing system

Fossil-fired power plants are currently enjoying a boom across the world. And hard coals, in particular, can be widely used for energy transformation purposes.

The decision to design a firing system with dry bottom ash removal or as a slag-tap furnace largely depends on the fuel properties themselves.

Volatile matter, ash content and chemical ash composition have always been of decisive significance.

The decision-making process was simplified with the launching of innovative DS burners followed by tremendous combustion stability. Modern steam generators are usually designed today solely as dry ash discharging boiler plants at low cost and high efficiencies. This applies to practically the entire range of fuels irrespective of their effects from high volatile bituminous coal to anthracite.

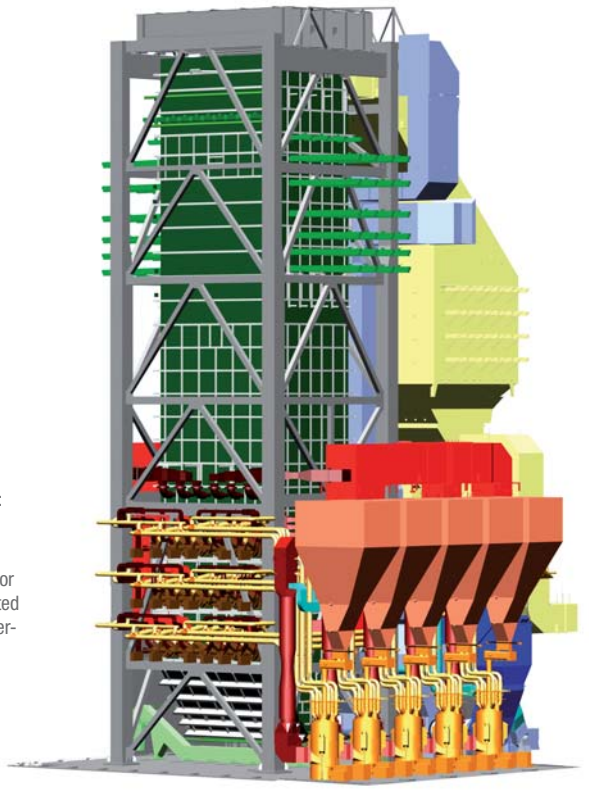
For many years now, the linear arrangement as front, double-front or opposed firing equipment complete with vertically offset burner levels has proved to be the most suitable system for pulverized hard coal firing systems.

Their principal features are:

- Uniform liberation of heat
- Low nitrogen oxide emissions coupled with practically a total fuel transformation
- Oxygen-rich flue gas atmosphere right next to the boiler tube walls

The clear arrangement of mill and burner level ensures that the highly complex systems are clearly designed and arranged. This, in turn, creates a high degree of accessibility and ease of maintenance.

- 1 x 1,100 MWel / 1 x 2,939 t/h
- Benson® Steam generator
- Hard coal
- Steam parameters: Superheated steam: 600 °C / 305 bar; Reheater: 620 °C / 78 bar
- Entering into service: 2011
- Scope of delivery: Utility steam generator including all the related components, engineering, installation and commissioning



CAD model of the Datteln 4 utility steam generator

Pulverized lignite firing system

Directly injecting firing systems are required for pulverized lignite. Vapor separation may be required in exceptional circumstances depending on the ash content and calorific value of the coal.

Even with the usage of very high ash lignites, the new HPE lignite swirl burners (RS burners) do not, as a rule, need any vapor separation.

The excellent igniting stability of the RS burners allows the burners to be arranged in a different way at the combustion chamber – for instance in the form of an all-wall firing system. Such a system combines the benefits of linear firing equipment with those of a tangential firing system. The firing steps alone enable the 200 mg/m³ NO_x standard to be undercut in RS burners. As a result, there is no need for complex, multiple air-staging concepts for adherence to the NO_x standards.

The stable ignition of RS burners produces a marked improvement in the percentage load operations of lignite firing systems. Even with problematical fuels, the excess stoichiometric operation of these burners has a positive effect on fouling and slagging and it optimally protects the evaporator tube walls from corrosive flue gas products.

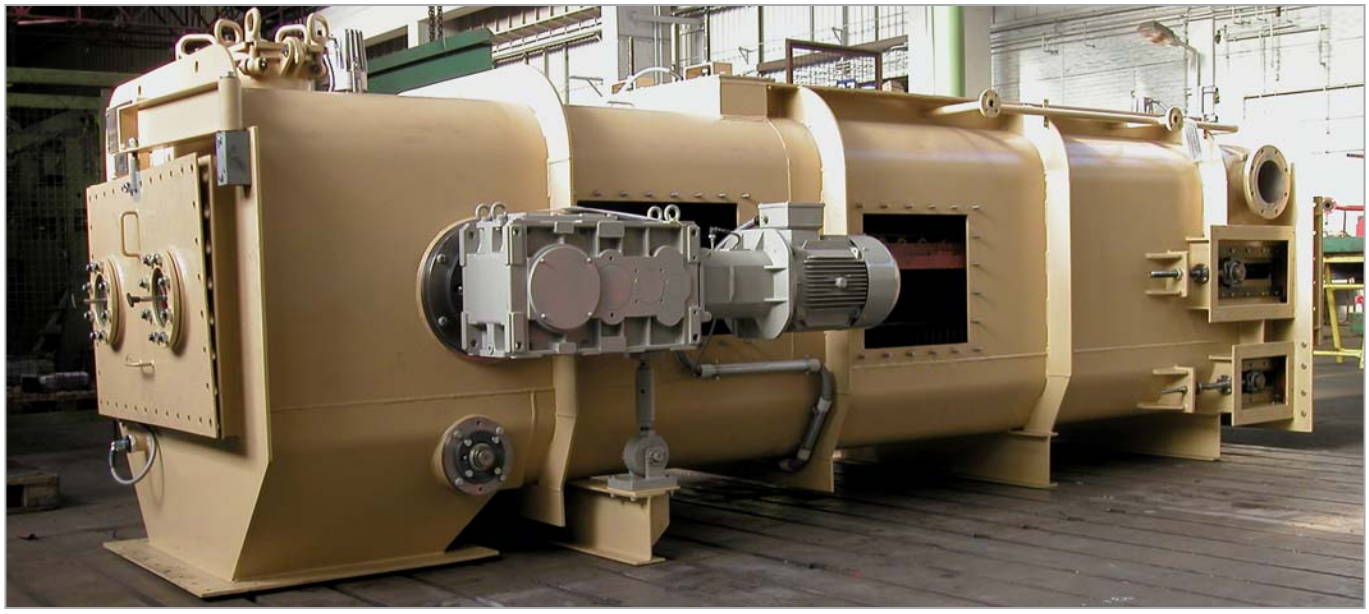
The future will see boiler plants mainly being planned for the use of dry pulverized lignite with interim storage.

- 1 x 670 MWel / 1 x 1,710 t/h
- Benson® Steam generator
- Lignite
- Steam parameters: Superheated steam: 600 °C / 315 bar; Reheater: 610 °C / 72 bar
- Entering into service: 2010 / 2011
- Scope of delivery: Utility steam generator including all the related components, engineering, installation and placing into service

CAD model of the Boxberg R utility steam generator

Reliability even under demanding requirements

Designed as coal bunker dischargers, the mill feeders supply the pulverizers with raw coal – evenly dosed and in keeping with boiler load requirements.



Belt conveyor

Even under very demanding requirements, the Hitachi Power Europe designed mill feeders operate both reliably and safely.

Experienced HPE staff establish the optimum feeder in keeping with the requested fuel quantity, design directives (including DIN EN 12952-9, NFPA 85 F) and customer requirements (for instance, volumetric and gravimetric metering).

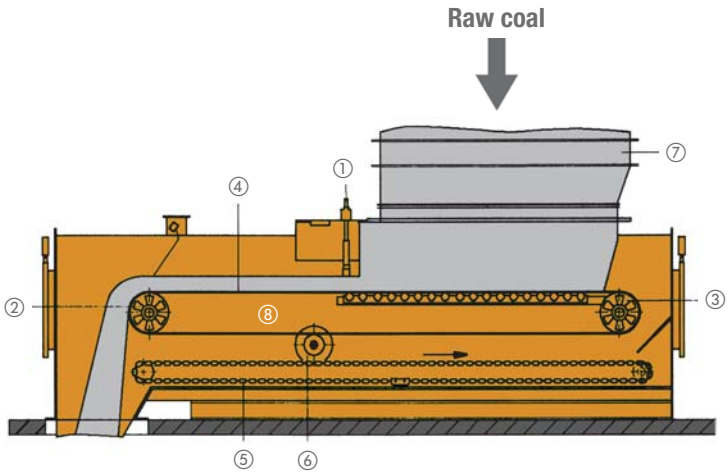
Other selection factors are the various bulk material properties, such as coal flow and erosion behavior.

The belt speed is determined by the quantity conveyed. Purge air is supplied to the housing to stop condensate forming and, in turn, to stop corrosion.

In hard coal boiler units, belt conveyors are used to discharge the raw coal from the bunker. In lignite plants, drag-chain conveyors together with belt conveyors are used to discharge the raw coal from the bunker.

Belt conveyor

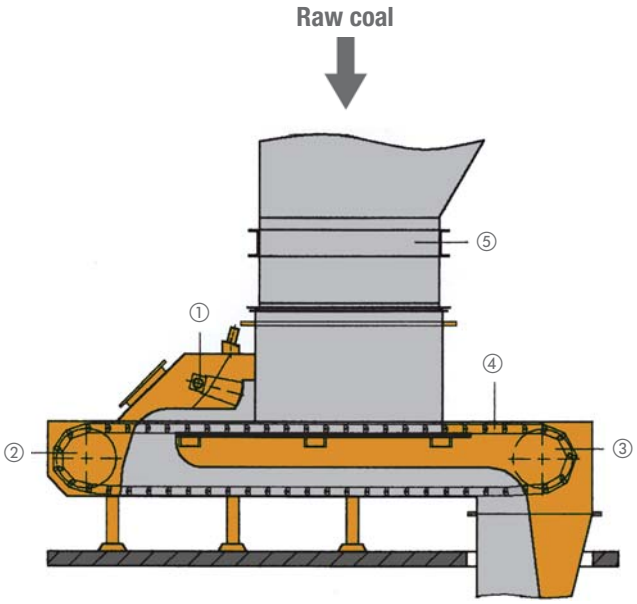
The belt conveyor with corrugated edge belt ensures high outputs, uniform bunker discharge and continuous mill charging – even under low conveying rates. This design permits volumetric/gravimetric metering and quantities conveyed of up to 120 t/h. Conveyed material falling to the bottom of the feeder is transferred to the coal downcomer by the simultaneously running scraper chain.



1. Bed depth limiter
2. Belt drive station
3. Belt tensioning station
4. Corrugated edge belt
5. Scraper chain
6. Lower belt supporting roller
7. Bunker shut off gate
8. Conveyor-type weigher (optional)

Drag-chain conveyor

Drag-chain conveyors are meant for limited conveyed quantities of up to approx. 40 t/h – this can, in special cases, be raised to 70 t/h. The fuel is discharged opposite to the direction of conveying. The drag-chain conveyor principle allows both a compact design with minimum spacing between bunker discharge and conveyor dumping as well as a possible large spacing between material charging and dumping.



1. Bed depth limiter
2. Belt drive station
3. Tensioning station
4. Forged fork link chain
5. Bunker shut off gate

Excellent results

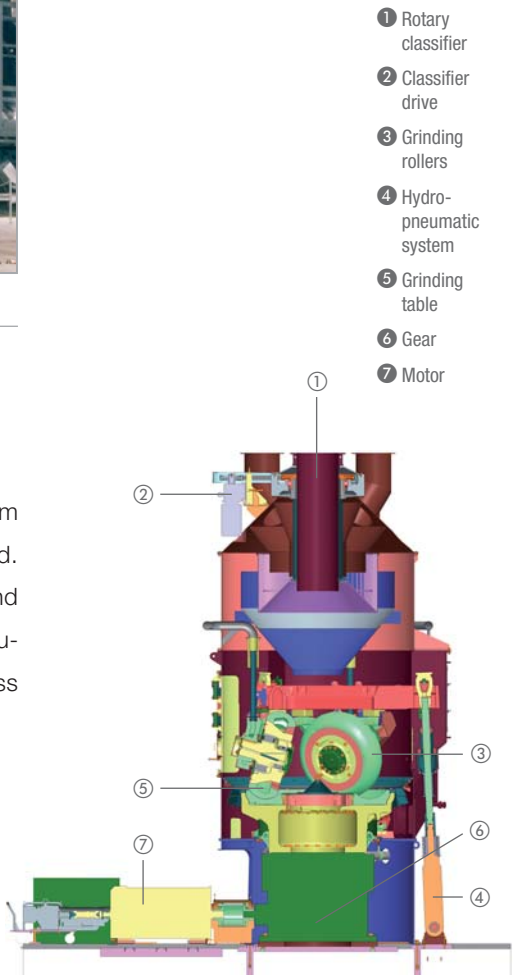
In the mills, the raw coal is simultaneously pulverized, dried and evenly distributed to the coal burners. Hot air or flue gases transfer the pulverized fuel to the burner and reduce the moisture in the coal.

MPS® Mill

MPS® Bowl & Roller Mill

The MPS® bowl & roller mill from Hitachi Power Europe grinds and dries hard coals and difficult-to-grind lignite with a low moisture content to pulverized fuel and distributes them evenly directly to the burners.

Various-sized mills for throughputs ranging from 10 t/h to 200 t/h can be supplied. Constant refinements and improvements have led to excellent crushing results with high fineness grades from raw coal found throughout the world. The positive operating properties and low energy requirements have contributed in no small measure to the success of these mills.

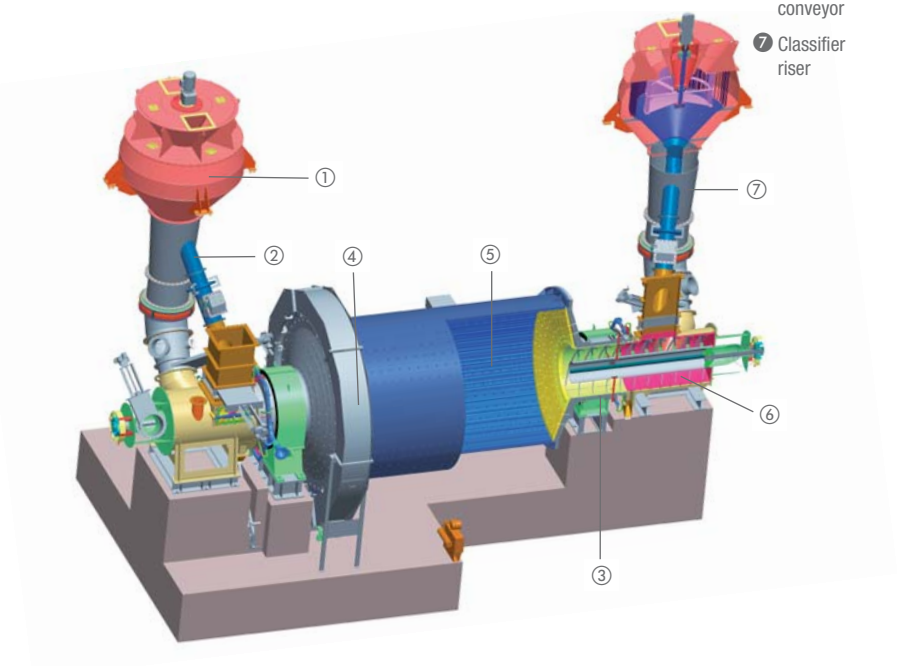


Long service life

RKD Mill

RKD Tube Ball Mill

The Hitachi Power Europe RKD tube ball mill grinds and dries difficult-to-pulverize hard coals (particularly low-volatile coals such as lean coal and anthracite). This mill type can deal with approx. 150 t/h of coal. Depending on size and space, the tube ball mill can be designed with drum or neck bearing and be of the single or double pass type.

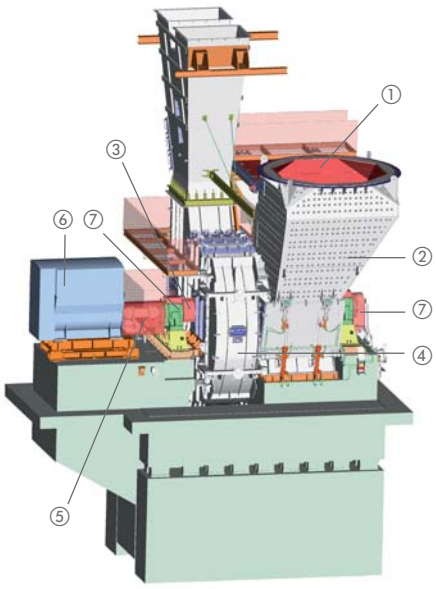


1. Rotary classifier
2. Oversize return
3. Neck bearing
4. Drive gear rim
5. Grinding ball filling
6. Feed spiral conveyor
7. Classifier riser

Low energy requirements

Pulverizing lignite is particularly challenging in view of its high moisture content and the considerable throughputs involved. Here again Hitachi Power Europe has the right products in this segment.

DGS Mill

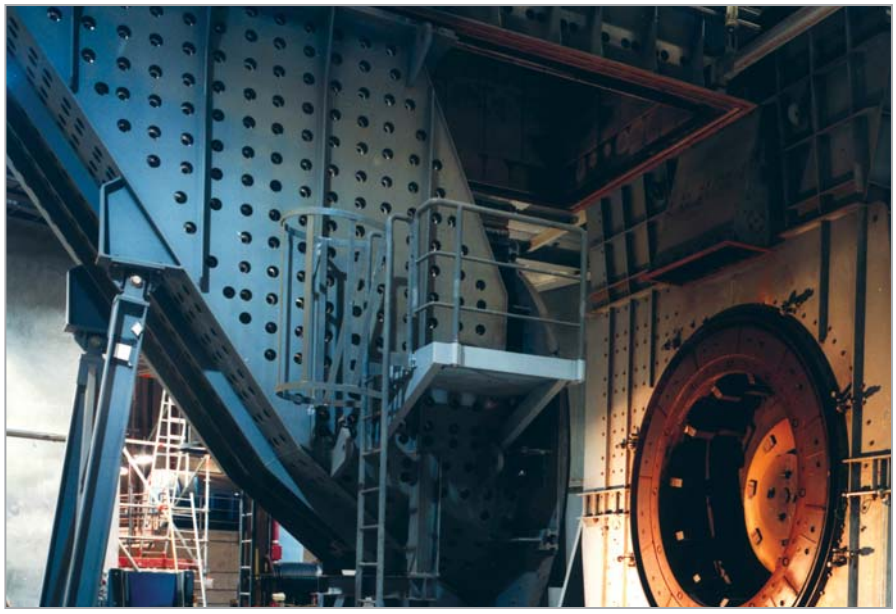


DGS Integral Fan Distributor and Beater Mill

HPE supplies DGS mills of various sizes up to a 180 t/h throughput for drying and pulverizing raw lignite and brown coals with a high moisture content.

DGS technology involves the raw coal and flue gases being initially put through the pre-crushing beater section of the beater wheel. This ensures excellent air and coal dust distribution into the beater wheel. Crushing in the DGS mill is usually so intensive that adequate grinding fineness can be obtained in one working operation – without the need of an additional classifier. This both raises the pressure balance and cuts back on energy requirements. The DGS mill has stood the test of time particularly with difficult-to-work lignites – something that explains its considerable lifetime and unrivalled properties.

Easy maintenance



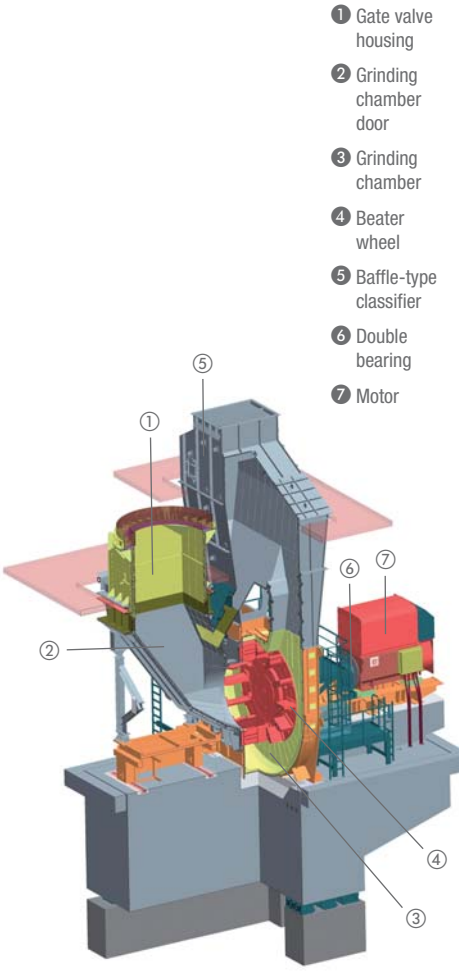
NV Mill

NV Wet Coal Fan Mill

The NV mills ranging from 10 t/h to 140 t/h throughputs are for crushing high moisture content lignites for direct injection into the furnace.

Together with the flue gases, the raw lignite is brought for crushing purposes into the beater wheel. It acts as a fan impeller fitted with beater plates. Baffle-type classifiers ensure that the required fuel fineness for combustion is fulfilled.

The high-tech NV mill more than meets the ongoing demands worldwide of operational availability and low costs.

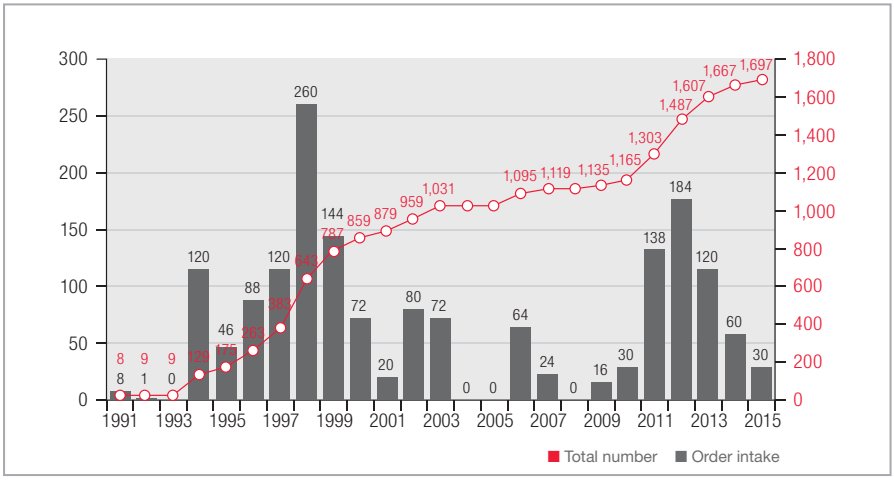


Pulverized Fuel Burners

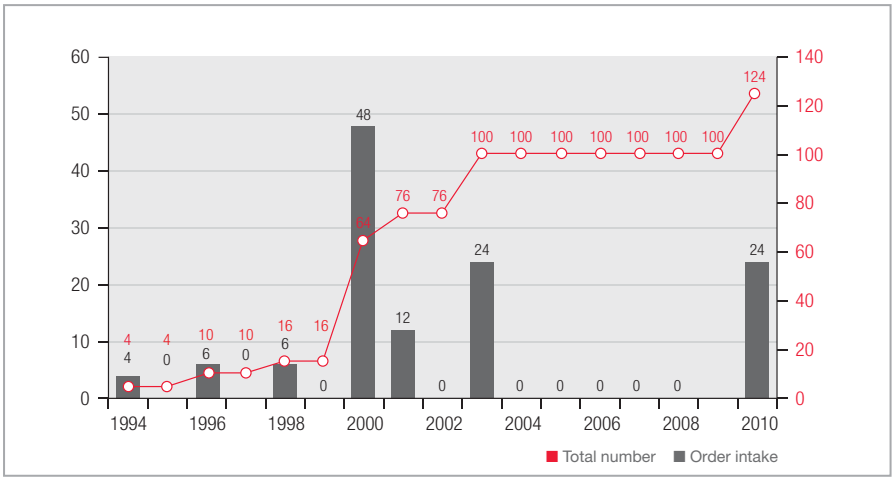
Optimum combustion

How do you lower NO_x emissions and at the same time control as many different fuels as possible? Questions like these are today determining the concept of pulverized fuel firing systems and burners.

DS Burners – Orders since 1991

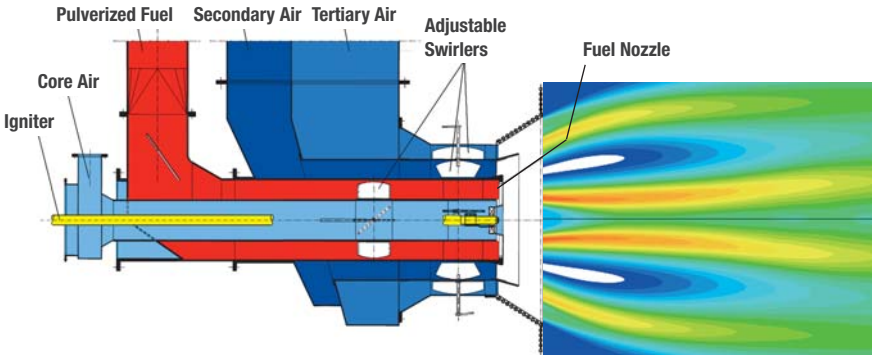


RS Burners – Orders since 1994



Refinements in pulverized fuel firing systems are moving towards fluid-dynamically optimized pulverized fuel burners. The main influence on combustion sequences in the burner proximate zone comes from the burner nozzle design. More than ever before NO_x formation can be affected directly where it arises rather than entire furnace sections being used as a reduction zone. Computer simulations (CFD – Computational Fluid Dynamics) assist in optimizing burner nozzle design on the combustion side.

DS Burner



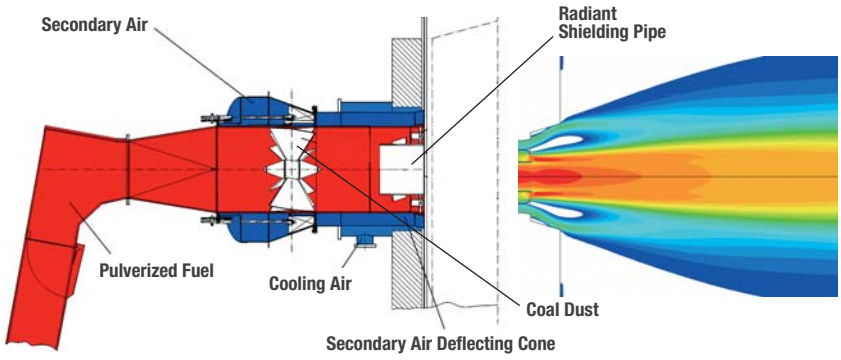
The DS burners from HPE are designed as circular burners with concentric nozzle arrangement. Typical for them are the pronounced swirl flows in all burner sectors and a defined igniting property.

Local and temporary coordination of pyrolysis and oxidation procedures enable the ignition point and sequence to be defined.

Ignition = Pyrolysis + Oxidation

A staged oxygen feed affects the combustion sequence to the extent that NO_x formation is either suppressed or reduced. Early defined ignition at the fuel nozzle gives DS burners a high level of ignition and flame stability, which is maintained over a very wide load range. Thanks to the high ignition stability, DS burners can be used with anthracite and low-volatile coals as well as with high-volatile bituminous coals and lignite.

RS Burner



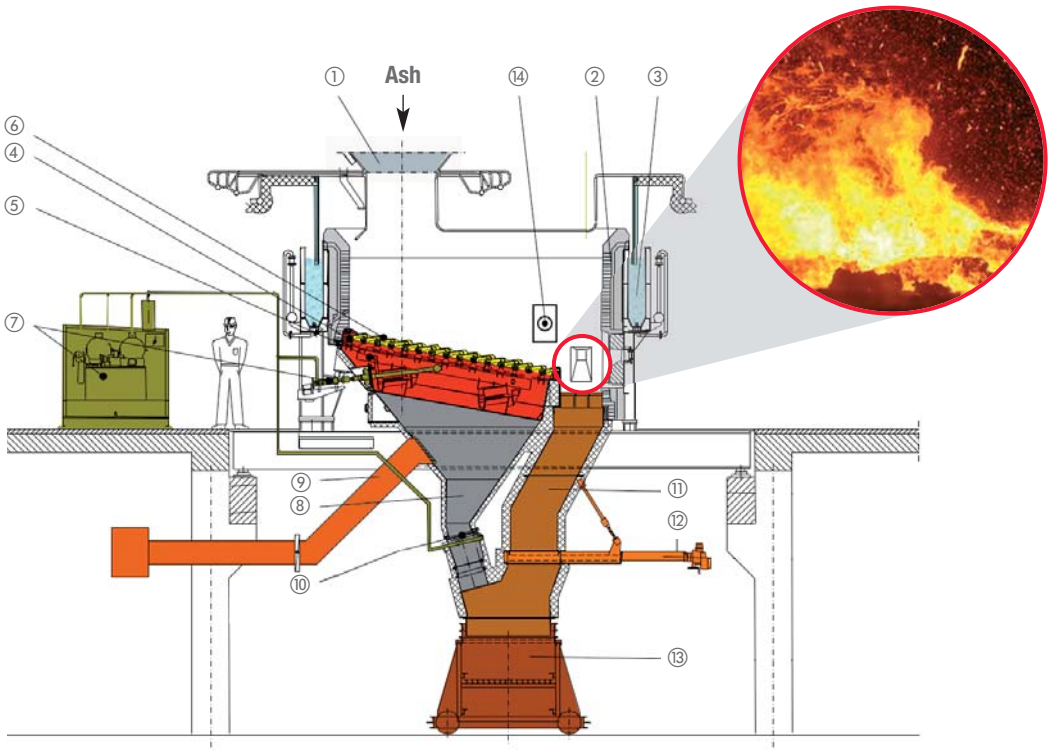
The extensive findings acquired from developing DS burner technology (flame stability, ignition, air staging in the burner proximate zone) are also available for lignite firing technology purposes.

What has arisen is the lignite RS burner. In contrast to the conventional jet burner, the RS burner permits control of the fuel / air mixture and flame propagation in the burner proximate zone.

Burn-Out Grate

High efficiencies

In lignite coal or peat-fired plants with a high proportion of xylitol or fibers in the fuel, the proportion of unburnt residue in the boiler hopper ash can be extremely high and this impairs firing efficiency.



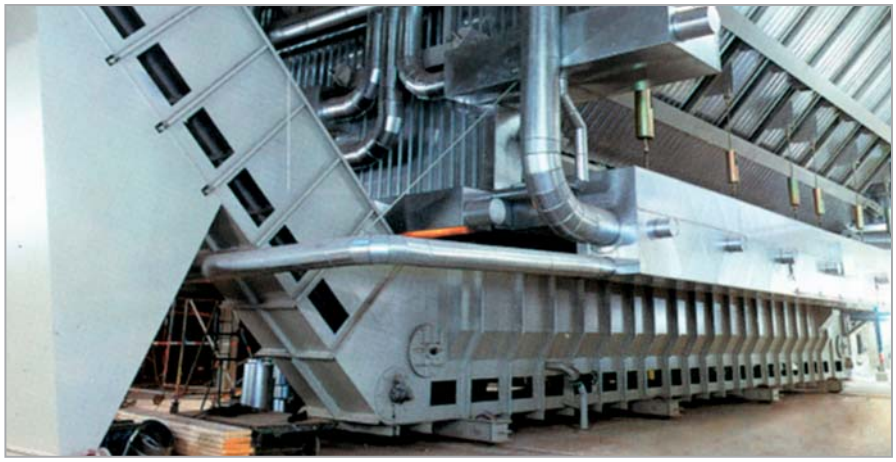
1. Boiler furnace hopper
2. Refractory jacket of retarded combustion reactor
3. Water seal gasket
4. Firmly fixed grate supporting bars
5. Grate carriage
6. Grate surface
7. Hydraulik system for grate carriage and deashing flap
8. Ash hopper
9. Cooling and combustion air
10. Deashing flap
11. Ash discharge chute
12. Shutoff gate valve in ash discharge chute
13. Deasher
14. Monitoring system

Burn-out grate diagram

The optimum designed burn-out grate ensures that the ash burnout in the boiler hopper is improved to over 80 % – thus substantially raising the overall efficiency of the boiler plant. In addition, after-burning results in additional heat input into the boiler hopper, which would otherwise be relatively cold. This leads to an even distribution of temperature in the furnace.

Stable in the extreme and long lasting

Ash removal systems have been part of HPE's range of production and supplies for many years now. This applies to bottom ash removal as well as to the transfer of ash accumulating in the course of air heater and electrostatic precipitator ash removal.

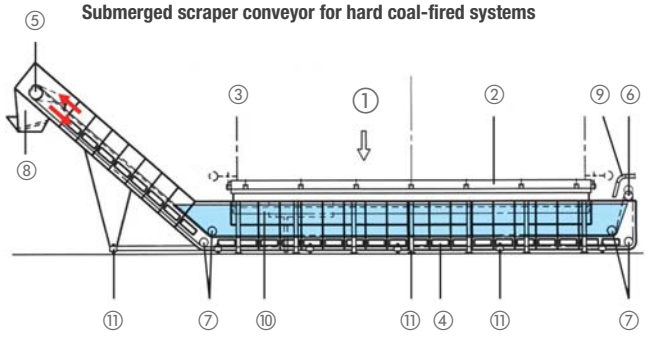


Submerged scraper conveyor

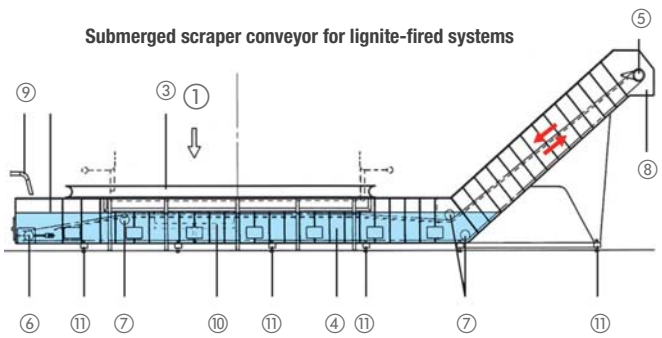
Submerged scraper conveyor functions:

- Air sealing to the boiler hopper
- Ash cooling
- Ash conveying
- Inlet for furnace inspection

Submerged scraper conveyor for hard coal-fired systems



Submerged scraper conveyor for lignite-fired systems



1. Bottom ash
2. Transfer chute with immersion piece
3. Expansion joint
4. Submerged scraper conveyor
5. Drive station frequency controlled
6. Tensioning station
7. Idler stations
8. Discharge chute
9. Cooling water inlet
10. Overflow
11. Travelling rails

Conveying direction

Other Ash Removal Systems

HPE provides a broad range of ash handling systems. These systems apply to ash handling for furnace bottom ash removal and also to the ash removal from all downstream ash accumulation points.

Our systems offer a lot of benefits: they are stable in the extreme, wear parts are long lasting and both the energy requirements and operating/upkeep costs are low. HPE provides the entire range for utility steam generators with pulverized hard coal and lignite firing: from design, manufacturing and erection up to commissioning the complete ash disposal systems including loading systems for transport by truck, rail and ship.

Ash removal components

- Ash silos and dewatering bunker
- Single-strand chain conveyors
- Apron conveyor
- Screw conveyors
- Single and double roller crushers
- Hammer crushers
- Rotary feeders
- Single and double pendulum flaps
- Shut off gates
- Ejectors
- Bucket-type conveyors
- Sluice ways

Our other ash removal systems

- Dry mechanical ash removal systems
- Hydraulic ash removal systems
- Pneumatic ash removal systems
- Mill reject systems
- Re-cooling systems for submerged conveyor overflow water

Replacement Parts Service

As a designer and manufacturer of original components, HPE is the ideal partner to contact when modernization or replacement parts are needed.

Our extensive expertise derived from designing and delivering utility steam generators with the associated components over many years enables our HPE experts to provide professional solutions matched to customer requirements in the matter of plant design and operations. Optimized plants ensure that performance and availability are raised and that efficient operations are attained as far as possible. As a competent and flexible partner, HPE' expertise is available in the fields of process engineering, plant optimization, measuring technology, plant-internal inspection, component installation and commissioning. At the same time, HPE supports customers in the design and configuration of their future plants – from the technical point of view (planning, design, optimizing) and in the matter of operating economy analyses.

Feeders conveyor	Coal Mills	Burners	Ash submerged scraper conveyor
Belts	Wear parts	Pulverized fuel line elbows	Chains
Chains	Linings	Pulverized fuel lines	Scraper bars
Drives	Nozzle rings	Impact plates	Wear plates
Bearings	Shaft seals	Housings	Drives
Gate valves	Feeding screw conveyors	Adjusting mechanisms	
Conveyor-type weighers	Beater sections	Bearings	
Expansion joints	Gear units		
	Drives		

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