

One Source

# Coromax<sup>®</sup> pulse system for coal-fired power plants



# Reducing high resistivity dust emissions

## Coromax® pulse system

- Reduces emission
- Reduces power consumption
- Reduces capital expenditures

The Coromax® pulse system is a proprietary and patented technology developed by FLSmidth. It was launched in 1985, and since that time more than 500 units have been installed, proving the benefits of the technology.

For many years, it has been the preferred power supply for coal-fired power plants applications given that it enhances the performance of the electrostatic precipitator (ESP) significantly.

Conditions as very fine dust particles, and high resistivity are all parameters which prevent the ESP in achieving maximum efficiency if controlled by a conventional DC or high frequency power supply.

### Increasing ESP efficiency

If the dust emissions of the ESP exceed the permitted levels, the ESP efficiency has to be improved. Normally this would be done by increasing the collecting area, but that would assume availability of space and requires a prolonged shutdown of the plant.

Therefore, more and more plants decide to replace the existing DC power supplies with the highly efficient Coromax pulse system.

This solution makes it possible to reduce dust emission without

increasing the footprint of the ESP, and restricting plant shutdown to a minimum.

For new ESP installations, the Coromax pulse system results in a smaller ESP footprint as compared to an ESP unit energized by other power supplies.

The Coromax pulse system reduces both the capital expenditures and the operating costs considerably. Additionally dust emission guarantees below 10 mg/Nm<sup>3</sup> can be given.

### How it works

In an ESP, airborne dust is designed to flow between rows of electrodes and collecting plates. A high voltage transformer is connected to the electrodes. When a high voltage is applied, electrons charge the dust with electrical energy, causing the dust to move towards the collecting plates.

The collecting efficiency depends on various factors, such as the size of dust particles, the high voltage peak value and its mean value. If dust resistivity is high, the maximum attainable voltage level in the precipitator is limited to the level where back corona and sparks occur.

Back corona is a phenomenon where positive ions in the dust layer on the collecting plates are released back into the gas stream, thereby eliminat-



Coromax control cabinet

ing the charge on the dust particles. Without this charge, the dust particles cannot be collected leading to higher dust emissions. Sparks likewise limits the efficiency, but the Coromax can operate at higher voltages without sparks limiting the efficiency.

### Independent mean and peak voltage control

During plant operation, variations occur in the coal composition, fuel, particle size, temperature, humidity, dust load or resistivity. To ensure consistency in the performance of the ESP, adjustments have to be made to the base voltage, pulse voltage and current.

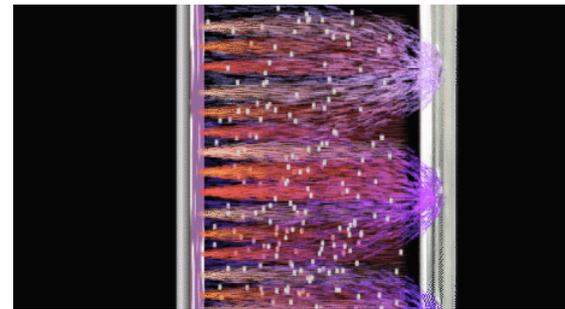
With the Coromax pulse system the voltage, current, and frequency is automatically changed to match current operating conditions. The option of controlling the current independently of the high voltage is not present in a conventional DC power supply nor in a high frequency power supply.

### Power consumption savings

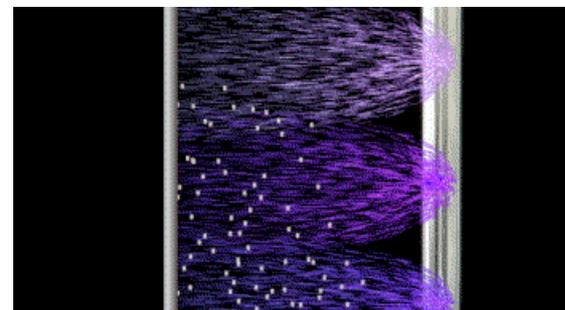
The Coromax pulse system superimposes an extremely narrow high-voltage pulse (up to 80 kV; depending on field size), lasting only 75 microseconds, on to a base voltage of up to 60 kV. This generates a total peak or pulse voltage of approximately 140 kV which is almost double the voltage of a conventional DC supply.

Usually, with a high voltage level, the current is high and may generate back corona using conventional DC or high frequency power supplies. The high current is wasted and may result in intensive sparking in the collecting process, resulting again in increased power consumption which is unnecessary. The charging of dust particles is essential to ensure low emission. Coromax eliminates the occurrence of back corona as the current is efficiently used only for charging the particles and hence there is no waste of current. Sparking originating from back corona is also eliminated.

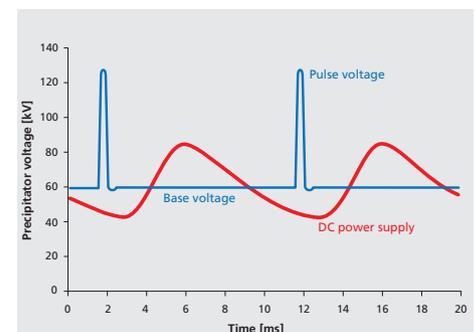
Despite the much higher peak voltage obtainable by the Coromax pulse system the power consumption is significantly less compared to conventional DC power supplies. As the power consumption of the power supplies is by far the highest contributor to the operation cost, the installation of Coromax pulse systems will reduce the total ESP operating costs considerably.



*Traditional DC energization - occurrence of back corona*



*Coromax pulse energization - back corona is eliminated*



*Pulse voltage waveform compared with the waveform generated by a conventional DC power supply*

# Technologies for coal-fired power plants

Typically, dust emission from coal-fired power plants are in the range of 40-100 mg/Nm<sup>3</sup> and to comply with new stricter legislation the plants are obliged to comply with emissions in the area of 10-30 mg/Nm<sup>3</sup>.

To adhere to future legislation which is expected to be even stricter, some plants are even planning to reduce emission down to 5 mg/Nm<sup>3</sup>.

## Technologies available

To reduce dust emissions in power plants there are several possible technologies.

To select the most suitable technology, the plant must carefully evaluate the various technologies based on the existing plant layout and specific needs. The following evaluates various technologies available and the results are summarized in the table below.

### Coromax pulse system

The Coromax pulse system is a simple replacement of the existing high voltage power supply. The replacement can be done very fast with a minimum of downtime and does not create additional environmental challenges.

Power consumption is reduced significantly as well as the PM<sub>2.5</sub> fine particle emission. Coromax also provides the ability to work with high efficiency regardless of coal type.

The Coromax pulse system is dependent of a well-maintained ESP. Therefore, FLSmidth specialists can assist with conducting an inspection of the ESP and compile a detailed recommendation for upgrading the ESP. Upgrading can include improve-

ments or modification of internal parts.

### High Frequency Power Supply

High Frequency Power Supply (HFPS) units represent an alternative solution to replace an existing DC high voltage power supply. Replacing the HFPS is often not sufficient to achieve the required efficiency improvement. A short downtime for installation is required, however the HFPS cannot increase capture of PM<sub>2.5</sub> fine particles.

### Moving Electrode ESP

Moving Electrode ESP (MEEP) consists of movable electrodes which mechanically removes high resistivity dust from the collecting plates. The technology has many moving parts inside the ESP which increases the need for maintenance and downtime.

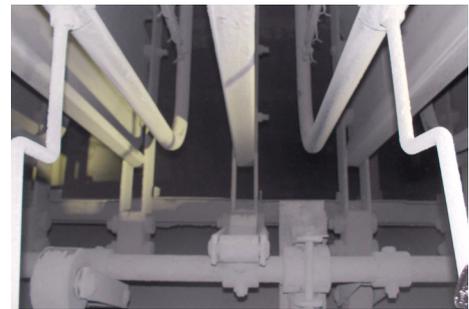
### Hybrid filter

The hybrid filter is a combination of ESP and fabric filter technologies in series in the same casing. The inlet ESP fields take out the major part of the dust leaving less to be collected on the bags. This reduces the required cleaning frequencies of the bags and thereby increasing bag life.

The bags act as a barrier and increases the pressure loss. In most cases a fan upgrade or replacement is required. A relative long down-time is required for removal of ESP internals and bag installation.

### Extending ESP footprint

Increasing the collection area of the existing ESP is in most cases not sufficient in order to meet the low emission demands alone. In addition,



Internal ESP parts



Internal ESP parts



Internal ESP parts

layout constraints often make this solution obsolete. Extending the ESP demands a downtime of several months.

### Wet ESP

Wet ESP (WESP) is a solution that is installed after the FGD system. This requires a low emission from the dry ESP, but has the ability to provide a very low stack emission. A wet ESP is expensive because it is made of stainless steel or alloy steel, and requires additional space and waste water treatment.

### Heat Exchanger

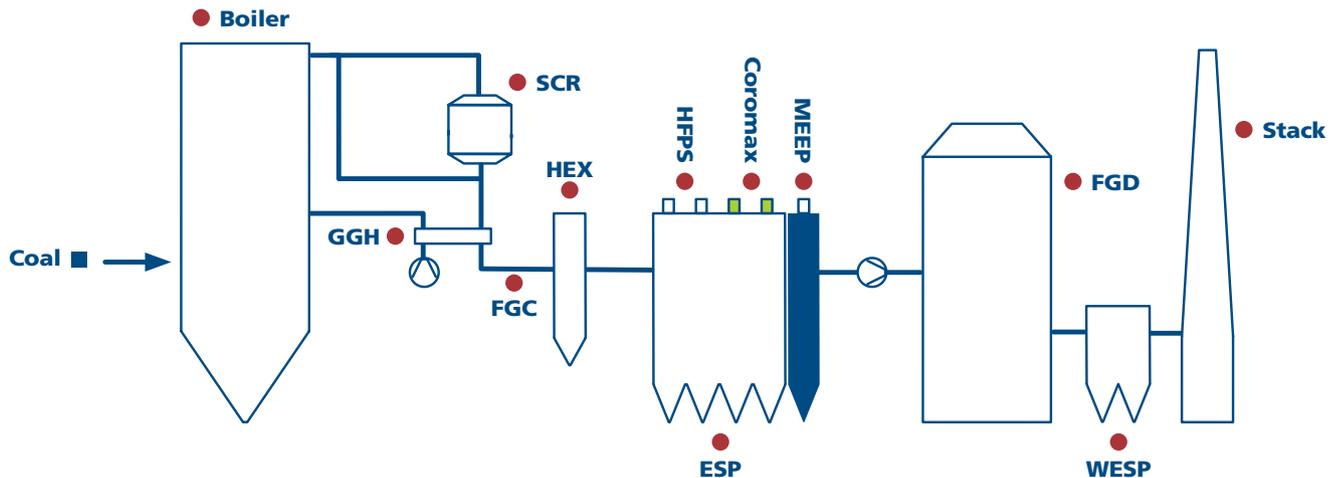
The Heat Exchanger (HEX) reduces the flue gas temperature before reaching the ESP in order to reduce the resistivity of the dust. The gas volume decreases which then reduces the dust emission. However, there is a risk of exposing the ESP to acid corrosion and shorter component lifetime due to the lower temperature.

### Flue gas conditioning

Flue gas conditioning (FGC) reduces the resistivity of the dust by injection of  $SO_3$

and/or  $NH_3$ . This enhances the collection process in an ESP.

FGC requires very short downtime, but efficiency improvement is not always sufficient if the difference between the existing and required emission level is too high. Depending on the type of chemical used for the FGC, storage facilities of chemicals must be established which evokes a new environmental risk.



Flowsheet including each of the described technologies for particular emission reduction of coal fired power station.

	Emission <math><20\text{mg}/\text{Nm}^3</math>	Reduce $\text{PM}_{2.5}$	Power consumption	Secondary pollution	Fan upgrade	Extra space required	Reliability	Delivery time	Installation boiler stop
<b>Coromax</b>	Yes	Yes	Low	No	No	No	High	Short	Short
<b>HFPS</b>	Maybe	No	Low	No	No	No	High	Short	Short
<b>MEEP</b>	Maybe	No	Medium	No	No	No	Low	Long	Long
<b>Hybrid</b>	Yes	Yes	High	Yes	Yes	No	Low	Long	Long
<b>Extend ESP</b>	Yes	No	Medium	No	No	Yes	High	Long	Long
<b>WESP</b>	Yes	Yes	High	Yes	Maybe	Yes	High	Long	Medium
<b>HEX</b>	Maybe	No	Medium	No	No	Yes	Low	Medium	Medium
<b>FGC</b>	Maybe	No	No	No	No	No	Medium	Medium	Short

# Cleaner air in China



## Emission reduced at Baosteel Group Corporation

Baosteel Group Corporation, Shanghai selected FLSmidth for ESP upgrade and Coromax pulse systems.

Baosteel and the local authorities in Shanghai reached an agreement on reducing the high level of dust emission from the plant's coal-fired boilers of 350 MW. The project scope involved upgrading of ESPs with two additional fields and Coromax pulse systems.

A total of 16 Coromax units for all new sections deliver a dust emission which is significantly reduced and meets the local requirement of maximum 20 mg/Nm<sup>3</sup>.

### Project scope

Boilers: 2 x 350 MW  
Fields: 3 HFPS + 2 Coromax  
Gas volume: 1,350,000 Nm<sup>3</sup>/h  
Temperature: 150 °C  
Dust load: 20 g/Nm<sup>3</sup>  
Guarantee: 20 mg/Nm<sup>3</sup>  
Inside voltage: 120 kV

### Performance test results:

Emission: 19 mg/Nm<sup>3</sup>



## Mawan reduces emission and power consumption

Shenzhen Energy Group, one of the main power generation companies based in Shenzhen, Guangdong, has on their Mawan power plant four power boilers of 300 MW and two boilers of 320 MW.

To succeed with the required emission reduction, a comprehensive upgrade of the existing ESPs which are more than 20 years old, was essential. The project also involved replacing of the existing DC power supplies with Coromax on the three fields - a total of 12 set per boiler.

### Project scope

Boilers: 6 x 300-320 MW  
Fields: 1 HFPS + 3 Coromax  
Gas volume: 1,228,000 Nm<sup>3</sup>/h  
Temperature: 129 °C  
Dust load: 28,9 g/Nm<sup>3</sup>  
Guarantee: 20 mg/Nm<sup>3</sup>  
Inside voltage: 116 kV

### Performance test results:

Emission: 15 mg/Nm<sup>3</sup>

## Coromax pulse system installed at Shajiao B power plant

At the Shajiao B power plant in Guangdong, owned by Shenzhen Energy Group, FLSmidth was selected to upgrade the existing ESP installed back in 1986. The plant has two power boilers of 300 MW.

The internal parts were rectified with assistance from FLSmidth specialists and Coromax pulse systems were installed on three fields.

### Project scope

Boilers: 2 x 350 MW  
 Fields: 1 HFPS + 3 Coromax  
 Gas volume: 1,230,000 Nm<sup>3</sup>/h  
 Temperature: 140 °C  
 Dust load: 20 g/Nm<sup>3</sup>  
 Guarantee: 80 mg/Nm<sup>3</sup>  
 Inside voltage: 115 kV

### Performance test results:

Emission: 52 mg/Nm<sup>3</sup>



## Datang Qitaihe installs Coromax

In order for Datang Qitaihe Power Generation Co., Ltd., Heilongjiang Province, to comply with the new regulation of a maximum emission of 30 mg/Nm<sup>3</sup> Coromax pulse systems will be installed at two of the plant's boilers. The boilers were installed in 2001 and has a traditional two chamber ESP layout.

FLSmidth carried out a detailed investigation and offered a Coromax solution that guarantees an emission of 30 mg/Nm<sup>3</sup>. The internal parts of the ESP remains and only minor adjustments are to be implemented.

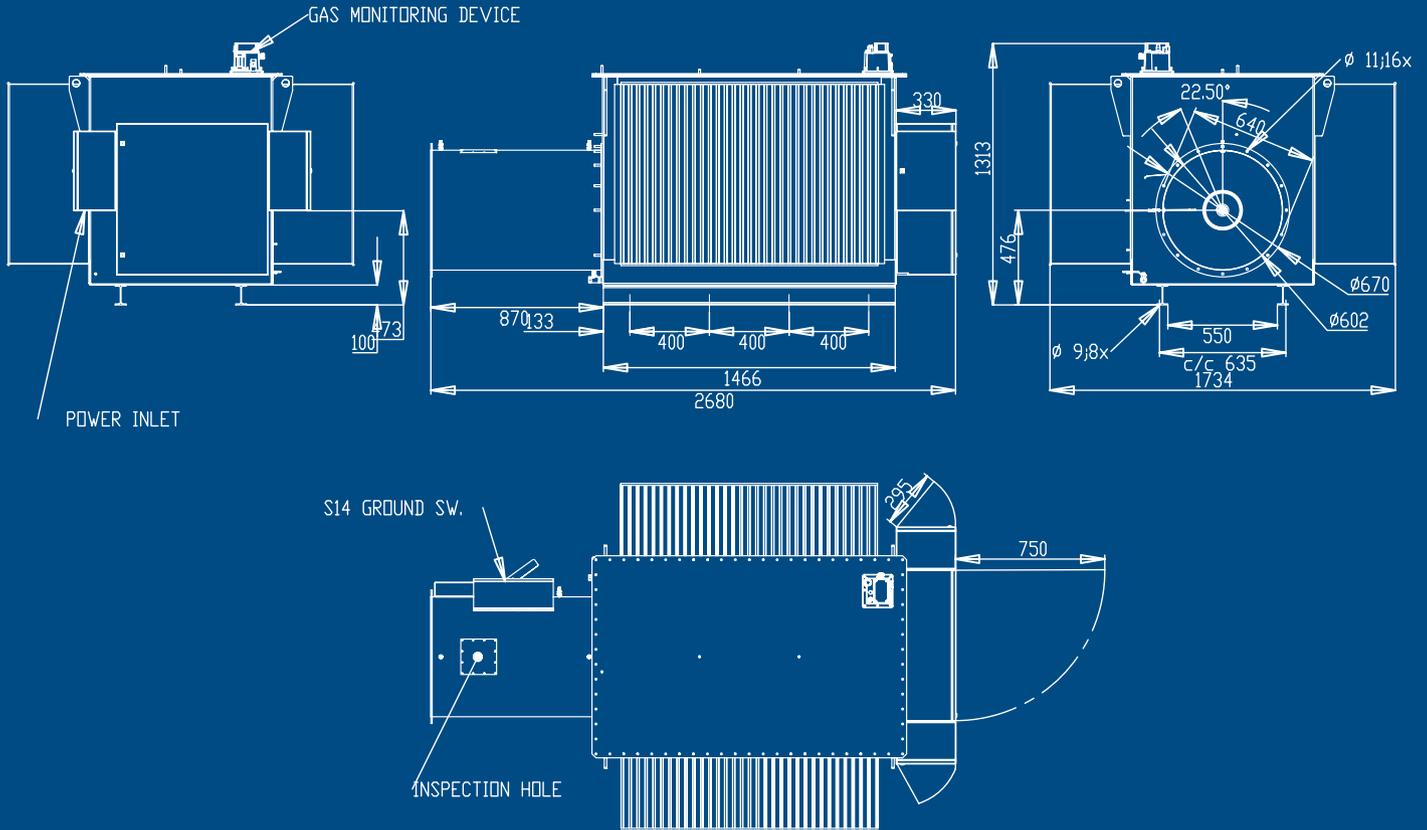
The boiler is put into operation by the end of 2014.

### Project scope

Boilers: 2 x 350 MW  
 Fields: 1 DC + 3 Coromax  
 Gas volume: 1.245.000 Nm<sup>3</sup>/h  
 Temperature: 117 °C  
 Dust load: 35 g/Nm<sup>3</sup>  
 Guarantee: 30 mg/Nm<sup>3</sup>



## Layout of Coromax pulse system



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