Application of Electrostatic-Fabric Integrated Collector for 660MW Power unit of Coal-fired Boilers

Zheng Kuizhao Zhu Zhaoping Yu en Wailing
Fujian Longking Co.,Ltd Longyan City, Fujian, China PC: 364000

Abstract

Since 2005, the Electrostatic-Fabric Integrated Collector (EFIC) of LongKing has been applied to coal-fired boilers for dust removal. Until now, we have signed contracts to supply 178 EFIC sets, 91 of these have been put into operation successfully for generating units with capacity from 15-660MW. Currently EFIC application for 1000MW power unit is being manufactured and it will be installed shortly. This paper mainly introduces the application of EFIC for 660MW power unit of coal-fired boilers. Since put into operation in Apr. 2009, it has been running steadily, with a stable dust emission below 30mg/Nm^3, and the pressure drop is maintained 900-1000Pa. This is the first time EEIC technology has been applied to 660MW power units. The success of this project is a milestone of LongKing's EFIC development and application to large scale coal-fired boilers.

***Keywords*:** Electrostatic-Fabric Integrated Collector (EFIC); ESP; Fabric Filter (FF) ; Pressure Drop; Collection Efficiency;

1. Introduction

At the end of 2000, after carefully researching the relevant technologies of integrating electrostatic precipitator (ESP) and Fabric Filter (FF), Fujian LongKing put forward the conception of EFIC, and set up research in 2001. In 2004, EFIC technology became the national scientific and technological project approved by State Ministry of Science and Techno1ogy (No. 2004BA650C); In 2005, it was firstly applied to a 50MW coral-fired power plant successfully. EFIC technology takes full advantages of high dedusting efficiency of the first electric field of ESP, by fist removing majority of the inlet dust including the large particles, followed by the bag filter area which cellects the remaining fine, thereby achieving the more strictest emission standard. Until the end of 2010, 91 FE-type EFIC have been put into operation successfully. The large amount of successful engineering projects demonstrate the FE-type EFIC can operate smoothly over long period with high collection efficientcy and control the emission of fine particles efficiently. EFIC is a new generation of economic dedusting product, with many advantages including high collection efficiency, energy-saving, low operation pressure drop, and small footprint.

2. Engineering Conditions

No.2 unit of Baoshan Power Plant of Huadian Xinxiang Power Generation Ltd. is a 660MW unit originally equipped with a four-field ESP. However, since operation started in 2007, the dust emission could not meet the emission standard due to variation of coal and ash properties and other operation conditions. After investigating and demonstrating for many times ,Baoshan Power Plant decided to adopt Longking's EFIC to upgrade the collection performance in order to meet the emission standard.

3. Design Condition

3.1 Technical parameters of boiler

Boiler type: supercritical parameter pressure swing boiler
Max continuous steam capacity: 2102 t/h

Max. coal consumption amount: design coal 281.39t/h

check coal 299.96t/h

3.2 Air Pre-heater

Type: Rotory Air Pre-heater

Design excess air coeffient (outlet) : 1.44

3.3 Fly ash resistivity

Temperature, ℃	Resistivity,ohm-cm	
	Design coal	Check coal
100	1.1×10^{11}	1.17×10^{11}
120	5.5×10^{11}	4.40×10^{11}
140	6.9×10^{11}	5.87×10^{11}
150	5.0×10^{11}	4.64×10^{11}
160	4.5×10^{11}	3.52×10^{11}
170	3.6×10^{11}	3.30×10^{11}
180	2.9×10^{11}	2.64×10^{11}
200	1.1×10^{11}	1.76×10^{11}

Table 1 Fly ash resistivity

3.4 Inlet flue gas parameters

Item	value
Max. inlet flue gas volume, m^3/h	4090049
Inlet flue gas temperature, ℃	133
Inlet dust concentration, g/Nm^3	27.32

Table 2 Inlet flue gas parameters

4. Reform Program

This upgrade project adopted EFIC technology by keeping the original first electric field of ESP, removal of the collecting electrode and discharge electrode system, and HV/LV devices of the second, third and fourth electric fields; and furnished the filter bags as the bag filtering area. The electric field and the bag filter area were both in the same casing, as shown in the Figure 1 and Figure 2:

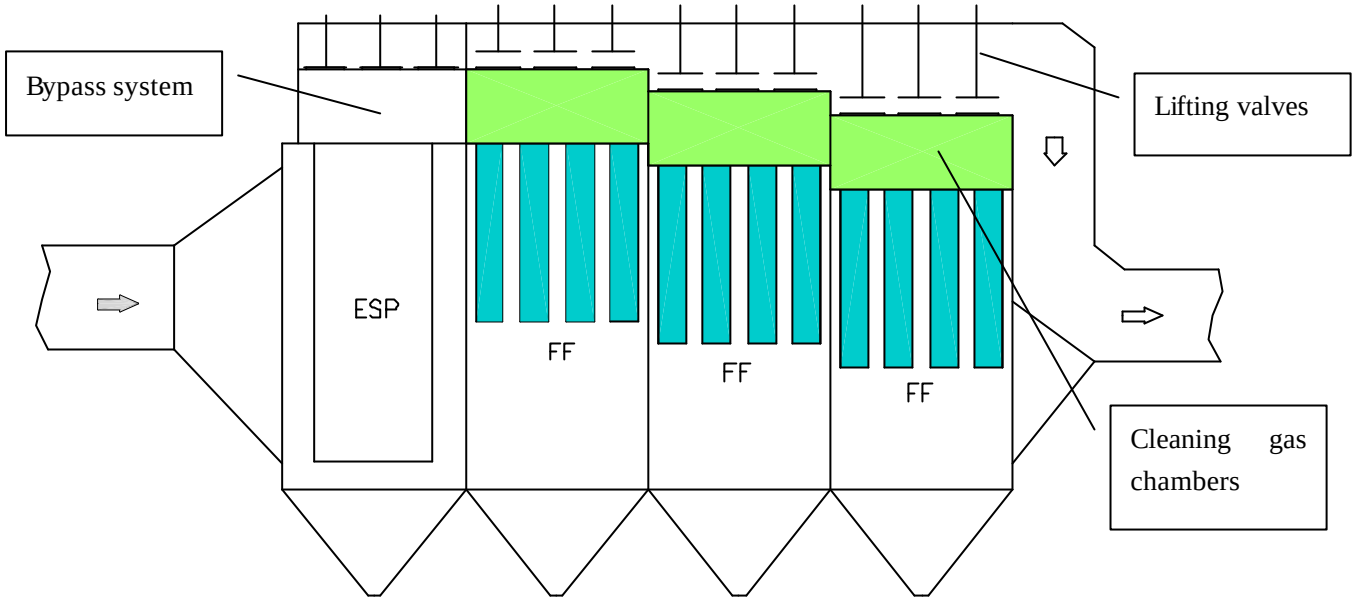

Figure 1 Side view of the EFIC

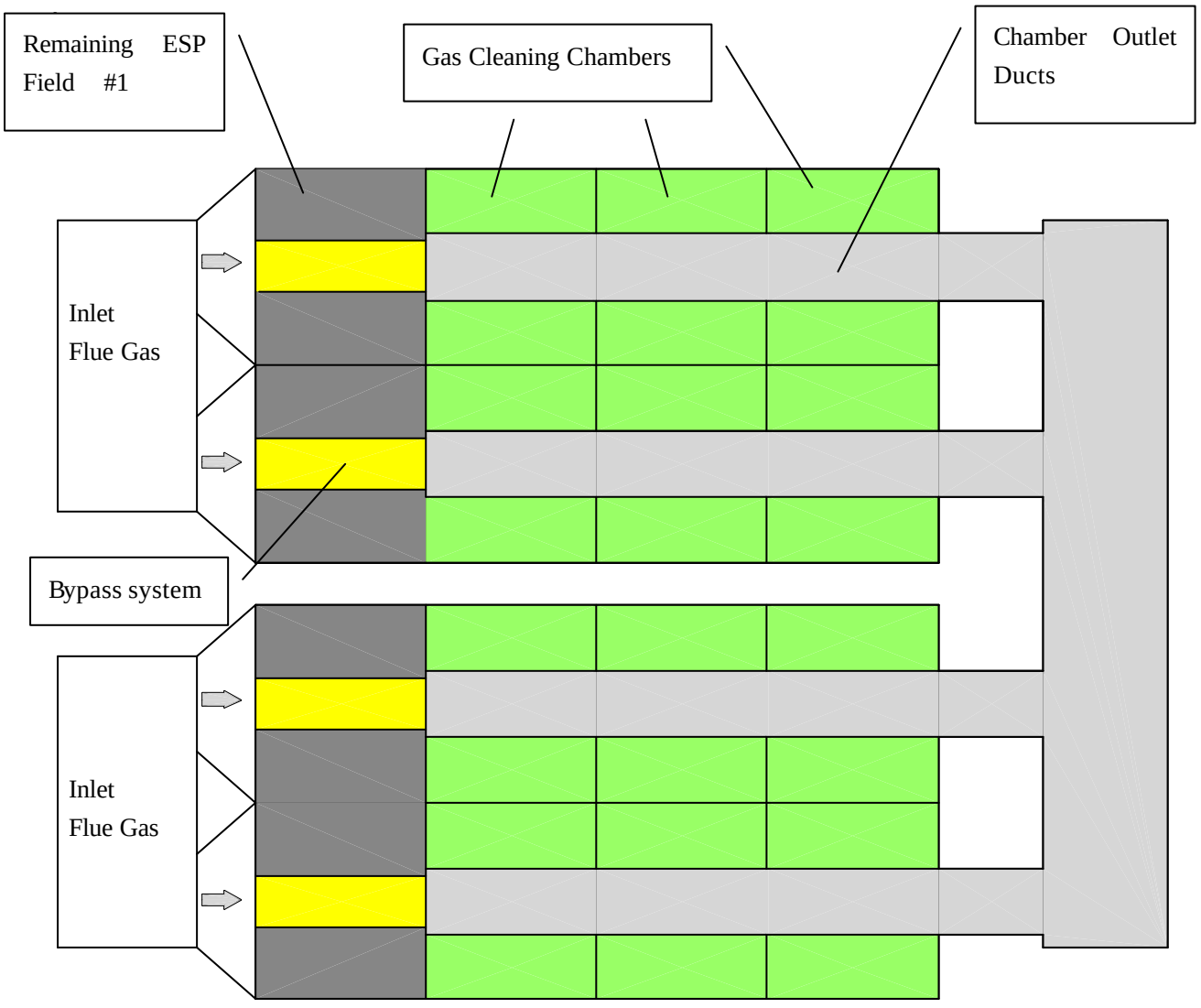

Figure 2 Top view of the EFIC

5. Technical Parameters

NO.	Items	Unit	Parameters
I	**Overall performance parameters of EFIC**		
1	Guaranteed collection efficiency	%	99.8
2	value of outlet flue gas emission	mg/Nm^3	=50
3	Flange to flange pressure drop	Pa	=1200
II	**Technical parameters of electric field**		
1	collecting area	m^2	18240
2	Flow velocity in electric field	m/s	1.25
3	Specific collection area (SCA)	$m^2/m^3/s$	16.05
4	Collection efficiency of ESP	%	80
III	**Technical parameters of bag filter area**		
1	Total filtering area	m^2	57476
2	Air to cloth ratio	m/min	1.19
3	Material of filter bag		PPS
4	cleaning pressure	MPa	0.2～0.3
5	cleaning manner of filter bag		On-line first, off-line is feasible
6	Compressed air consumption	Nm^3/min	20

Table 3 Technical Parameters

6. Technical Features

According to the features of this project including large flue gas volume, high inlet particles concentration, small footprint, and compact structure etc., FE-EFIC adopted a series of advanced technologies including 13 EFIC patented technologies. It can be summarized as follows:

6.1 Long-bag pulse technology

The height of plates in electric field is 15 meters. In order to make full use of height space, 8.25 metre filter bags are used. The four-inch pulsing valve are used, each pulsing valve handles 25 filter bags, which greatly saves the filter bag space. The structure of whole precipitator are more compact, the gas flow distribution is more even. The application of these two technologies overcome some problem in handling large flue gas volume, limited available space, complex structure.

6.2 Low cleaning pressure and energy consumption, low cleaning frequency, minimal filter bag damage

The cleaning pressure of FE-type EFIC is usually 0.2～0.3Mpa, lower than that for conventional pulse-jet fabric filter(FF). Due to the collection effect of the front-end electric field, the loading of bag area is greatly reduced. Therefore, the cleaning frequency of FE-type EFIC is lower. The ash cleaning period is usually above 2-3 hours, some even up to 12 hours. Thus, it greatly reduces the compressed air and energy consumptions, as well as the damage of filter bags.

6.3 Reasonable flow distribution

Since the flue gas volume handled by the precipitator for lager unit is large and the strucutre is comlex, therefore the air flow distribution in the bag area of EFIC is a difficult issue. CFD was used to simulate the flow distribution inorder to guide the design of EFIC. Various measures including step-down arrangement of bag area compartments (see Figure 1), sizing of clean air chamber exit valve ,and proper bag filter arrangement,have been adopted to ensure the even distribution of air flow entering into each chamber.

6.4 Large sealed clean gas chamber

FE-type EFIC adopts the structure of large clean gas chamber. It leads to lower flue gas flowing velocity, which is beneficial to gas flow distribution, and lowers the pressure drop access the device.

6.5 Installation of inlet and outlet damper, to ensure on-line overhaul

Considering the reliable and stabe operation of large generating units, dampers are provided at the inlet and outlet of EFIC. Partition walls are installed in the middle of two chambers , dividing the gas flow area into four independent passages. Any of these passage can be isolated for on-line overhual.

6.6 Small chamber structure of bag area

The back part of bag area adopts the stucture of small chamber, with a total of 24 sub-chambers. Each sub-chamber is equipped with lifting valves at the top of each chamber, thereby ensuring on-line overhaul and off-line overhaul capabilities.

6.7 Internal bypass system

FE-type EFIC adopts a particular internal bypass structure with double layer zero leakage bypass valve at the electric field. When commissioning or the working condition of flue gas is abnormal, the bypass valve will be open automatically. Then the flue gas will go to the outlet ducts via the bypass instead of going through the bag area, and protects the filter bags. At the same time, because the bypass system is located at top of the electric field, so when the flue gas passed through the bypass system, the electric field can still provide dust removal effect, thereby minimizing the effects on equipments behind the deducting system.

7. Application Conditions

The installation of this project began in Feb. 2009, and successfully put into operation in Apr. 2009. Since its

operation, EFIC has been running steadily with low pressure drop and long cleaning period. Henan Electric Test and Research Insitute carried out the performance test of this precipitator in Aug. 2009 and July 2010, the results showed that the devices were in good operation condition, high dust removal efficiency, low pressure drop, and excellent energy-saving.

No.	Pressure drop, Pa	Inlet mass concentration, g/Nm^3	Outlet mass concentration, mg/Nm^3	Dedusting efficiency, %
A	719	25.74	24.06	99.91
B	775	25.82	21.98	99.91

Figure 4 Testing data on Apr. 2009

No.	Pressure drop, Pa	Inlet mass concentration, g/Nm3	Outlet mass concentration, mg/Nm3	Dedusting efficiency, %
A	820	23.68	28.30	99.88
B	850	23.59	29.97	99.87

Figure 5 Testing data on July. 2010

Year	Annual power generation volume (× 10^4 KWH)	Power consumption of induced draft fan (× 10^4 KWH)	Power consumption of precipitator (× 10^4 KWH)	Induced draft fan + precipitator power consumption (× 10^4 KWH)	Power consumption ratio (%)
2008 (Before upgrade)	277437	1827	1069	2896	1.04
2009 (After upgrade)	266975	1868	282	2150	0.81

Figure 6 Contrast table of power consumption before and after reform

8. Conclusion

Xin Xiang Project is the first LongKing EFIC project applied to 660MW unit. In Jan 2011, LongKing completed successfully the Anhui Pingwei 600MW project with all performance indexes meeting the designed requirement. The FE-type EFIC for 2× 1000MW of Henan Xinmi Power Plant is now being installed, and will be put into operation at the end of 2011. The successful implementation of these projects definitely will push the development of FE-type EFIC technology into the nxet level.

Reference

1. Huangwei, Research and Application of FE-type EFIC , China Dedusting and Gas Purification , Second

issue of 2008