Retrofit Project of 2×100 MW Units in Yushe Power Plant, Shanxi Province Using Two Boilers-One CFB FGD

LIN Fulin[1], LIAN Egui[2]
(1 Fujian Longking Co., Ltd, Fujian, PR China E-mail: linfulin19@126.com
2 Fujian Longking Co., Ltd, Fujian, PR China E-mail: leg5202003@yahoo.com.cn)

Abstract: This paper takes the example of the retrofit of 2×100 MW units of Yushe Power Plant in Shanxi Province, and summarizes the applications of circulation fluid bed flue gas desulphurization (CFB-FGD) adopted "two boilers one line" in the retrofit of existing power plants.

Keywords: CFB-FGD, two boilers one line, retrofit

1 INTRODUCTION

Due to the CFB-FGD technology has the advantages of water saving, power saving, no clean gas reheating necessary, no need for special materials for corrosion protection and so on, it has excellent technology-economy, especially in flue gas desulphurization projects of large-scale and low-sulphur coal-fired power plant units or at water deficient areas. Therefore, many power plants at home and abroad have adopted CFB-FGD technology and have attained good economic benefit. Among them one 200 MW unit in Hebei Matou power plant has used CFB-FGD technology and has been operated successfully. Subsequently, lots of units more than 200 MW in China and one 350 MW unit and 3×100 MW units in Brazil have used the technology.

According to the governmental file 'notice about all of the coal-fired power plants in the province schedule to take flue gas desulphurization mission', Yushe power plant was asked to accomplish 2×100 MW units retrofit before July in 2007. There are the main existing disadvantages when adopt the wet FGD technology:

- The dust emission of YuShe 2×100 MW units existing ESP was up to 800 mg/Nm^3, in the result of which the existing ESP needed to entirely retrofited both according to the environmental protection regulation and the wet FGD technology request.
- Due to temperature of the gas from the boiler regularity higher than 160 □, there is the risk of 'bag-burned' if changing the existing ESP into fabric filter or electric-fabric deduster. At the same time, it will greatly cut off the life time of the filter bag and increase the maintenance cost when the deduster operating under high temperature for a long time.
- There is much more civil engineering work of wet FGD plant, which includes equipments, ducts and the stack need corrosion protection, long construction period, high demand of construction conditions. It is proved that there only need 10 months to achieve the project when adopting dry CFB-FGD process, within 30 days for ducts connection.

It has obvious technology-economy and smaller retrofit risk to use CFB-FGD adopted "two boilers one line", so 2×100 MW units in Yushe power plant has been confirmed to use the technology.

2 GENERAL SITUATION OF PROJECT

Yushe power plant locates in Taiqu village, Yushe country, Shanxi province and it is a typical area full of coal but short of water.

2×300 MW units with CFB-FGD system at Yushe power plant have passed the 168h test at the beginning of October and the middle of November, 2004, and the desulphurization efficiencies reached more than 90%. In early July of 2005, Northeast Electric Power Research Institute commissioned by power plant took the Check and Accept Test for the FGD island. As a result, all of the targets attain the designing one. Since taken into work, the whole FGD plant has operated stably and reliably, and has performed well in techno-economy. In November, 2006, Yushe 2×300 MW units FGD plants passed the state Finish Check and Accept Test.

Retrofit project of 2×100 MW units in Yushe Power Plant started in September, 2006.and which is the first FGD project to use the scheme of "two boilers-one CFB FGD, with Fabric filter". The system, which is completed in the shortest construction period (about 9 months), has passed the 168 h test at the first time. Under the situation of saving 10 million yuan on ESP retrofit, the desulphurization efficiency reached more than 93%, and dust emission was less than 30 mg/Nm^3, which is lower than the latest emission requirement in China.

2.1 Design Conditions

Features of the coal (see in Table 1).

Table 1 Analyzed data of coal

No.	Item	Mark	Unit	Design value
1	water	Mar	%	6.10-8.05
2	ash	Aar	%	25-35
3	sulphur	St.ar	%	2.2
4	Volatile	Vdaf	%	14-18
5	heat	Qar.net	kJ/kg	19660

2.2 Gas Parameters

The parameters of the gas at the CFB-FGD island inlet are as follow (Table 2).

Table 2 Gas parameters of the CFB-FGD Island

No.	Item	Unit	Design value
1	Sulphur in the coal	%	2.2
2	Volume flow at inlet (dry std.)	Nm^3/h	864673
	Volume flow at inlet (wet std.)	Nm^3/h	923004
3	Inlet/outlet temperature	□	154/75
4	Pressure at inlet	kPa	89.61
5	Composition of the gas at inlet		
	Humidity (wet std.)	%Vol	6.51
	O_2 (wet std.)	%Vol	6.36
	SO_2 (dry std.,6% O_2)	mg/Nm^3	5500
	SO_3 (dry std.,6% O_2)	mg/Nm^3	50
	Dust (dyr std.,6%O_2)	g/Nm^3	1.8
6	Desulphurization efficiency (guarantee value)	%	93
7	Dust at outlet (dry std.,6% O_2)	mg/Nm^3	50

2.3 Analysis of Absorbent

- Name: quicklime;
- Quality Requirement: gently burned quicklime, particle 1mm, CaO contain more than 77 %, hydrate rate t 60 shorter than 4 min (according to standard DIN EN459-2).

3 CONSTRUCTION OF THE PROJECT

The FGD island is built on the area next to the stack downstream the boilers. The field for the project is limited, at left of which is ash conveying pipes built on stilts. The outlet ducts of Id fans is in front of the area and existing ash silos behind it. There are trestle for coal conveying, cable channel, drain for wash water and heating pipes at right side. The room for use is: length 65400 mm, width 30000 mm. For the limited area, the layout of FGD system must be standing saving and at the same time construction and installation become very difficult.

4 THE GENERAL LAYOUT

Each part of the YuShe 'two boilers one line' CFB-FGD system is set independently, which in a line with absorber, fabric filter, id fans and so on. The system makes full use of the area, furthest saving the ground. Main assistant equipments, such as water system, lime, hydrated lime adding and fluidized flow system surround the absorber. The conbination of each system exhibit both divided and reasonal, closed and convenient, which appears nice and harmonizes with other constructions in the power plant (see in Fig. 1).

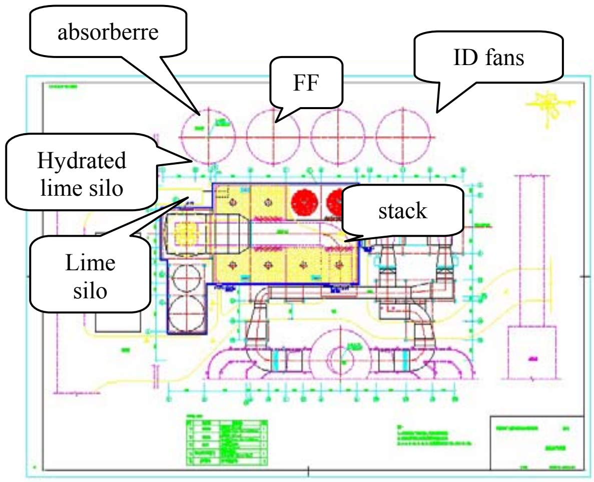

Fig. 1 The layout of Yushe 2×100 MW units CFB-FGD plant

Main of the FGD island are absorber, fabric filter, lime silo, hydrated lime silo and the control room. The picture of the island is shown in Fig. 2.

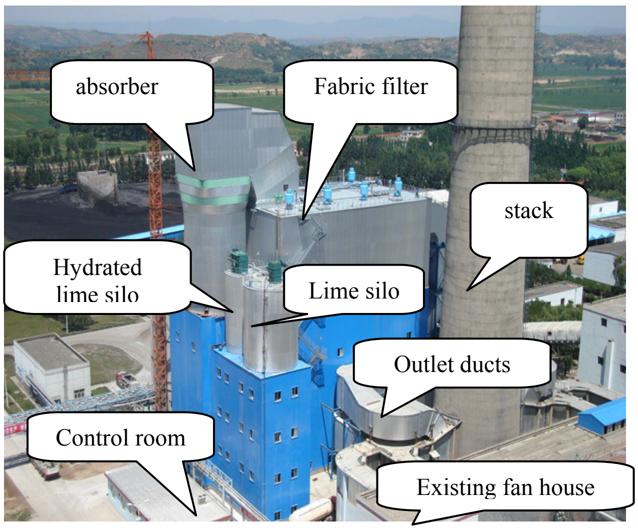

Fig. 2 Picture of Yushe 2×100 MW units CFB-FGD Island

5 BASIC INFORMATION OF THE PROCESS

5.1 Process Flow

The process of CFB-FGD is based on circulating fluidized bed principle,which uses lime and hydrated lime as absorbents. The process flow is seen in Fig. 3. It constitutes of absorber, fabric filter, absorbent preparation and feeding, desulphurization products recirculation and emission and instrument and control system.

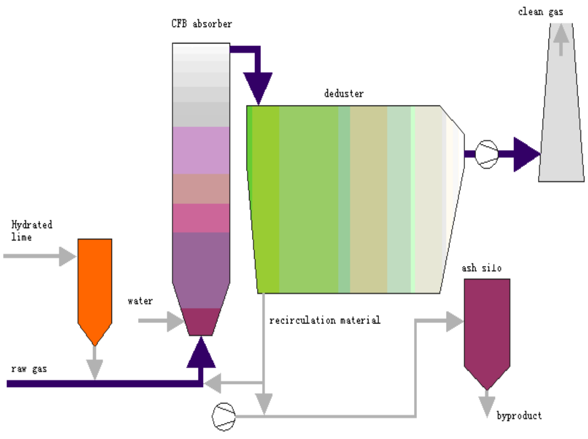

Fig. 3 The flow of CFB-FGD process

5.2 Design Data

Design of the FGD system should satisy the requirement of burnt coal, the detail parameters list in Table 3.

Table 3 design data of the FGD system

No.	Item	Unit	Design value (2.2% Sulphur contain)
1	Guarantee efficiency	%	92
2	Dust emission	mg/Nm^3 Dry, %6 O_2	50
3	Ca/S	mol/mol	1.3
4	Drop pressure	Pa	3600
5	Gas temperature	□	70
6	Power consumption	kW, including id fans	2800
7	Water consumption	t/h	40
8	Lime consumption	t/h	6.5
9	Useableness	%	98
10	Gas leakage	%	5
11	Noise	dB(A)	85
12	Life time	year	30

6 COMMISSIONING AND TRIAL OPERATION

6.1 Brief Introduction

CFB-FGD system was started in October,2006,beginning to install in January 2007 and finished on 15 th May of 2007. Then turn into single and subsystem commissioning. The strictly quality control system for the whole process including design, manufacture, supply and installation, had guaranteed the project, and it took only one month to single commissioning and subsection trial operation.

6.2 Targets

Targets got from 168 h test are seen in Table 4.

Table 4 Targets got from 168 h test

No.	Item	Unit	Value	Remarks
1	FGD system operation time	h	168	
2	Best efficiency	%	98.5	
3	Average efficiency	%	93	
4	Inlet highest SO_2	mg/m^3	5500	
5	Inlet lowest SO_2	mg/m^3	2800	
6	Inlet average SO_2	mg/m^3	3500	
7	Outlet average SO_2	mg/m^3	252	
8	Outlet dust	mg/m^3	18-25	
9	Scope of units load change	MW	67-105	Single unit
10	Scope of inlet temperature	□	135-175	Average at 154
11	Outlet temperature	□	70	
12	Purity of lime	%	78	

6.3 Control System (see in Fig. 4)

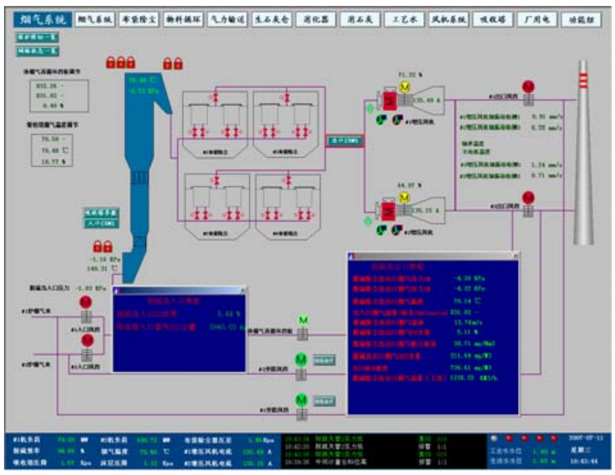

Fig. 4 The Distributing Control System picture of CFB-FGD

7 CONCLUSIONS

It proves that CFB-FGD technology can solve area limit and power generation time waste problem that encountered by existing units retrofit. The desulphurization efficiency reached more than 93%, and dust emission can meet the environmental issues requirement (actually less than 30 mg/Nm^3). In addition, the use of clean gas recirculiation makes 'multi-boiler one line' CFB-FGD system operate stably in the case of boiler operation load waving heavy.

The successful use of the CFB-FGD technology in Huaneng Yushe power plant 2×100 MW units retrofit indicates that CFB-FGD technology has advantages of mature, economical, water saving, stand saving and taking less time to construct. This project is a good example for existing units desulphurization retrofit in our country, espesially for ‘multi-boilers one line’ use.

REFERENCES

1. Ma Guojun. Introduction of CFB-FGD Technology. Electric Power Environment Protection, 1994, 48.
2. Lin Chunyuan. The use of Circulating Fluidized Bed Dry Flue Gas Desulphurization plant for Shanxi YuShe Power Plant Unit 3 and Unit 4,300MW(gross) Coal-Fired Units. Conference Proceedings of the Secondary Exhibition of China International DeS and DeN Technologies and Equipment, 2006, 61.
3. Yan Yan, Peng Xiaofeng, Jia Li, et al. Analysis of the Feature in the process of CFB-FGD. Journal of Basic Science and Engineering, 2003, 84.