Technology Solution for Sox Reduction in Thermal Power plants

Bharat Heavy Electricals Ltd.

Topics

- Technology (FGD) for SOx reduction
- SOx emission level in Thermal power plants
- MOEF norms
- Type of FGD technologies
- BHEL experience FGD technology
- BHEL-MHI FGD Technology and its advantages
- Limestone sources and Gypsum disposal
- Conclusion

FGD

The Flue Gas Desulphurization (FGD) is a process of removal of sulphur dioxide (SO_2) from the flue gas

Need for FGD

- Combustion of fuel having sulphur results in SO_2 Emission
- 95 – 96 % of sulphur is converted into SO_2
- Sulphur content in Indian coal ranges from 0.25 to 0.5 % and in imported coal it is more than 0.6 %.
- Coal with 0.5 % sulphur, generates SO_2 of range 1500 - 2000 mg/Nm3
- SO_2 emission results in Acid-rain, corrosion of buildings & structures and affect human health

MOEF - Notification on 7.10.15

Pollutants	TPPs (units) installed before 31st December, 2003*	TPPs (units) installed after 1st January,2004 upto 31st December, 2016*	TPPs (units) to be installed from 1st January, 2017**
Particulate Matter (PM)	100 mg/Nm3	50 mg/Nm3	30 mg/Nm3
Sulphur Dioxide (SO2)	600 mg/Nm3 (Units < 500MW) 200 mg/Nm3 (Units >= 500MW)	600 mg/Nm3 (Units < 500MW) 200 mg/Nm3 (Units >= 500MW)	100 mg/Nm3
Oxides of Nitrogen (NOx)	600 mg/Nm3	300 mg/Nm3	100 mg/Nm3
Mercury (Hg)	0.03 mg/Nm3(for units having capacity of 500MW)	0.03 mg/Nm3	0.03 mg/Nm3

*TPPs (units) shall meet the limits within two years from date of publication of this notification.

**Includes all the TPPs (units) which have been accorded environmental clearance and are under construction.

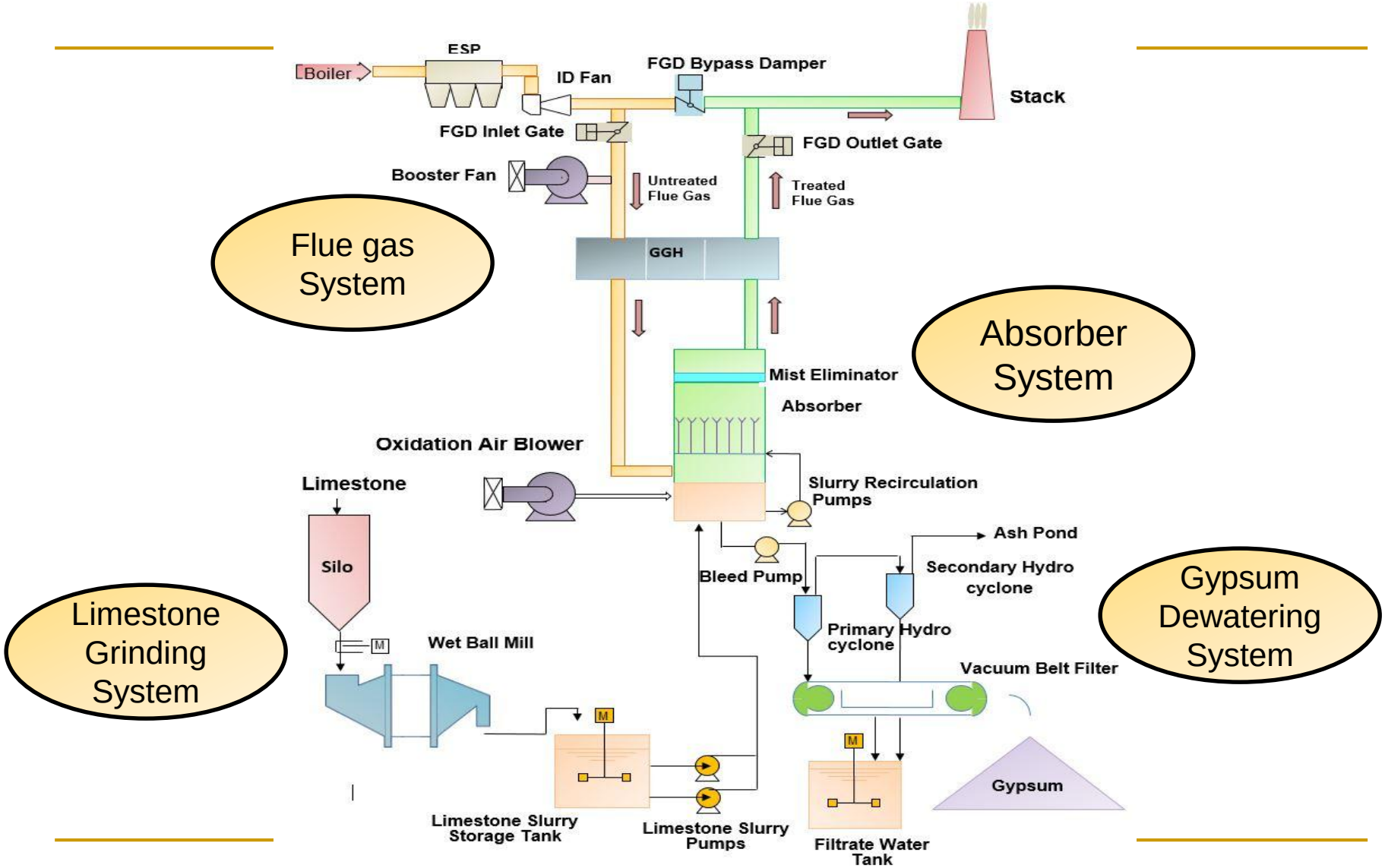
BHEL Experience in FGD

- Successfully commissioned sea water based FGD at Trombay unit#8 250 MW of MHI Technology in 2010
- Supplied Wet Limestone based FGD to NTPC Bongaigaon 3X250MW of Ducon Technology in 2012.
- **BHEL has signed a TCA with M/s MHPS for Wet FGD technology in April 2013.**

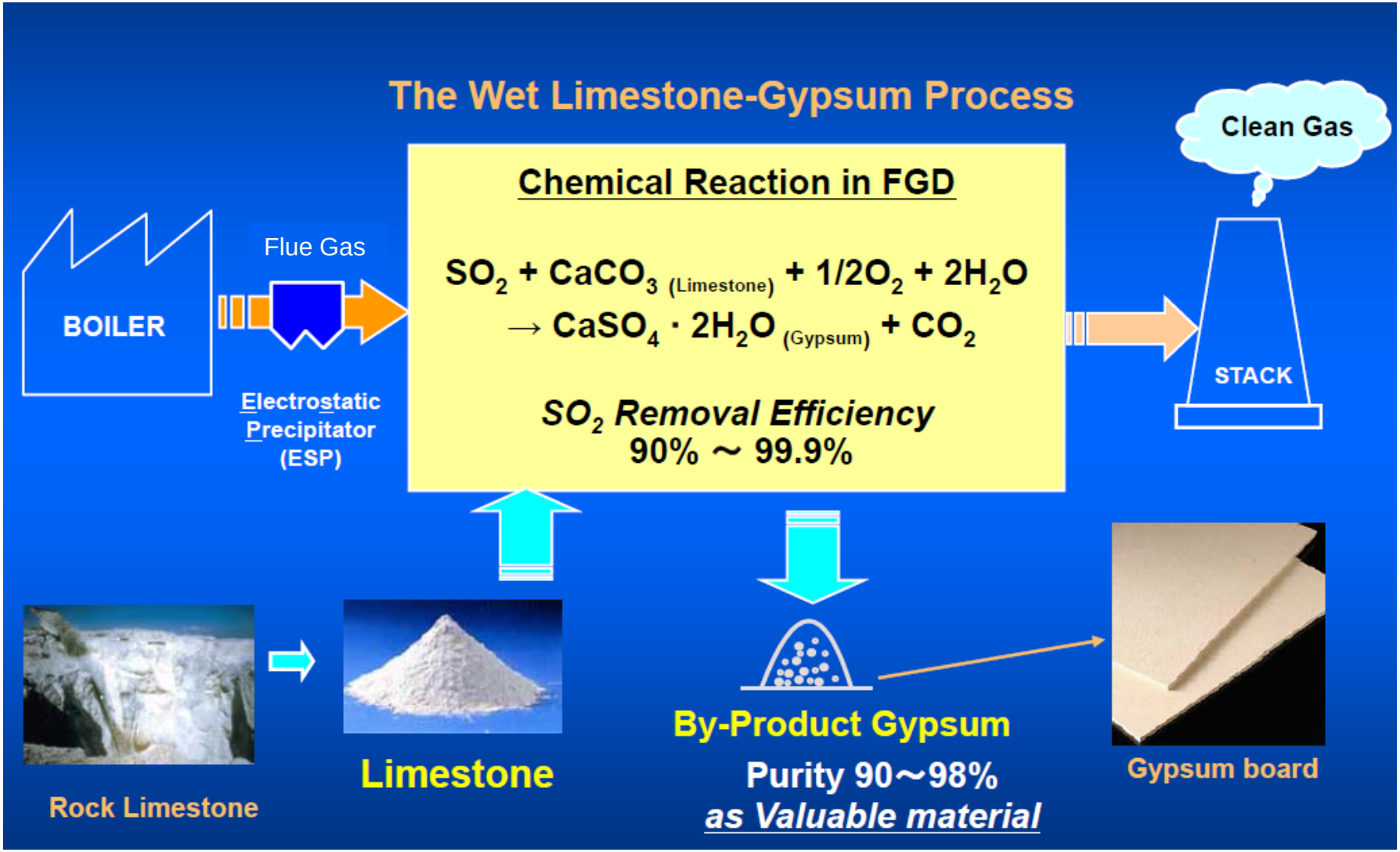
Types of FGD

- Wet Lime/Limestone FGD
- Seawater FGD
- Dry FGD

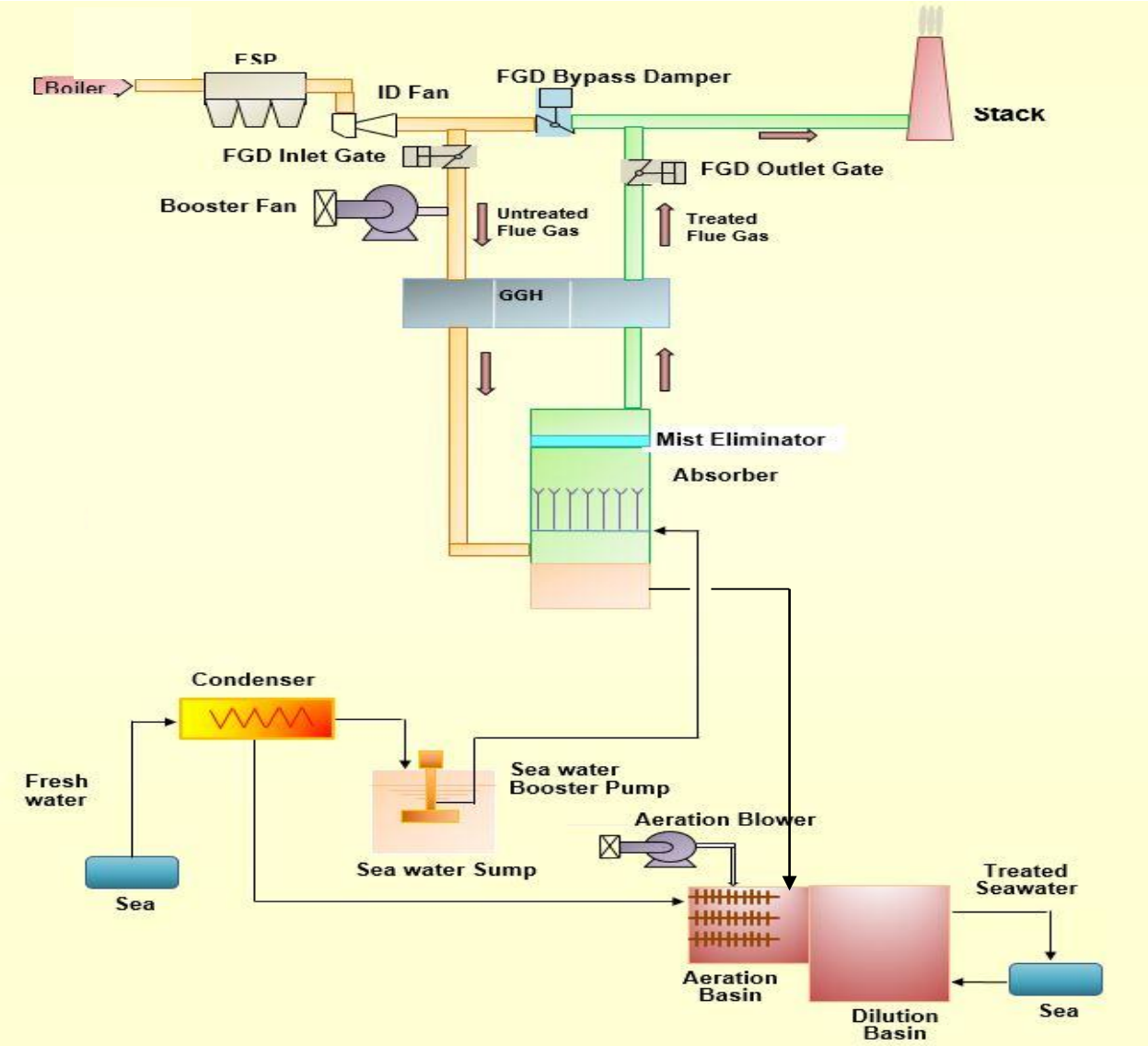
FGD Process Flow Diagram



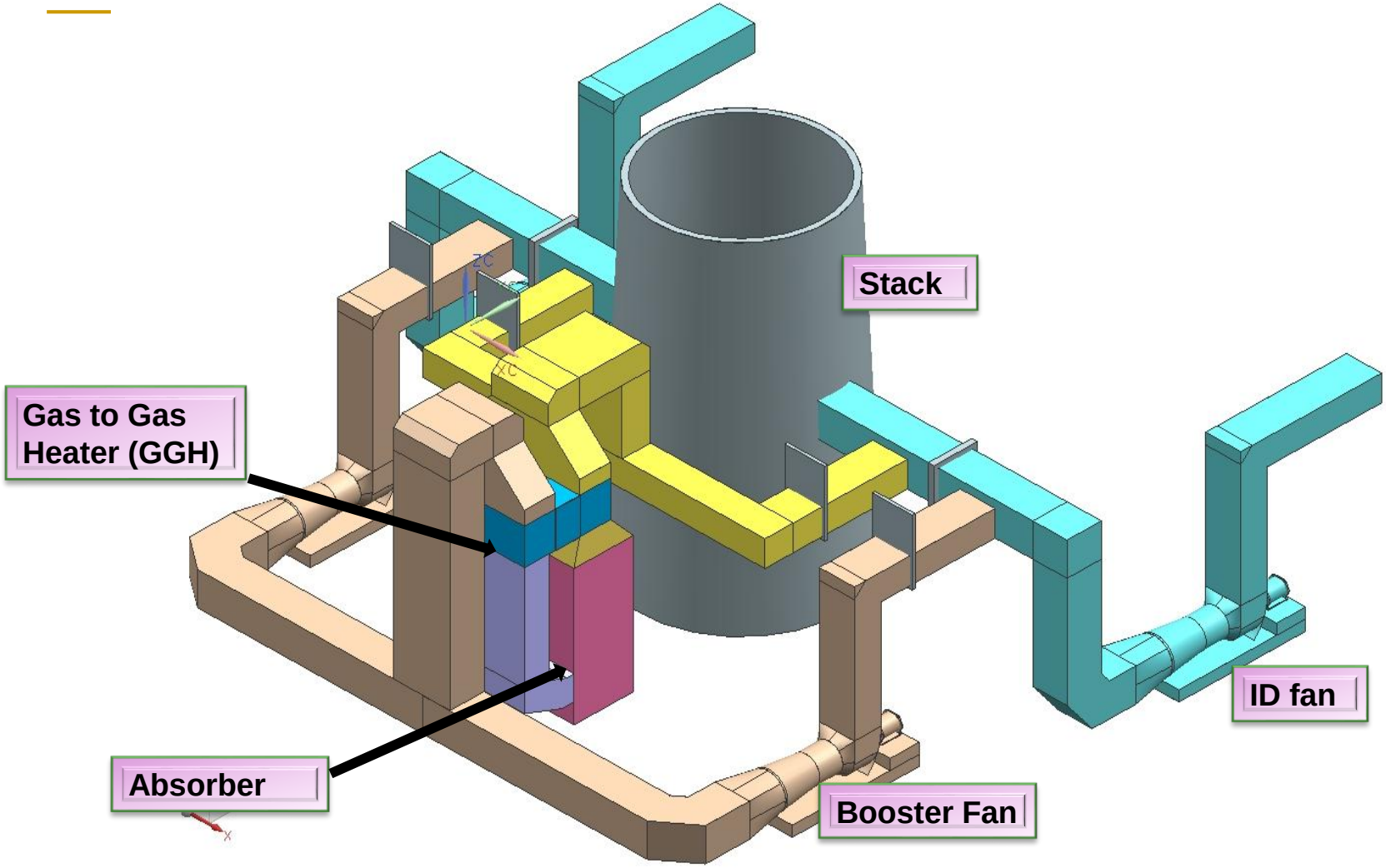
Principle of FGD System



Sea Water Based FGD

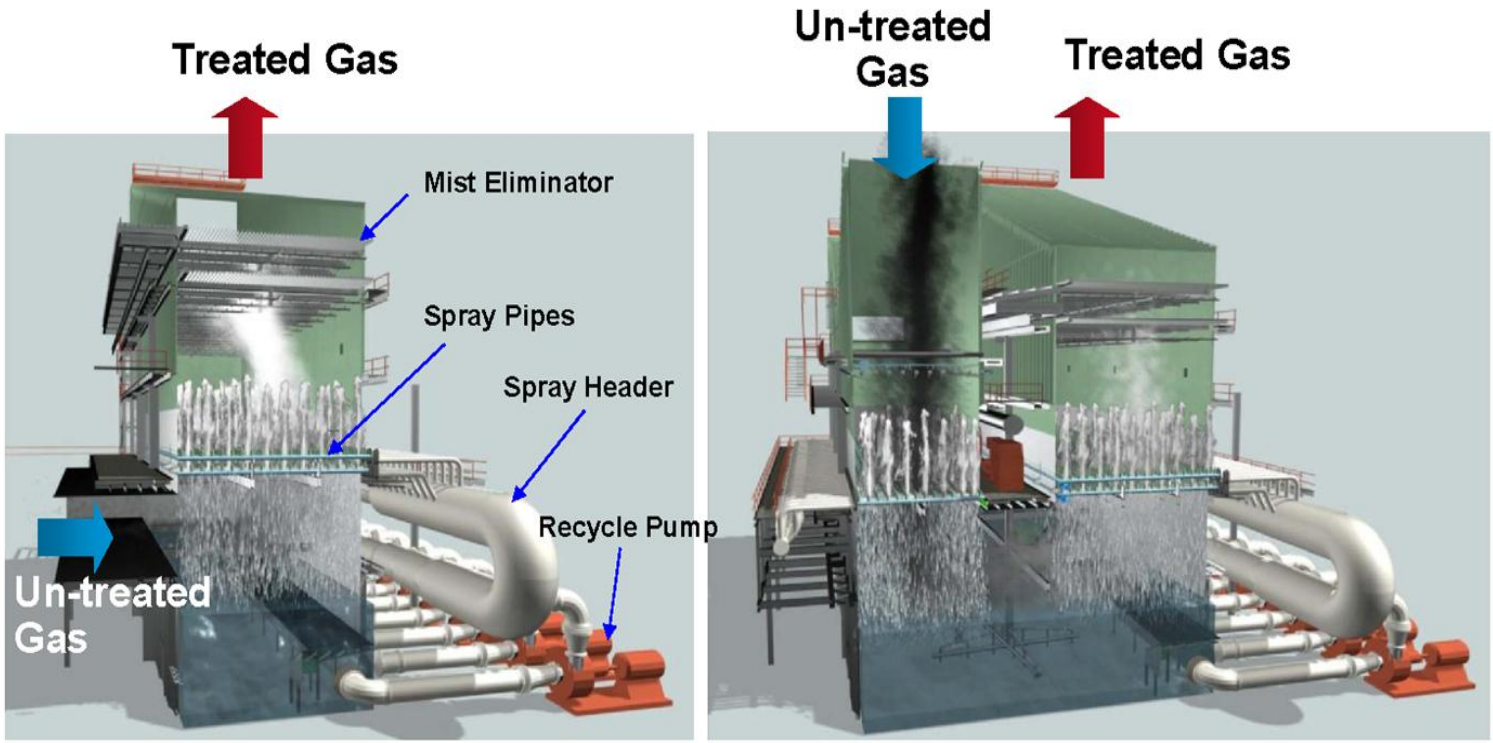


Typical FGD Layout



Typical Layout of online FGD

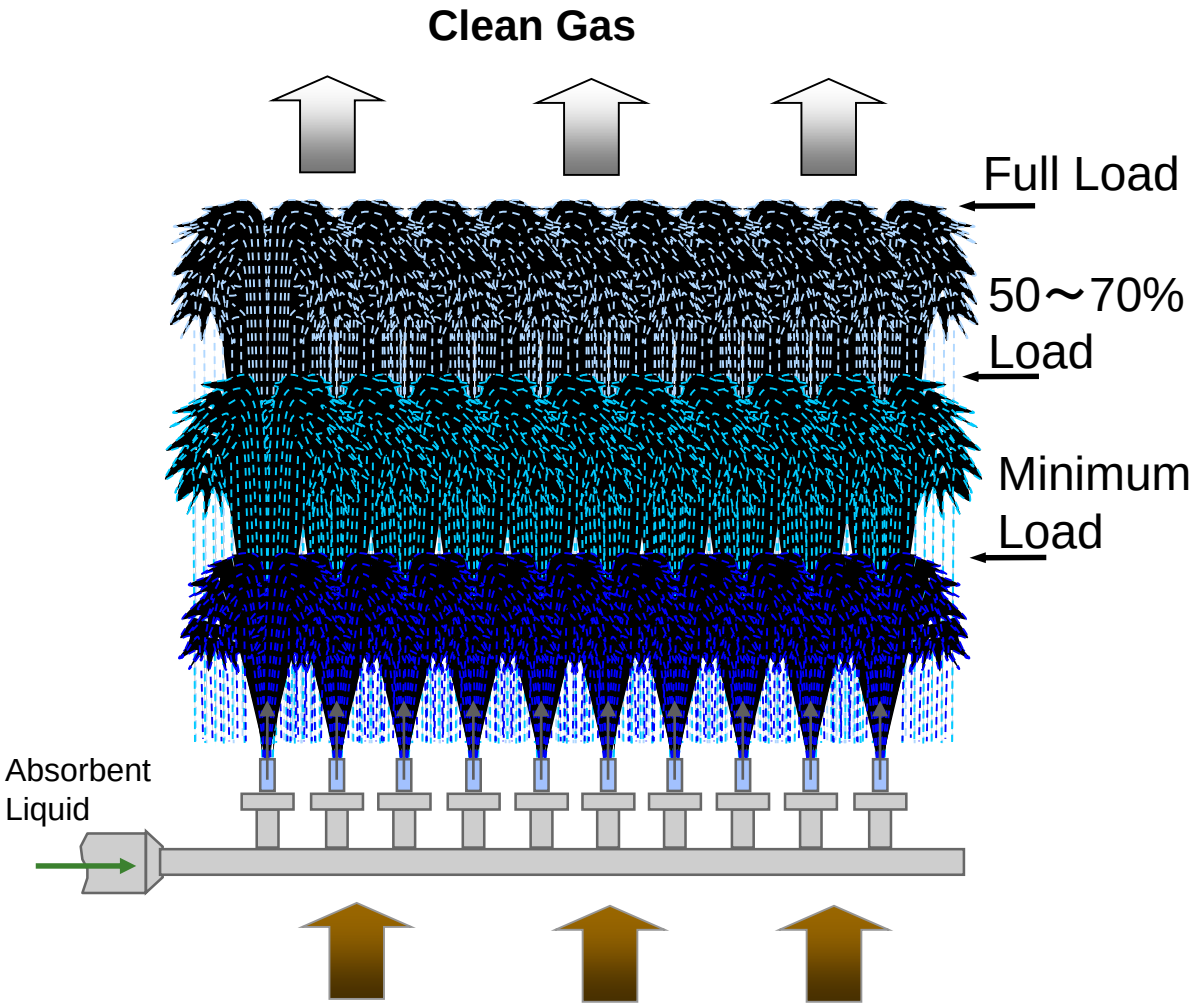
DCFS – Double Contact Flow Scrubber



Single Tower DCFS

Twin Tower DCFS

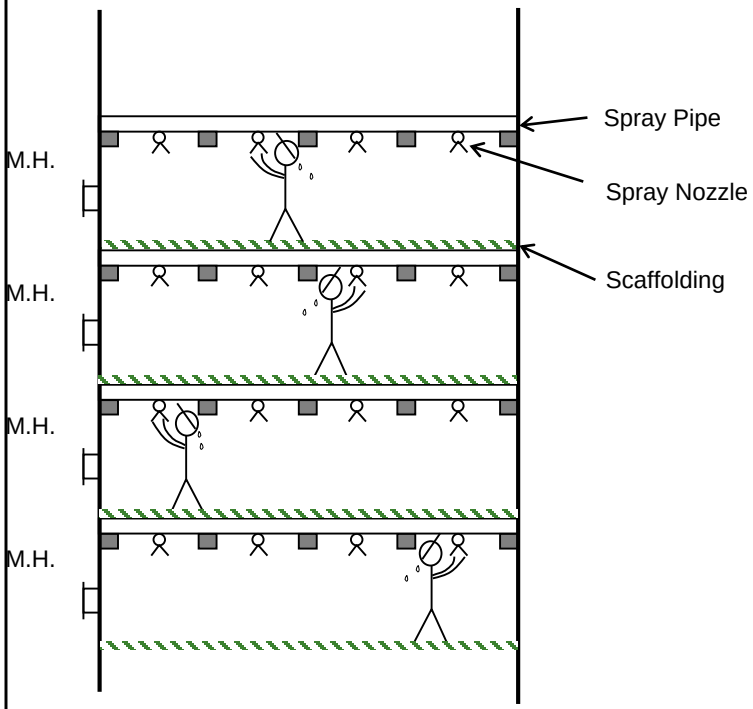
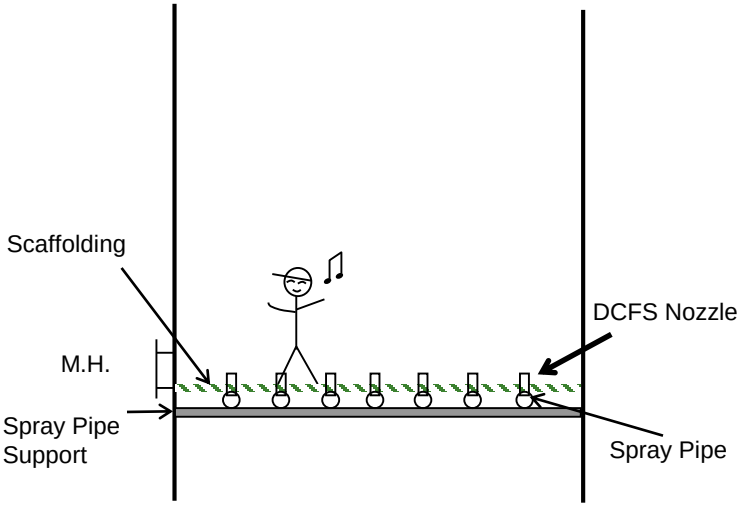
Spray System Load Adjustment



Energy Saving for Partial Load

Liquid column height is adjusted by changing the number of recirculation pumps according to boiler load, thus for energy saving.

Comparison with Conventional Spray

Item	Spray Tower	BHEL-MHPS DCFS
Maintainability		
Features	• **Scaffolding is required for each stage of spray pipe.** • **It is hard to install the scaffolding for each stage of spray pipe.** • **Maintenance work is hard because the workers are forced to keep looking up the spray pipes and nozzles**	• **Only one stage scaffolding is required.** • **It is easy to install the scaffolding on spray pipes.** • **Maintenance work is easy because the workers can inspect nozzles by looking down.**

Internals of DCFS after operation

No special maintenance is required, because scaling will not occur due to Mitsubishi's unique absorber design without internal elements, except for single-stage nozzles of the DCFS system.

Kashima-minami (136MW)

After 6 year operation

(6th Periodical Inspection)

Misumi (1,000MW)

After 2 year operation

(1st Periodical Inspection)

Mikuni (250MW)

After 2 year operation

(1st Periodical Inspection)

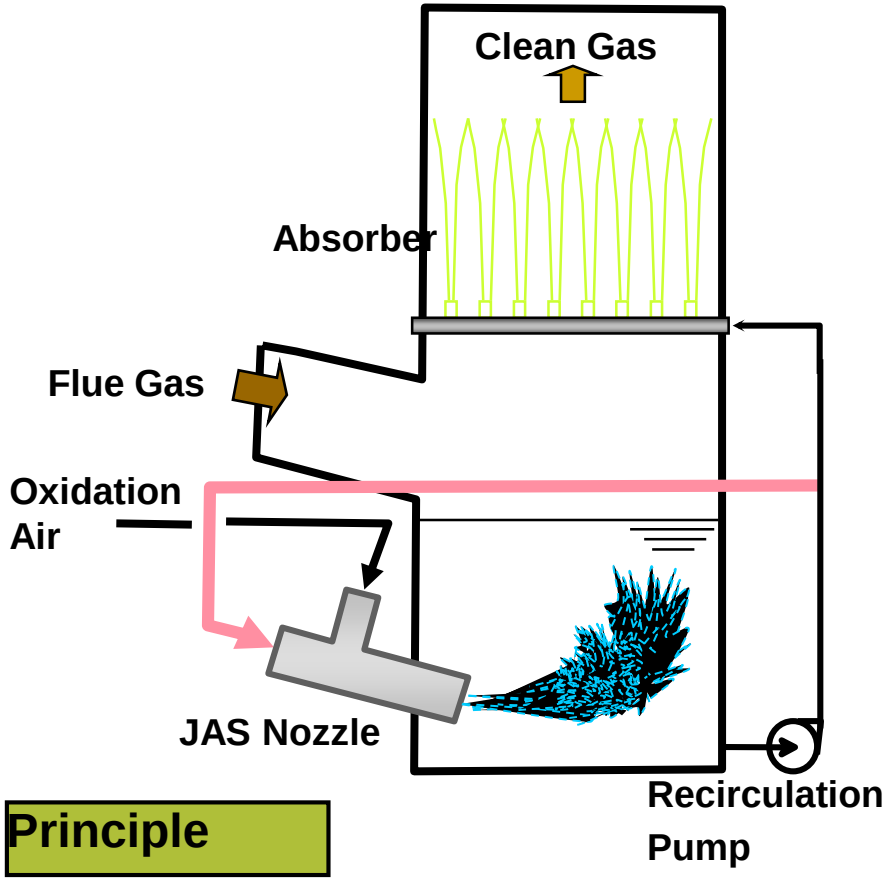
Reference Plant (Compact Footprint)

Independent Type

Absorber-mounted Type

Absorber-mounted Type fit even small space

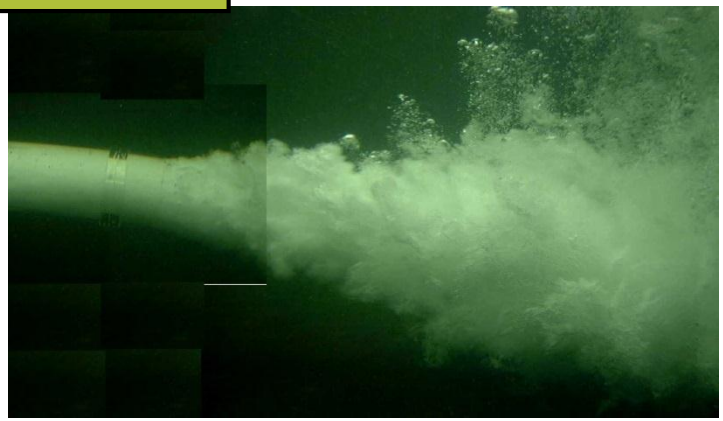
Jet Air Sparger (JAS)



Principle

- A part of the absorber slurry is fed to JAS.
- Low pressure area is generated in JAS where air is sucked directly through blower.

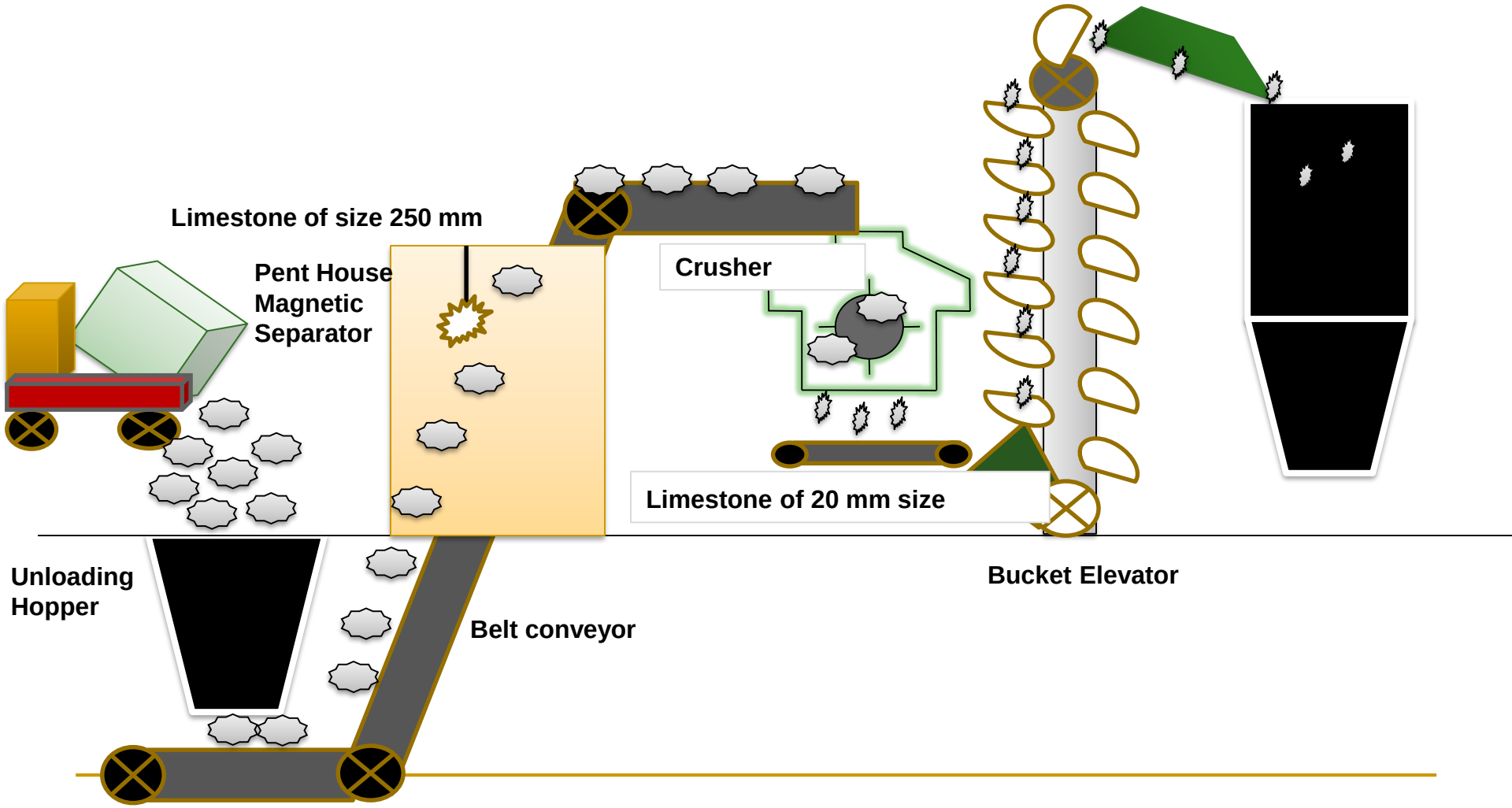
Features



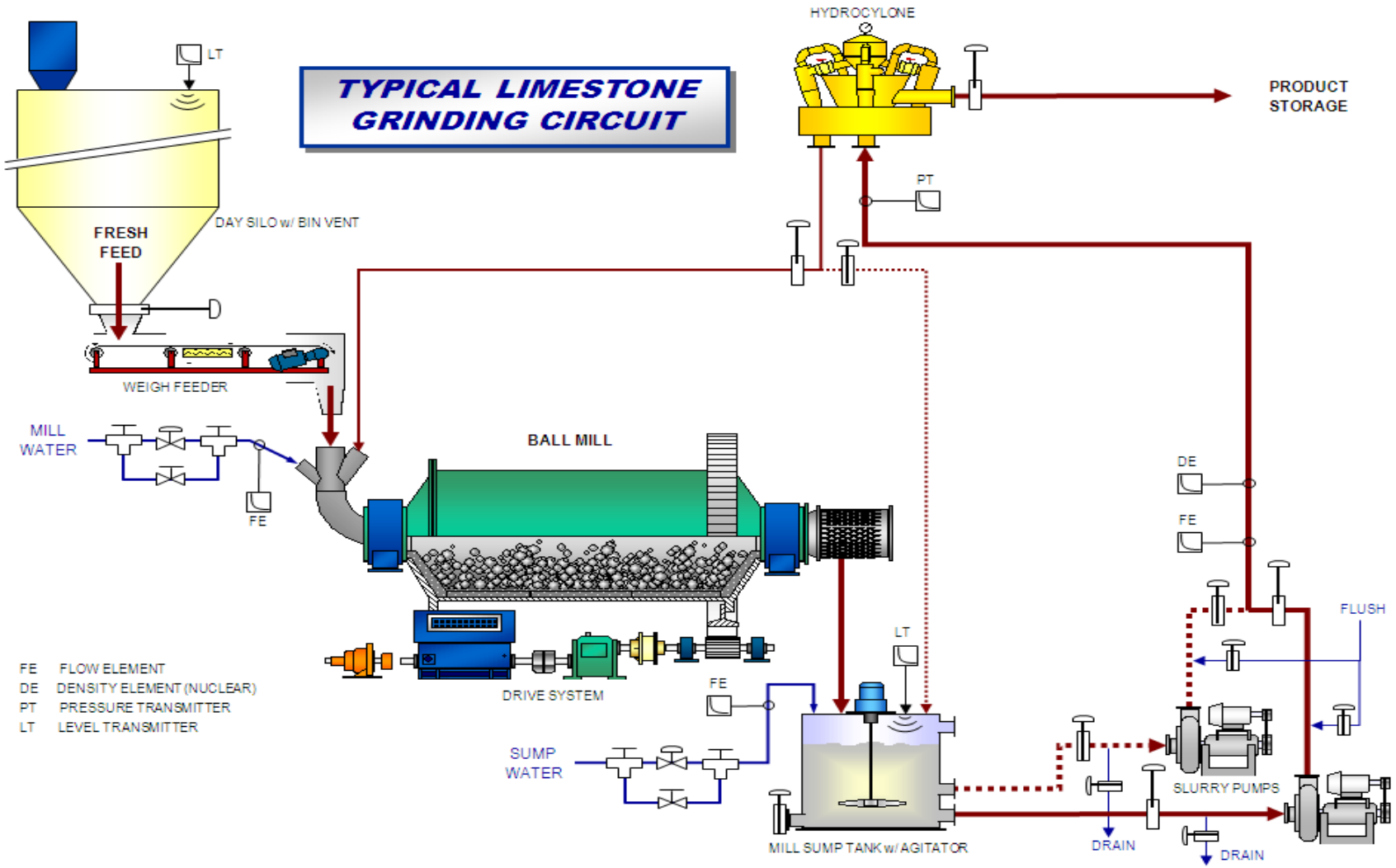
Oxidation Method	Jet Air Sparger	Side-entry Oxidation Agitator	Fixed Air Sparger
Air utilization Percentage (Indicative)	60	30	20

- Energy Saving – High air-utilization percentage
  – Blower less
- Reduced maintenance and high reliability – No rotating equipment
  – No structural parts

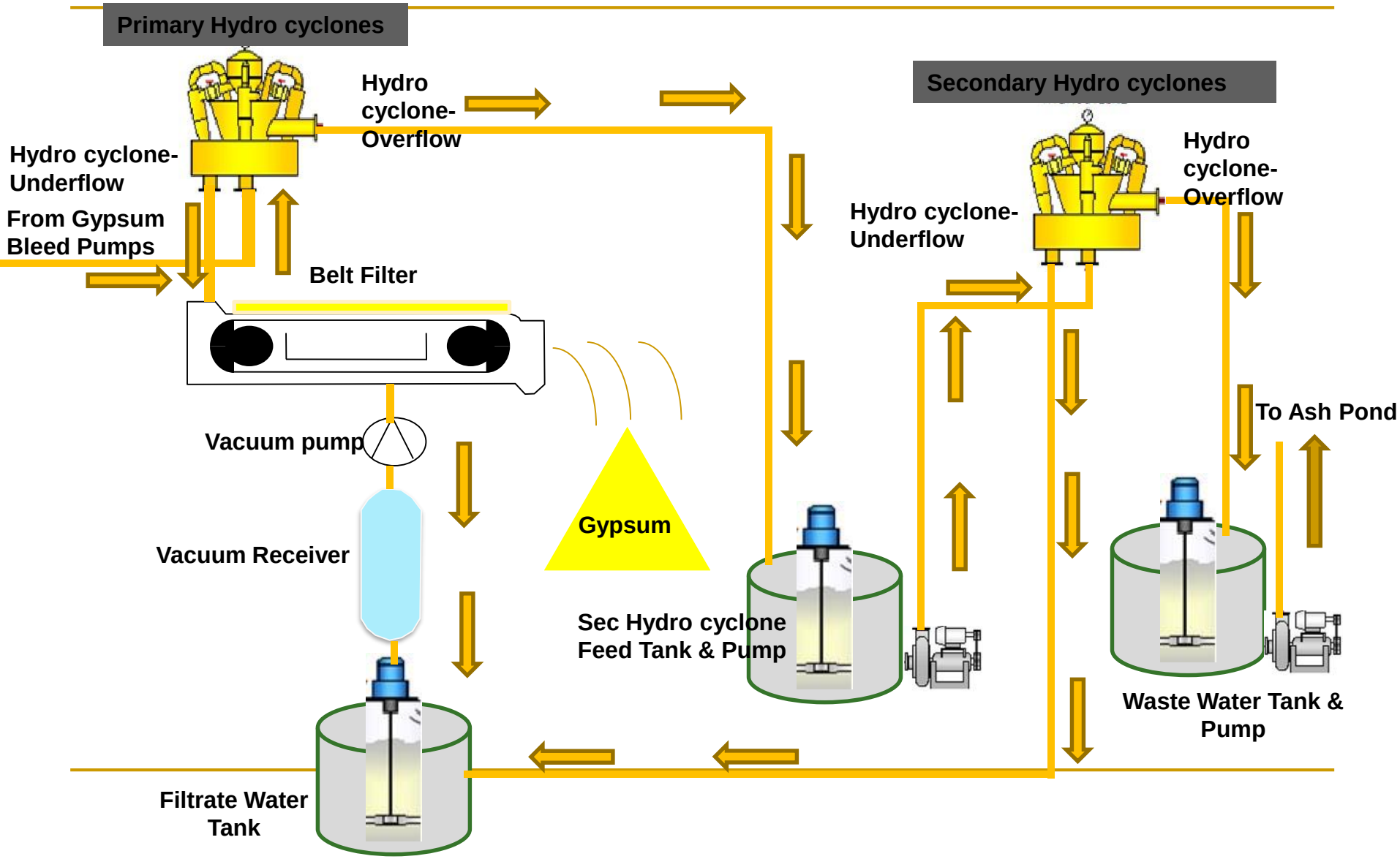
FGD-Limestone Preparation System



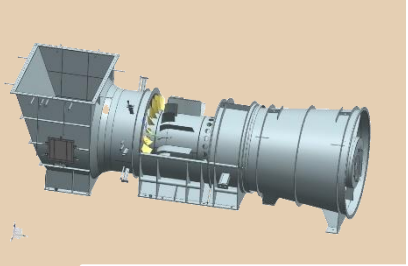
Limestone Grinding System



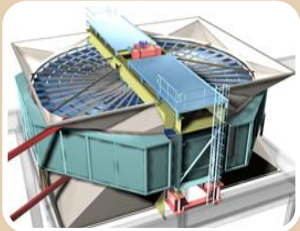
FGD-Gypsum Dewatering System



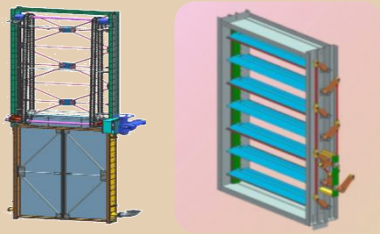
Critical Equipment of FGD system



Booster Fan



Gas Gas Heater



Gates & Dampers

Wet Ball Mill

Gypsum Dewatering System

Oxidation Blower

Recirculation Slurry Pump

Agitator

Wet Ball Mill System

- *Quarry Ground Limestone or On-Site Mill*
- *Horizontal Ball Mill*
- *95% - 325 Mesh (44 µm)*
- *30% to 35% Solids*

Gypsum Dewatering System

Hydrocyclone

Vacuum Belt Filter

Byproduct Gypsum

Full Scale DCFS R&D SETUP

Reference Plant

Client : Tennessee Valley Authority

Plant : Bull Run Fossil Plant , USA

Fuel (Sulfur Content) : Coal (S = 2.12%)

Generating Power : 920 MW

Gas Flow Rate : 3,311,200 $Nm^3/h(w)$

Inlet SO_2 Conc. : 1,343 ppm(d)

(3,938 mg/Nm^3)

Inlet Gas Temp. : 149 deg.C

Desulfurization Efficiency : 98.0 %

Start up : Nov. 2008

Absorber Type : DCFS

Reference Plant

Client	:	**British Energy**
Plant	:	**Eggborough #3 and 4, UK**
Fuel	:	Coal (S = 1.6%)
Generating Power	:	500 MW each
Gas Flow Rate	:	1,980,000 $Nm^3/h(w)$
Inlet SO_2 Conc.	:	3,589 mg/Nm3
Inlet Gas Temp.	:	125 deg.C
Desulfurization Efficiency	:	90.0 %
Start up	:	2004
Absorber Type	:	DCFS

LIMESTONE SOURCE

Lime stone sourcing

Limestone production in India

- Andhra Pradesh (21%)
- Rajasthan (19%)
- Madhya Pradesh (13%)
- Gujarat (9%)
- Karnataka, Chhattisgarh & Tamil Nadu (8% each)
- Maharashtra, Himachal Pradesh (4% each)
- Remaining 6% from other states

Other states of limestone resource

- **Tamil Nadu**

  (Ramanathapuram, Tirunelveli, Tiruchirappalli, Salem, Coimbatore, Madurai and Thanjavur)

- **Maharashtra**

  (Yavatmal, Chandrapur, Nanded and Ahmednagar)

- **Himchal Pradesh**

  (Bilaspur, Kangra and Chamba)

- **Orissa**

  (Sundargarh, Sambalpur and Kalahandi)

- **Other states Haryana**, **Assam, Meghalaya, Uttar Pradesh, Jammu and Kashmir**

Gypsum Disposal

- Manufacture of wallboard,
- Cement,
- Plaster of Paris,
- Soil conditioning,
- Hardening retarder in portland cement.

Conclusion

Why BHEL?

- OEM of majority of power plants in India
- BHEL is having the best FGD technology in the world
- Optimum design, layout and better interface with Boiler
- Unified DCS running on common platform
- Assured Service after Sales
- BHEL is ‘Making in India’

Thank You