

# Electrostatic Precipitator



August 2013

**KC Cottrell Co., Ltd.**

# ESP Table of Contents



**Principle**

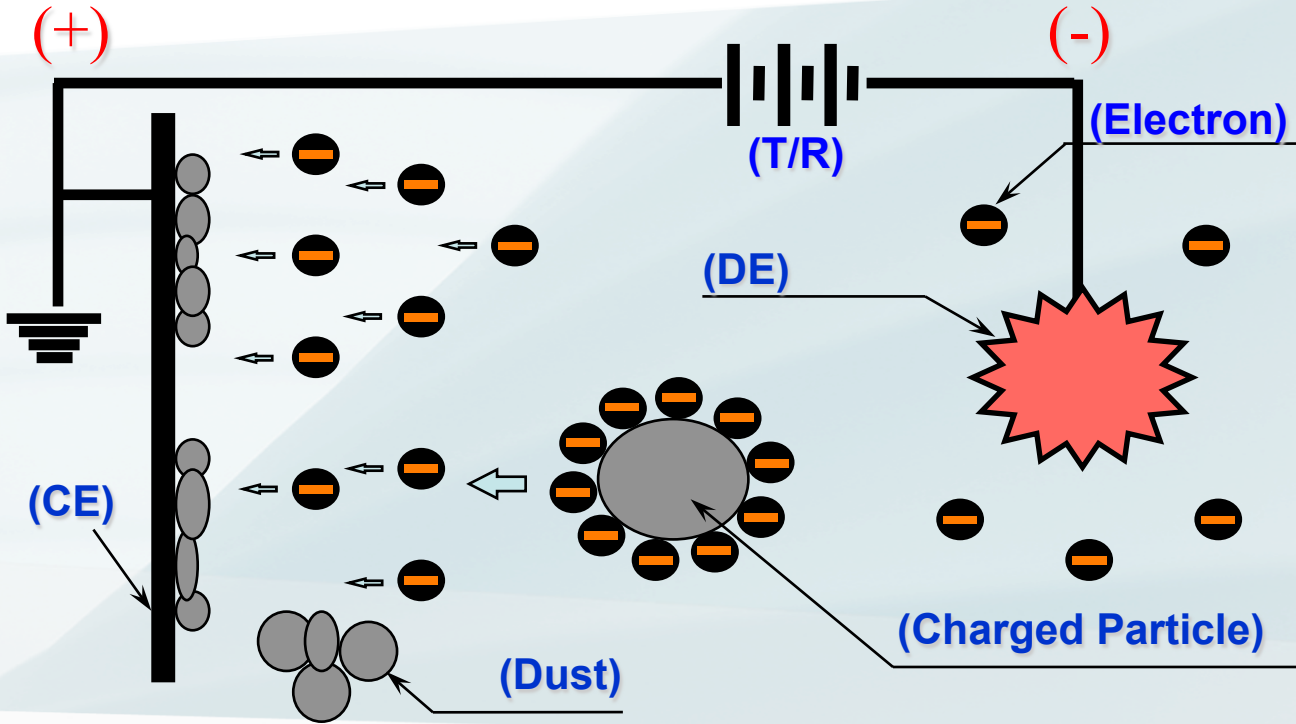
**ESP Product**

**Technical**

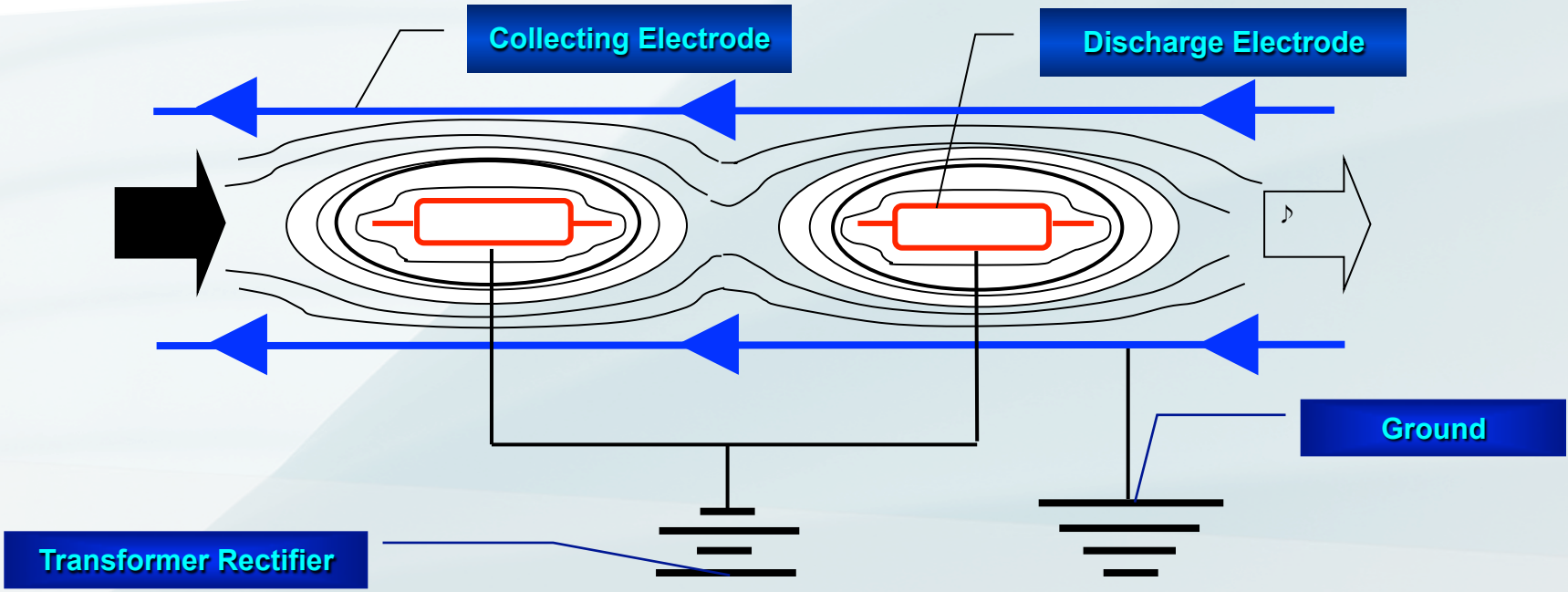
**Major Part**

**References**

# ESP Operation Principle



# ESP Operation Principle



## ESP Operation Principle

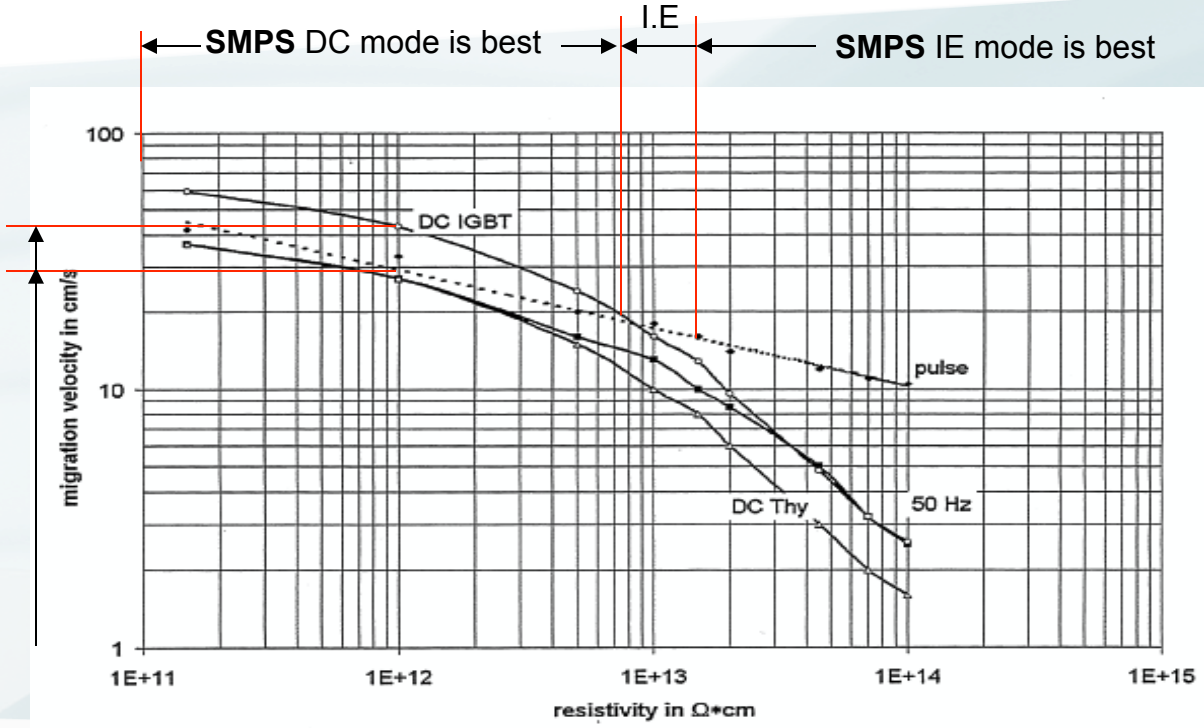
Electrostatic precipitation is a physical process which the particulate suspended in a gas stream electrically charged in a corona field and under the influence of the electric field, is driven to a collecting surface and separated from the gas. This process is exceedingly complex. Electrical, mechanical, chemical and aerodynamic phenomena are intimately involved.

Three aspects of the process are :

- Charging the suspended particulate.
- Collecting the particulate under the influence of the electric field.
- Removing the particulate from the collecting surfaces and transfer from the system.

An electrostatic precipitator consists of electrically grounded plates with negatively-charged electrode suspended between them. A gas stream with particulate (material to be removed) is introduced between the plates. The electric charge on the electrode creates a corona field which imparts a negative charge to the particulate. The charged plates are repeatedly struck by rappers installed above them, dislodging the particulate which falls into a hopper beneath the plates. Periodically, the particulate is removed from the hoppers.

# Efficiency upon Particle Resistivity in $\Omega\text{cm}$



IEEE TRANSACTIONS ON INDUSTRIAL APPLICATIONS, VOL. 41, NO. 4, NOVEMBER/DECEMBER 2004

Application of Different Types of High-Voltage Supplies on Industrial Electrostatic Precipitators

Nobert Grass, Member, IEEE, Werner Hartmann, Associate Member, IEEE, and Michael Klockner

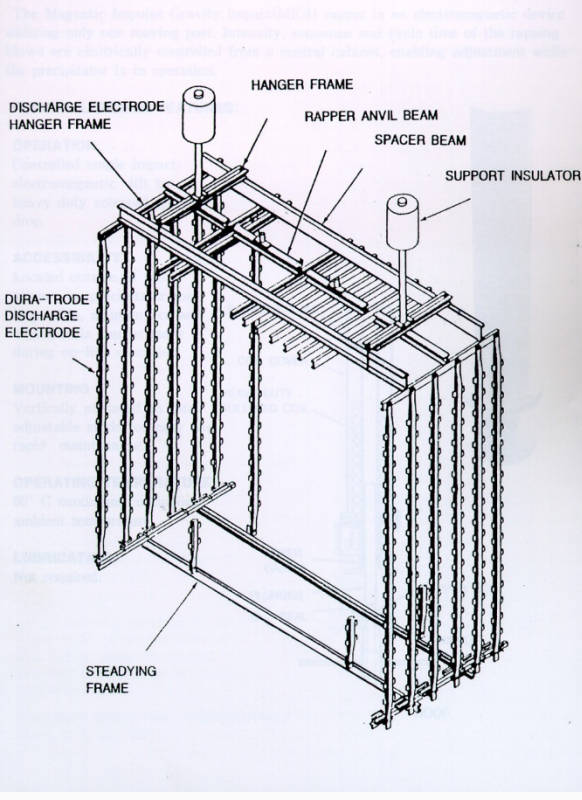
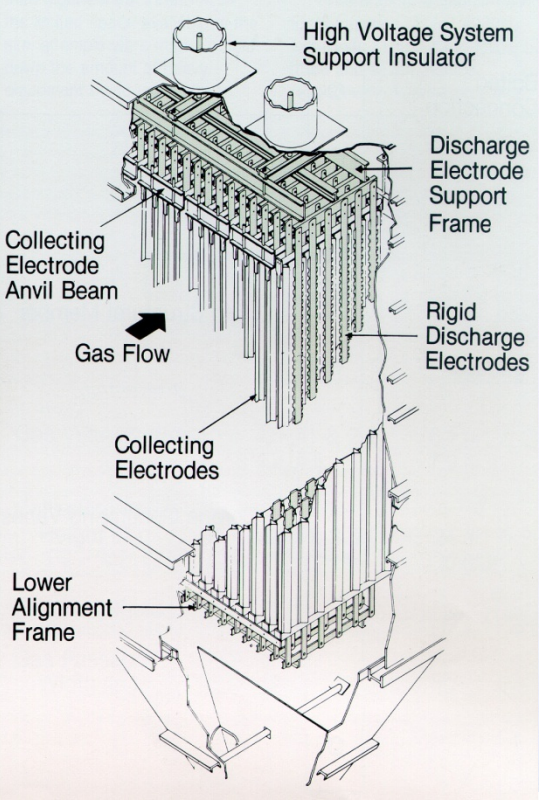
## ESP Product by KC

**(Top Rapping Type)**

**(Side Hammering Type)**

- **ESP Technology with Top & Side Rapping Design**
- **Various Experiences during more than 30 years**
- **Total Solution for various application**
- **Available for every industrial processes**

# Top Rapping ESP

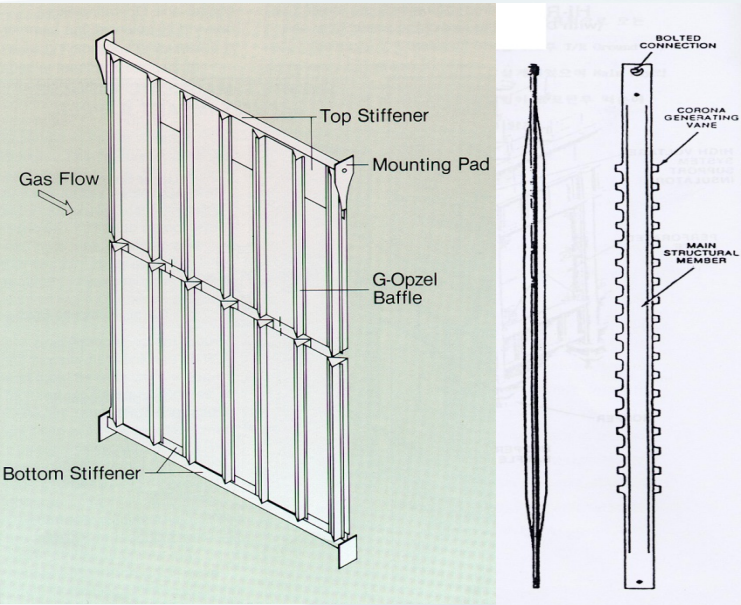


## Major Parts

- Rapping System
- CE
- DE
- Main Body
- T/R & Control System



# Top Rapping ESP Technical Focus



## ● KC Opzel CE and Rigid Dura-Trode DE

- Dura-Trode DE, Rigid to keep straightness and edge to generate corona easily.
- KC Opzel CE, Double baffle to keep flow smoothly and no re-entrainment of dust. Rigid to keep straightness and easy install by factory pre-assembly.

# Top Rapping ESP Technical Focus

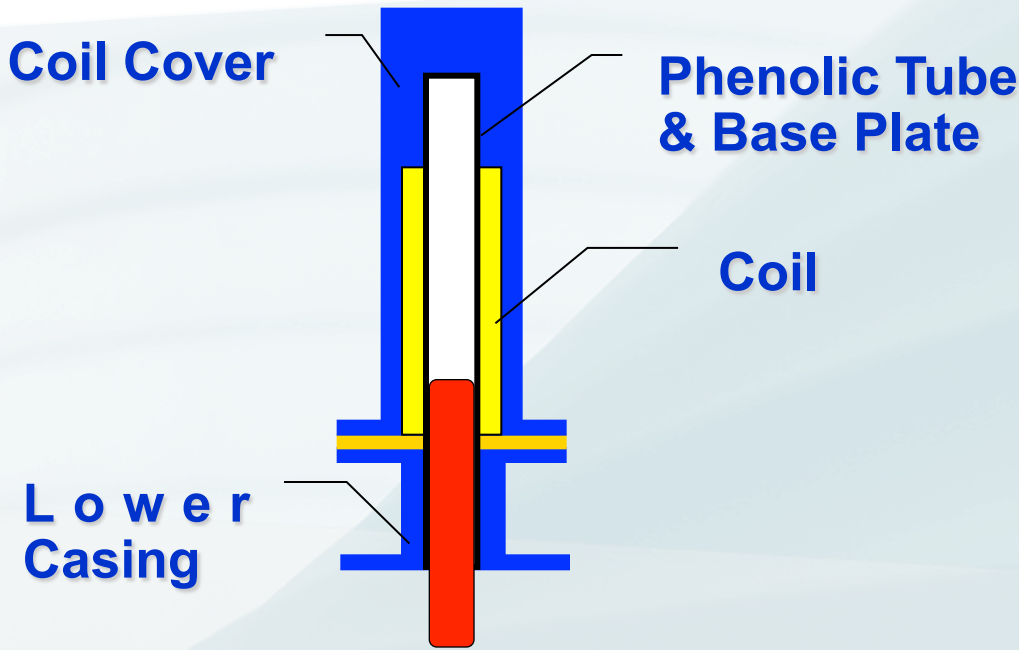


## ● Rapping system

- ▲ Control By Micro Process
- ▲ Installed ESP Top
- ▲ No need lubrication
- ▲ Maintenance in Operation



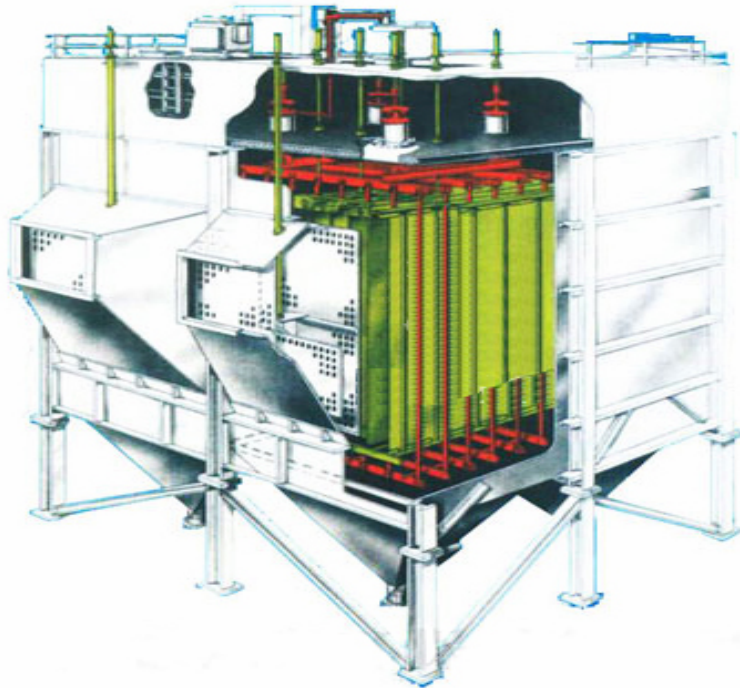
# Top Rapping ESP Technical Focus



## ● Rapping System

- ▲ MIGI (Magnetic Impulse Gravity Impact)
- ▲ Max. 16" Height Up
- ▲ Time Interval 1Second
- ▲ Max. 226Rappers with One Controller

## Top Rapping ESP Technical Focus



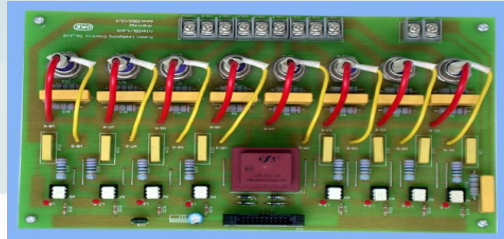
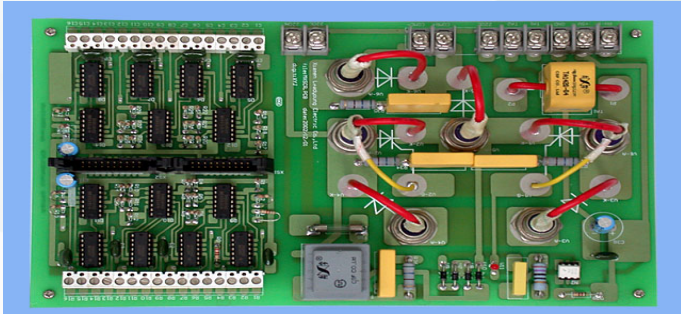
- **Easy Installation, Easy Operation**
- **Compact area upon top arrangement**
- **Rappers in outside of flue gas, maintenance possible in operation**
- **Rapping force control available by height and interval adjustment**
- **Controlled by micro processor**

# Top Rapping ESP Technical Focus

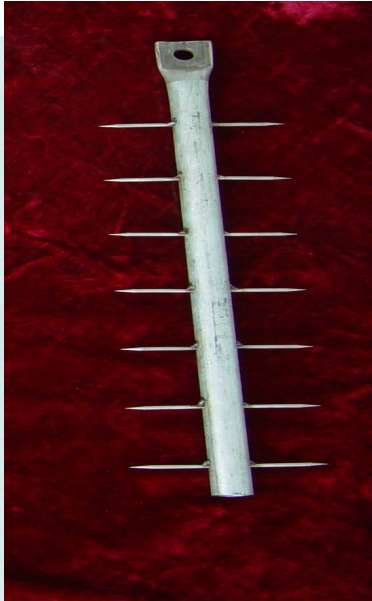


## ● Blocked Rapping Concept

- Every rapper controlled individually with different height and interval
- Optimization available along with field separately or block separately
- Easy setting by micro processor



# DE Installation & Shape



# CE Installation & Manufacture

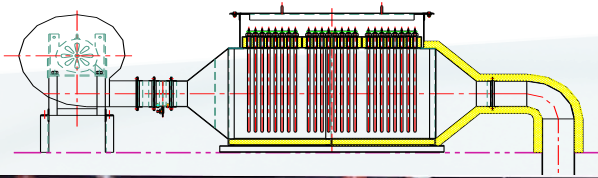


# CE/DE Installation





# Top Rapping ESP Technical Focus



## ● Insulator

- Hot roof applied to keep temperature for insulator
- Seal air heater and blower applied for control of insulator



# Top Rapping ESP Technical Focus







## ● Control System

- T/R & Controller
- ACB or VCB
- MCC
- System Control with PLC

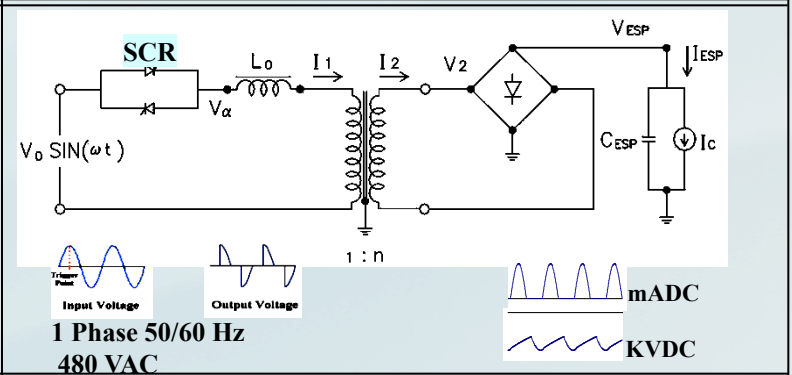
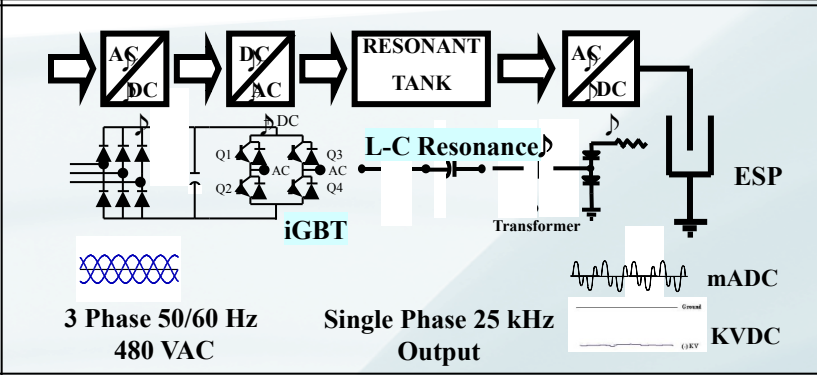


# Power Plus & Conventional T/R Comparison

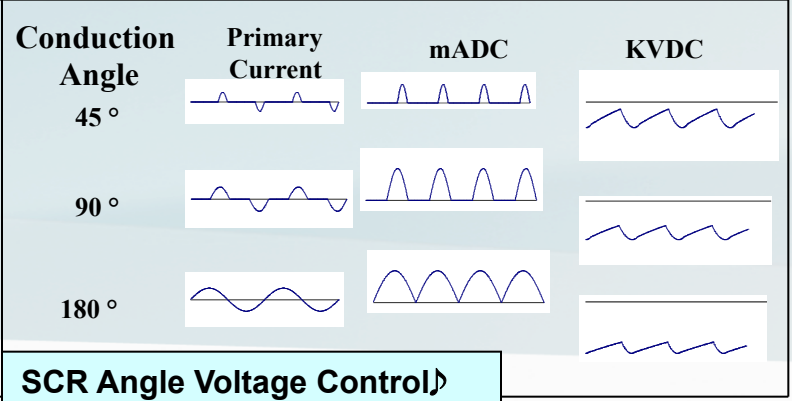
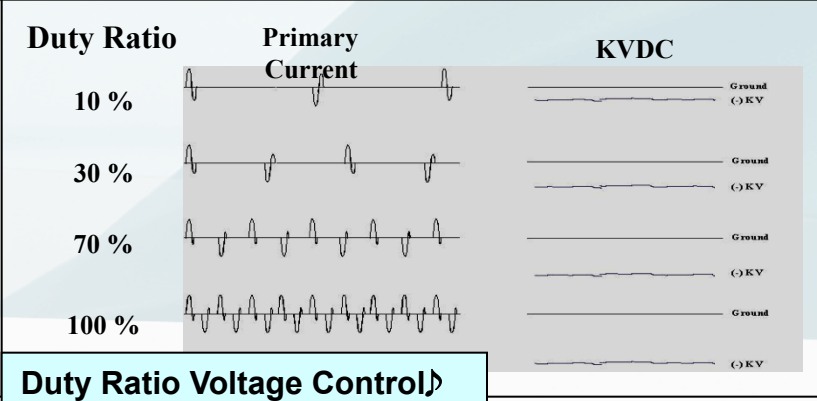
	Power Plus	Conventional T/R
Outside Form	  <p style="text-align: center;"><b>Power Plus</b></p>	  <p style="text-align: center;"><b>T/R Controller</b></p>
Component	<b>Power Plus (High frequency T/R + Controller)</b>	<b>Si T/R , T/R Control Panel</b>
Control Method	<b>SMPS (Switching Mode Power Supply)SP (Digital Signal Processor)</b>	<b>SCR Angle Control (60Hz) <math>\mu</math>-processor</b>
Control Frequency	<b>iGBT Current Control (High Frequency 25kHz)</b>	<b>SCR Angle Control (60Hz)</b>
Input Power	<b>3Phase 60Hz 480V</b>	<b>1Phase 60Hz 480V</b>
Power Factor	<b>0.94</b>	<b>0.63</b>
Arc Response Time	<b>0.03 ms</b>	<b>8.33 ms</b>

# Power Plus & Conventional T/R

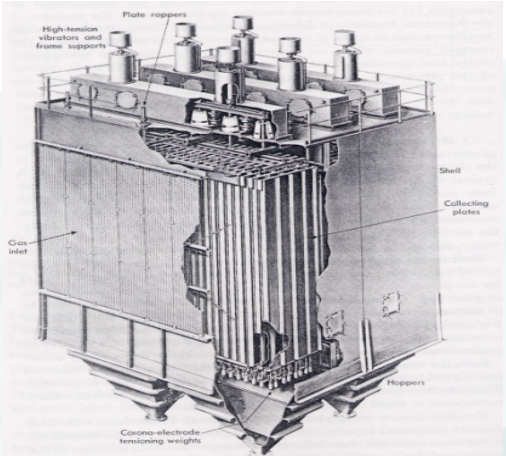
**Circuit**  
**Input/Output**



**Voltage Control Method**



# Top rapping ESP View



SECTIONAL SIDE ELEVATION

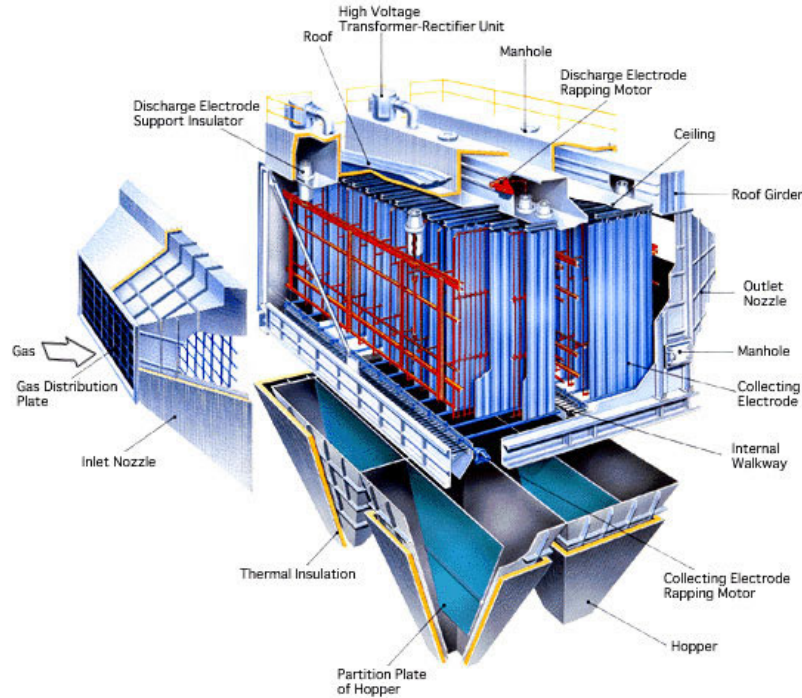
SECTIONAL END ELEVATION

NO	DESCRIPTION	MATERIAL	QTY	UNIT	REMARKS
1	SP. PLATE				
2	PLATE				
3	PLATE				
4	PLATE				
5	PLATE				
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50	PLATE				

FOE CONSTRUCTION

KC Cottrell

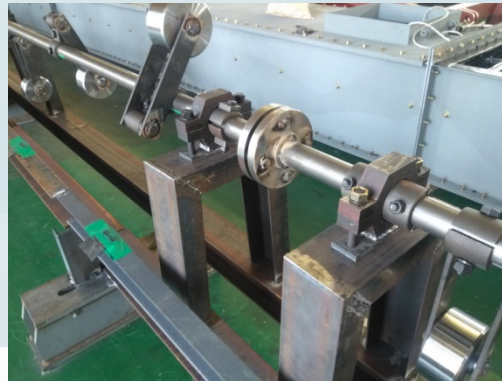
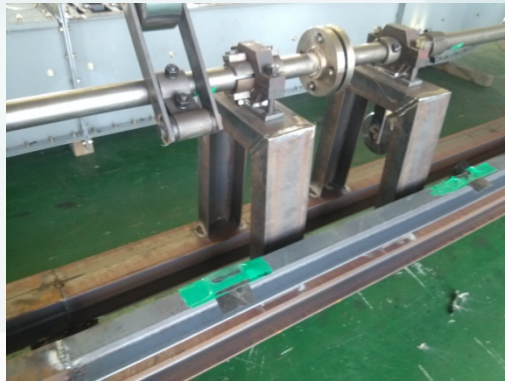
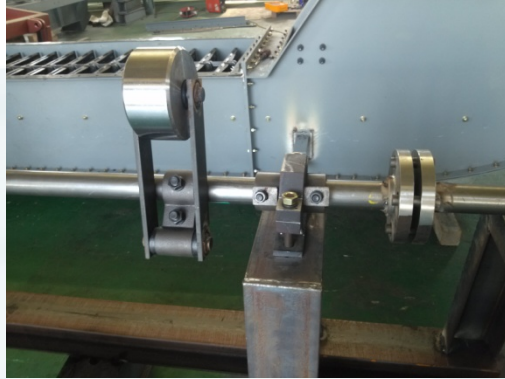
# Side Rapping ESP



## Major Parts

- Rapping System
- CE
- DE
- Main Body
- T/R

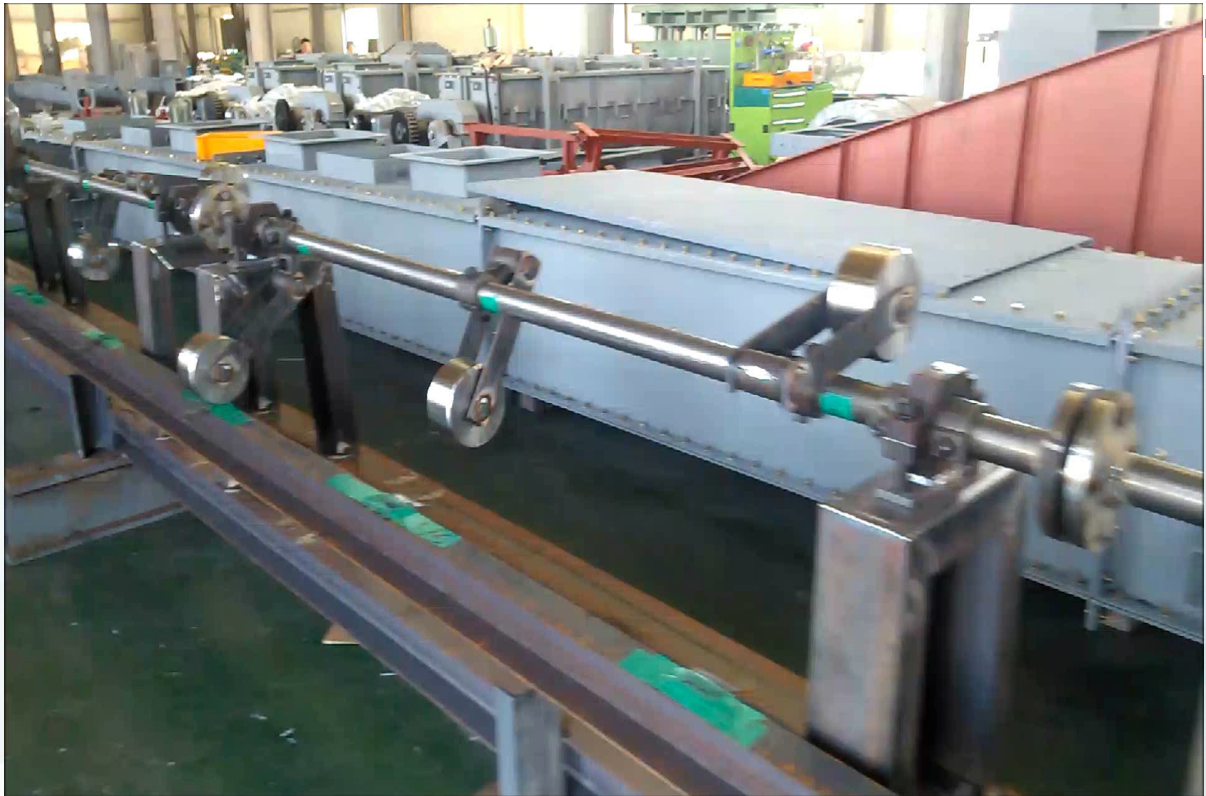
## Side Rapping ESP Technical Focus



### ● Rapper Assembly

- Mechanical rapping, big rapping force, long height CE applicable。
- Equal rapping force, dust removal from CE more effective,

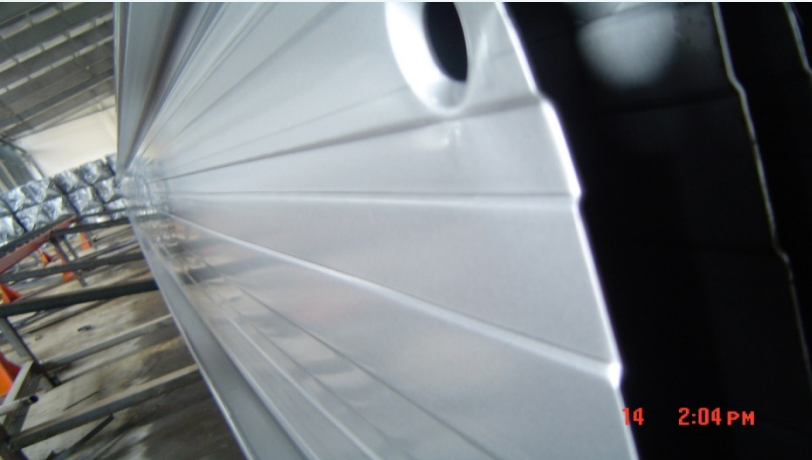
# Side Rapping ESP Rapping Test





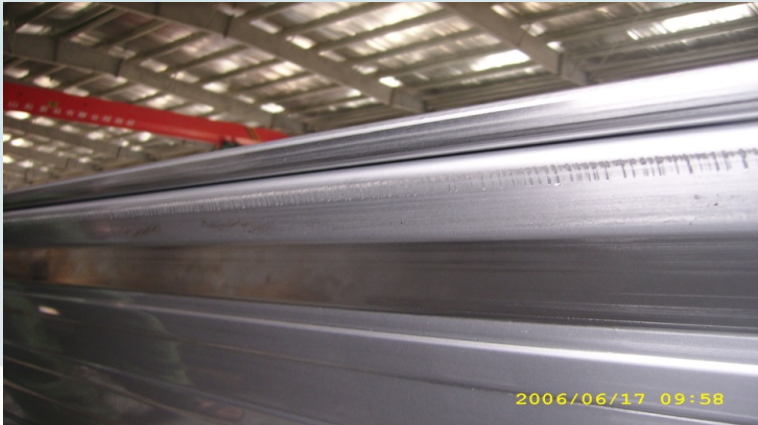
## Side Rapping ESP Technical Focus

### ● CE: SIGMA Type 480mmC Panel



- Rapping force transferring good, easy dust removal from surface
- Weight for unit area more light
- Under high temp., anti-detouring during rapping
- Top connection with welding type, keeping straightness good

# CE Manufacture



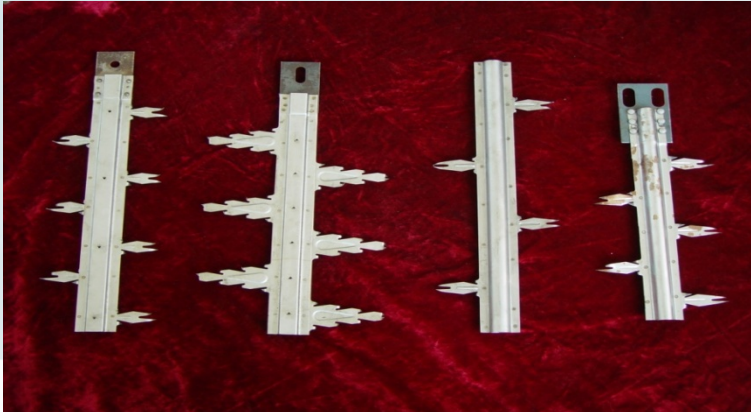
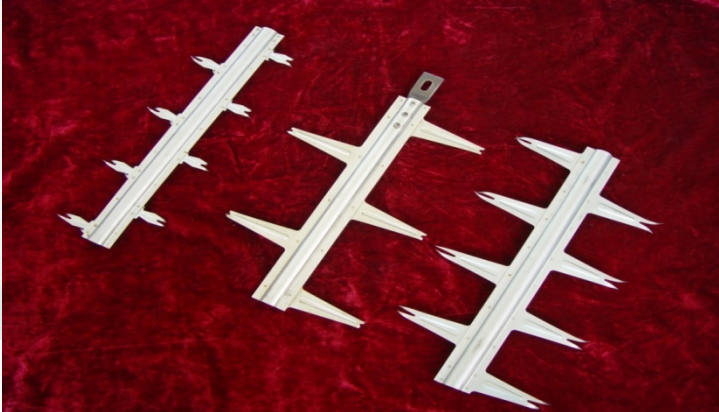
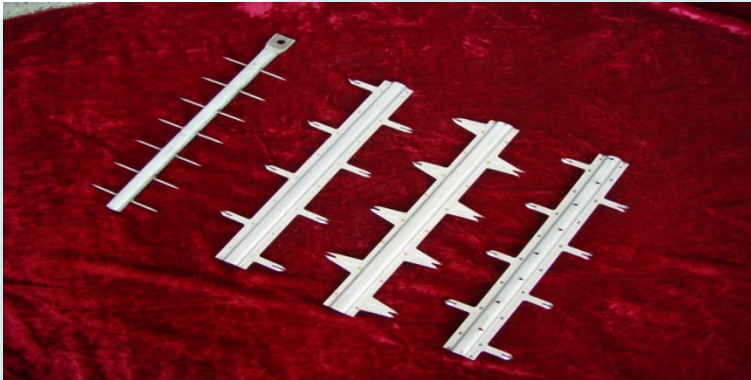
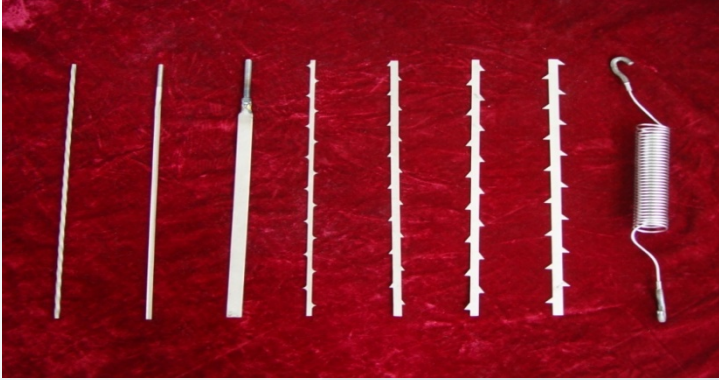
## Side Rapping ESP Technical Focus

### ● DE: Newly Developed DE Shape Applied

- More sharp edge, more strong corona
- More current density with equilibrium, Rigid enough for anti-cutting.
- Low corona starting voltage available upon new edge shape.
- More energy into ESP without Spark, Arc.
- Insulator installed in weather protection box with electric heater.

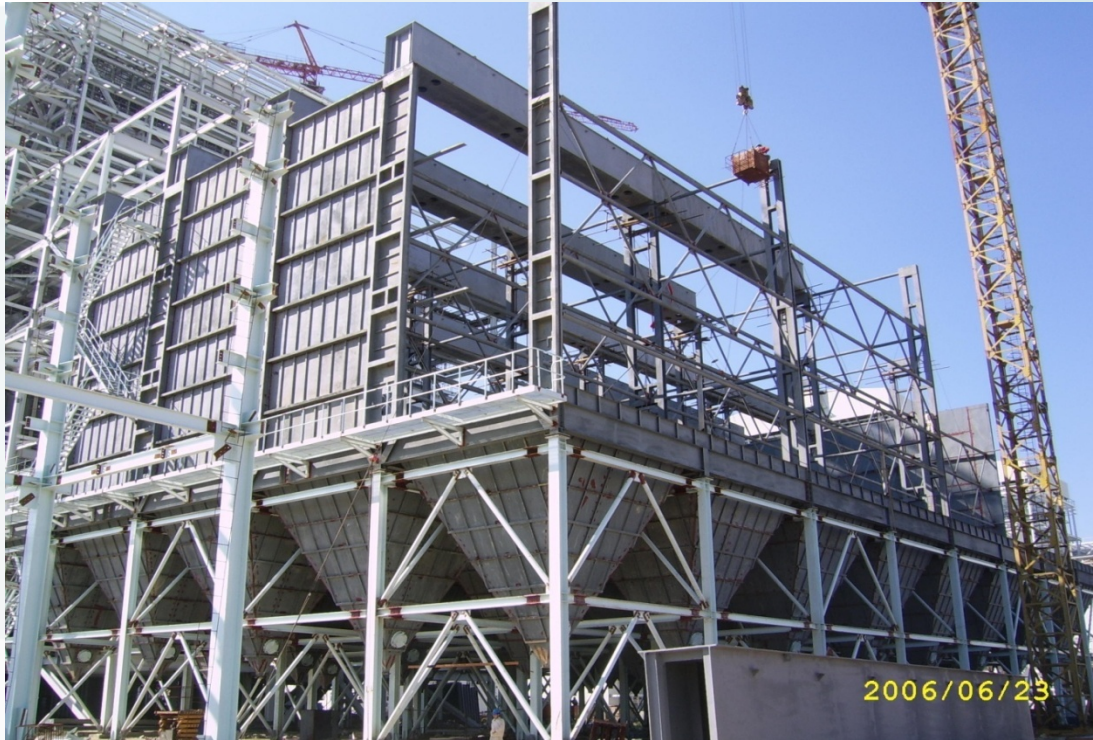


# DE Shape Applicable



# Side Rapping ESP Technical Focus

- Main Body: Box Girder Support Type



# Side Rapping ESP Technical Focus

● CE/DE: SIGMA Type, New Type RS



# Side Rapping ESP Technical Focus

- Hopper: Reasonable Arrangement Design, Easy Insulation Work



# Side Rapping ESP Technical Focus

- Nozzle: Equilibrium Gas Distribution





# Side Rapping ESP Technical Focus

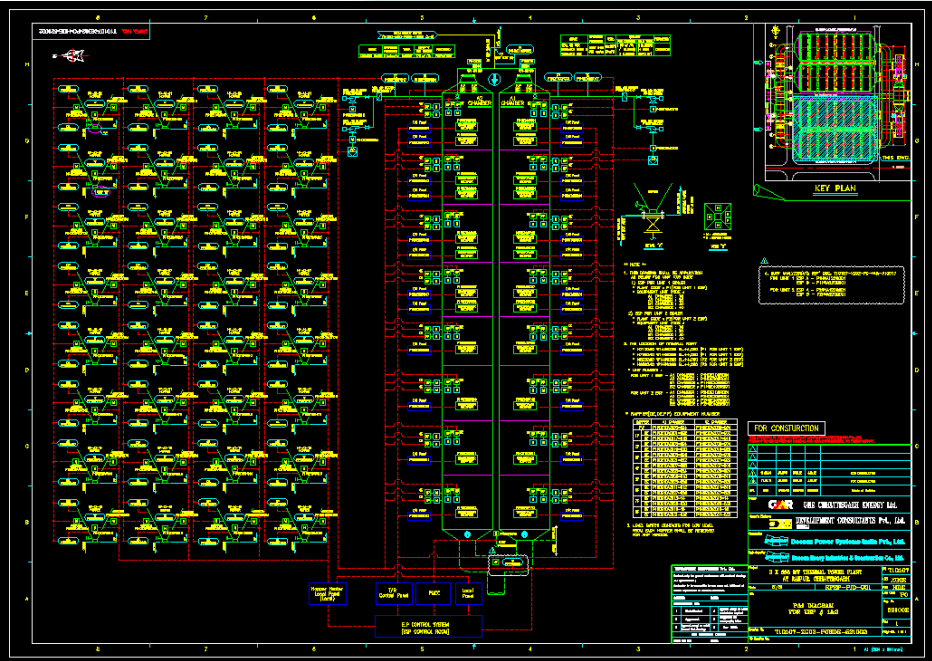
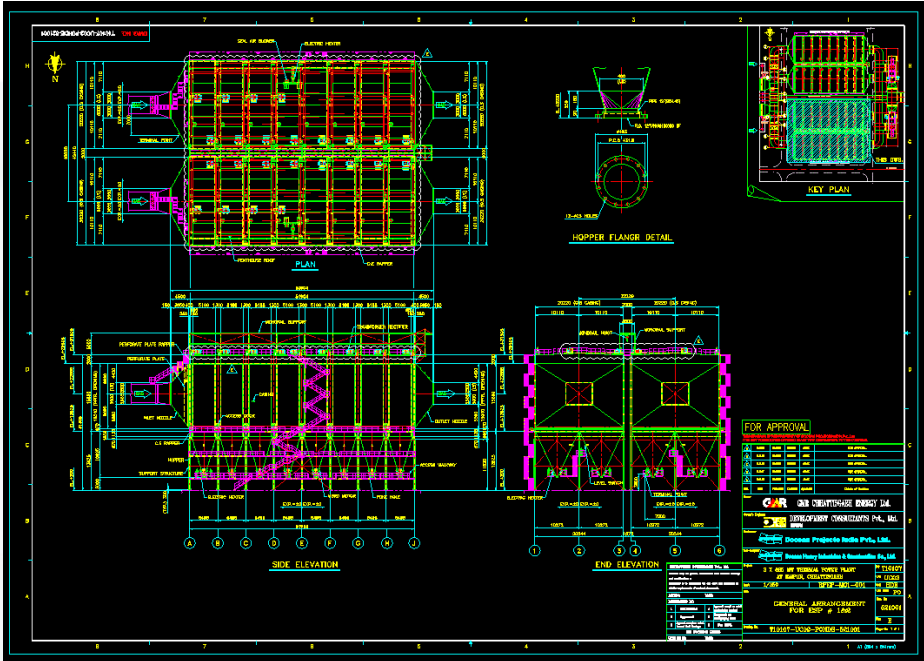


## ● Control System

- T/R Control System
- Transformer Rectifier
- MCC
- System Control by PLC



# Side Rapping ESP View on Drawing



## Reference Site



### Korea Electric Power Corp.

**Application : Coal Fired Boiler (CFB) - 2016**

**Location : Samcheok Green Power  
1 & 2**

**Rapping : Top + Side**

**T/R : 25KHz High Frequency**

**Capacity : 2x1,000 MW(500Mwx4)**

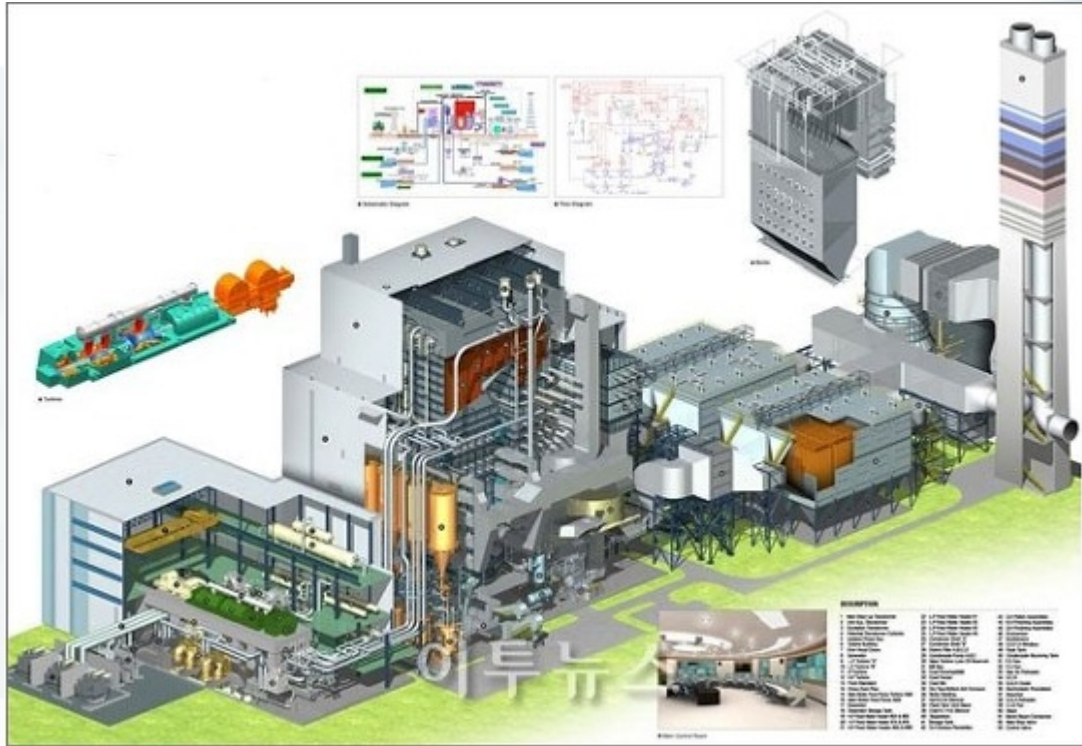
**Gas Volume : 3,230,220Am<sup>3</sup>/h**

**Inlet Dust : 15.6g/Nm<sup>3</sup>**

**Outlet Dust : ≤15mg/Nm<sup>3</sup>**

**Korea**

# Reference Site



## Korea Electric Power Corp.

- Application** : Coal Fired Boiler – 2016,2017
- Location** : Shinboryeong Thermal Power No. 1 & 2
- Rapping** : Top
- T/R** : 25KHz High Frequency
- Capacity** : 2 x 1,000 MW
- Gas Volume** : 5,262,000Am<sup>3</sup>/h
- Inlet Dust** : 21.69g/Nm<sup>3</sup>
- Outlet Dust** : ≤30mg/Nm<sup>3</sup>

Korea♪

# Reference Site



## Korea Electric Power Corp.

Application : Coal Fired Boiler - 2015

Location : Dangjin Thermal Power  
No. 9 & 10

Rapping : Top

Capacity : 2 x 1,000 MW

Gas Volume : 4,950,000Am<sup>3</sup>/h

Inlet Dust : 20.7g/Nm<sup>3</sup>

Outlet Dust : ≤30mg/Nm<sup>3</sup>

Korea♪

## Reference Site



### Korea Electric Power Corp.

**Application** : Coal Fired Boiler - 2014

**Location** : Youngheoung Thermal Power  
No. 5 & 6

**Rapping** : Top

**T/R** : 25Khz High Frequency

**Capacity** : 2 x 870 MW

**Gas Volume** : 4,200,000Am<sup>3</sup>/h (95°C)

**Inlet Dust** : 15.7g/Nm<sup>3</sup>

**Outlet Dust** : ≤10mg/Nm<sup>3</sup>

**Korea**♪

## Reference Site



### Gheco Thermal Power Plant

**Application** : Coal Fired Boiler

**Location** : Gheco Thermal Power

**Rapping** : Top

**Capacity** : 1x700 MW

**Gas Volume** : 2,977,800Am<sup>3</sup>/h

**Inlet Dust** : 17.4g/Nm<sup>3</sup>

**Outlet Dust** : ≤30mg/Nm<sup>3</sup>

**Thailand** ↲

## Reference Site



### Taiwan Power Company

**Application : Coal Fired Boiler**

**Location : Taichung Thermal Power  
9 & 10**

**Rapping : Top**

**Capacity : 2x550 MW**

**Gas Volume : 3,160,140m<sup>3</sup>/h**

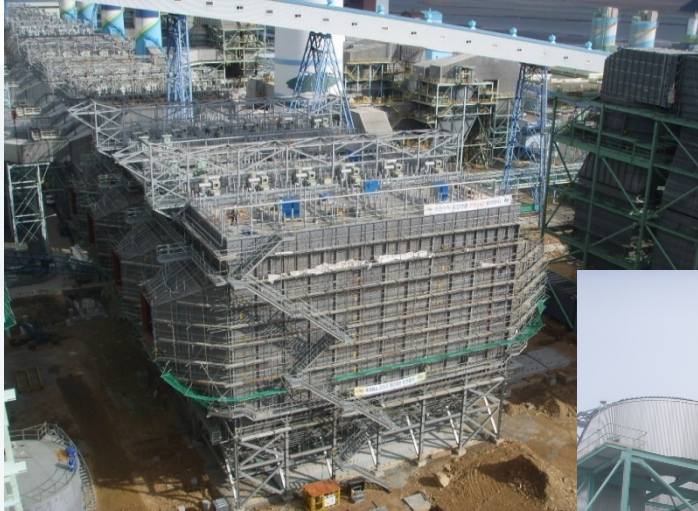
**Inlet Dust : 16.9g/Nm<sup>3</sup>**

**Outlet Dust : ≤28mg/Nm<sup>3</sup>**

**Taiwan**



## Reference Site



### Korea Electric Power Corp.

**Application** : Coal Fired Boiler

**Location** : Boryeong Thermal Power No. 1 ~ 8

**Rapping** : Top

**Capacity** : 8 x 500 MW

**Gas Volume** : 2,977,800Am<sup>3</sup>/h

**Inlet Dust** : 17.4g/Nm<sup>3</sup>

**Outlet Dust** : ≤30mg/Nm<sup>3</sup>

Korea 

## Reference Site



### Korea Electric Power Corp.

**Application** : Coal Fired Boiler

**Location** : Taeahn Thermal Power  
No. 3 ~ 8

**Rapping** : Top

**Capacity** : 6 x 500 MW

**Gas Volume** : 2,785,200Am<sup>3</sup>/h

**Inlet Dust** : 17.4g/Nm<sup>3</sup>

**Outlet Dust** : ≤18mg/Nm<sup>3</sup>

Korea 

## Reference Site



### POSCO

**Application** : Sintering

**Location** : Pohang Steel Mill 1~4

**Rapping** : Top

**Capacity** : Sinter Bed 460m<sup>2</sup>

**Gas Volume** : 2,280,200Am<sup>3</sup>/h

**Inlet Dust** : 1.0g/Nm<sup>3</sup>

**Outlet Dust** : ≤20mg/Nm<sup>3</sup>

Korea▶

## Reference Site



### Sumitomo Metal

**Application** : Sintering

**Location** : Sumitomo Steel Mill 1~2

**Rapping** : Top

**Capacity** : Sinter Bed 420m<sup>2</sup>

**Gas Volume** : 2,160,000Am<sup>3</sup>/h

**Inlet Dust** : 1.0g/Nm<sup>3</sup>

**Outlet Dust** : ≤40mg/Nm<sup>3</sup>

Japan 

## Reference Site



### Taiwan Power Corp.

**Application : Coal Fired Boiler**

**Location : Hsinta Thermal Power  
No. 1 ~ 2**

**Rapping : Side**

**T/R : 25KHz + 60Hz**

**Capacity : 2 x 550 MW**

**Gas Volume : 3,100,000Am<sup>3</sup>/h**

**Inlet Dust : 16.47g/Nm<sup>3</sup>**

**Outlet Dust : ≤26mg/Nm<sup>3</sup>**

**Taiwan**

## Reference Site



### Sumitomo Metal Corp.(FHI)

**Application** : Coal Fired Boiler(CFB)  
**Location** : Taganito Thermal Power No. 1  
**Rapping** : Side  
**Capacity** : 1 x 110MW  
**Gas Volume** : 954,320Am<sup>3</sup>/h  
**Inlet Dust** : 25.0g/Nm<sup>3</sup>  
**Outlet Dust** : 45.0mg/Nm<sup>3</sup>

Philippines 

## Reference Site



### EVN(Marubeni)

**Application : Coal Fired Boiler**

**Location : Nigh Son Thermal Power  
No. 1 & 2**

**Rapping : Side**

**Capacity : 1 x 300MW**

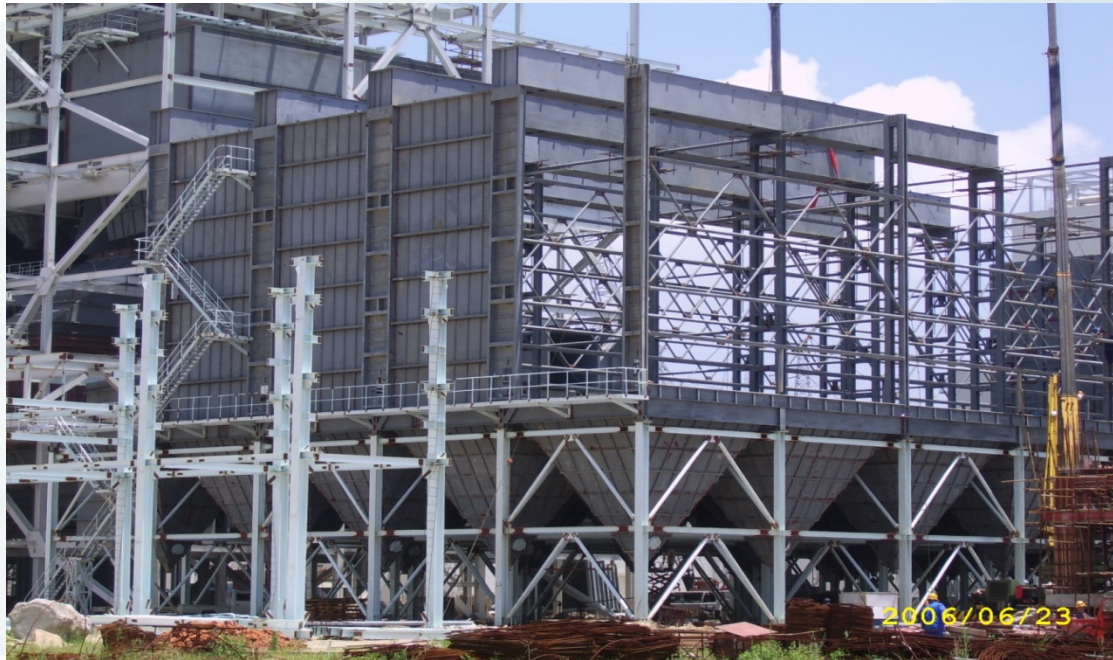
**Gas Volume : 1,641,686Am<sup>3</sup>/h**

**Inlet Dust : 41.835g/Nm<sup>3</sup>**

**Outlet Dust : 98.9mg/Nm<sup>3</sup>**

**Vietnam**

## Reference Site



### Shamen Power Corp.(FCFC)

**Application** : Coal Fired Boiler

**Location** : Hushi Thermal Power  
No. 7

**Rapping** : Top + Side

**Capacity** : 1 x 600MW

**Gas Volume** : 3,191,040Am<sup>3</sup>/h

**Inlet Dust** : 18.11g/Nm<sup>3</sup>

**Outlet Dust** : ≤25mg/Nm<sup>3</sup>

China♪



## Reference Site



### Formosa Chemical Fibre Corp. (FHI)

Application : Coal Fired Boiler(CFB)

Location : VN Thermal Power No. 2

Rapping : Side

Capacity : 1 x 150MW

Gas Volume : 954,320Am<sup>3</sup>/h

Inlet Dust : 19.0g/Nm<sup>3</sup>

Outlet Dust : 22.9mg/Nm<sup>3</sup>

Vietnam

## Reference Site



### Guacolda Power Corp.(MHI)

**Application** : Coal Fired Boiler

**Location** : Guacolda Thermal Power  
No. 1~5

**Rapping** : Side

**Capacity** : 5 x 150MW

**Gas Volume** : 985,000Am<sup>3</sup>/h

**Inlet Dust** : 25.0g/Nm<sup>3</sup>

**Outlet Dust** : 50.0mg/Nm<sup>3</sup>

Chile

Thank you

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