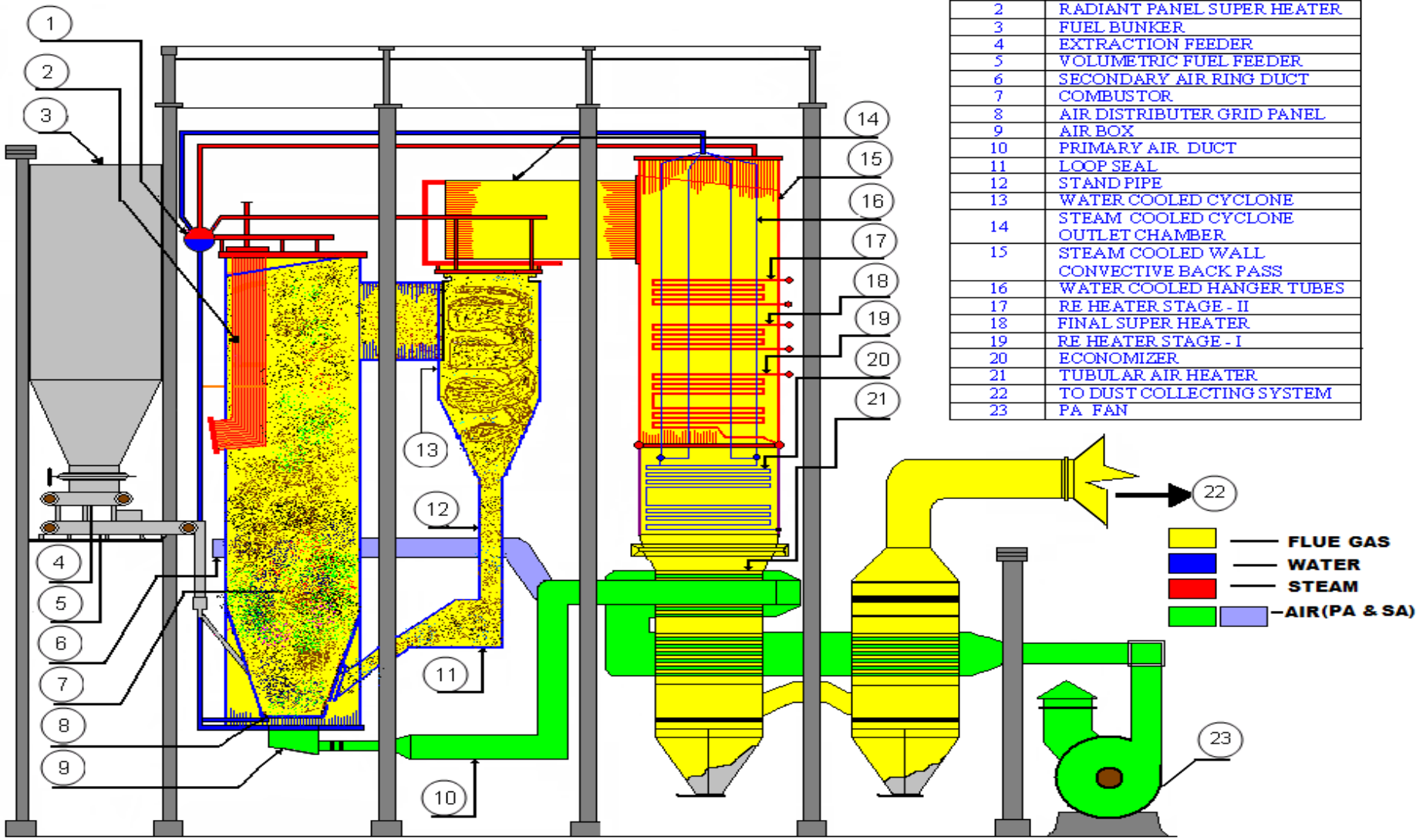
Circulating fluidized bed boilers

Tiruchirappalli, India

Typical CETHAR CFB Boiler



PART.NO	DESCRIPTION
1	STEAM DRUM
2	RADIANT PANEL SUPER HEATER
3	FUEL BUNKER
4	EXTRACTION FEEDER
5	VOLUMETRIC FUEL FEEDER
6	SECONDARY AIR RING DUCT
7	COMBUSTOR
8	AIR DISTRIBUTER GRID PANEL
9	AIR BOX
10	PRIMARY AIR DUCT
11	LOOP SEAL
12	STAND PIPE
13	WATER COOLED CYCLONE
14	STEAM COOLED CYCLONE OUTLET CHAMBER
15	STEAM COOLED WALL CONVECTIVE BACK PASS
16	WATER COOLED HANGER TUBES
17	RE HEATER STAGE - II
18	FINAL SUPER HEATER
19	RE HEATER STAGE - I
20	ECONOMIZER
21	TUBULAR AIR HEATER
22	TO DUST COLLECTING SYSTEM
23	PA FAN

Design Features of CETHAR CFB Boiler

- A High degree of fuel flexibility
- Higher combustion efficiency
- Lower Sox emission
- Lower Nox emission
- A High degree of Turn down
- Elimination of slagging
- High availability
- Easy to operate and maintain

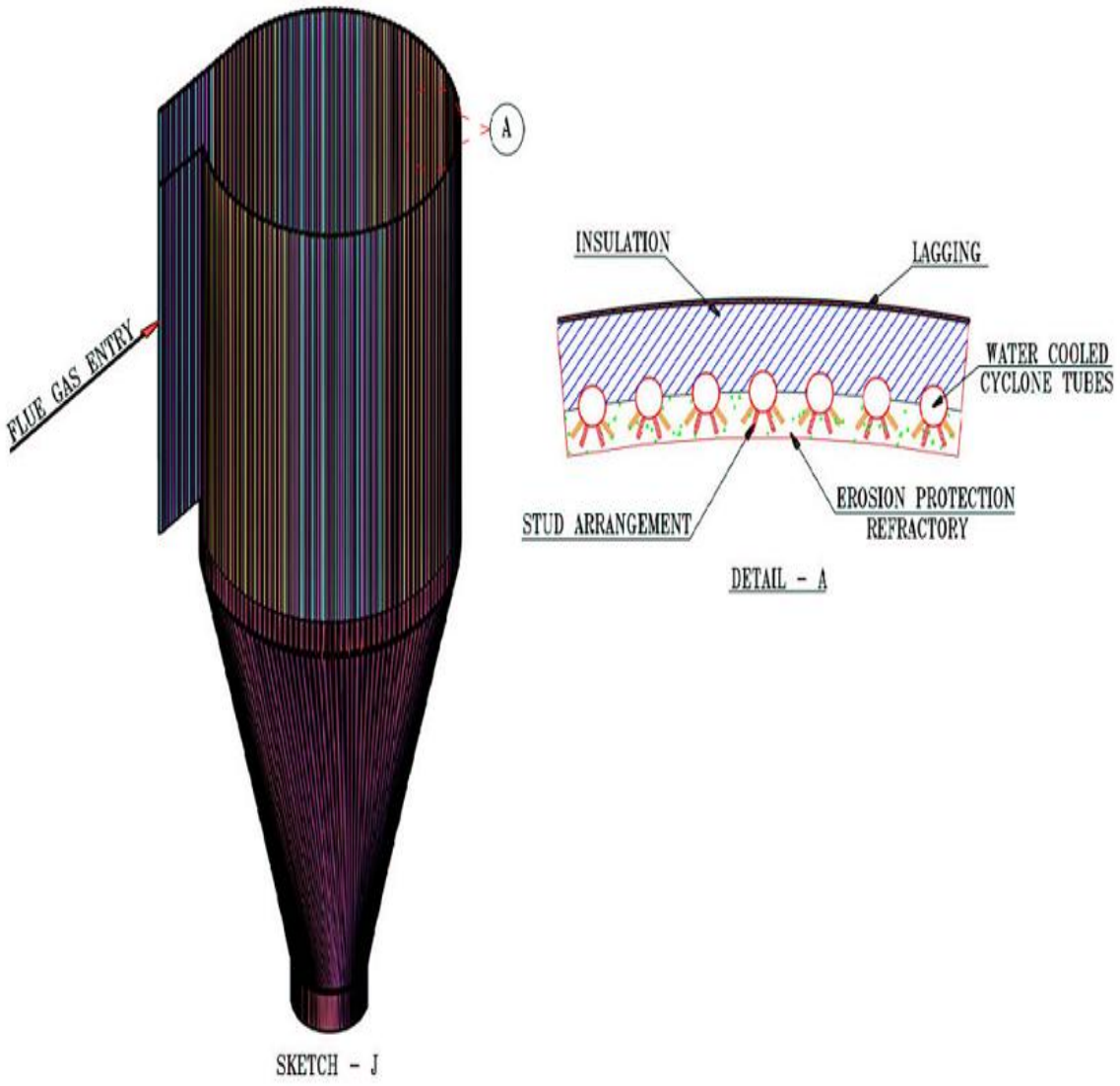
SOx and NOx CONTROL

- **Lower Sox emission due to –**
  - Optimized bed operating temperature
  - Higher residence time for the sorbent (Limestone)
  - Better cyclone efficiency and recirculation of sorbent
  - Higher turbulence in the bed
  - Optimized sorbent particle size distribution
  - Better interaction of sorbent with air / sulphur
- **Lower Nox emission due to –**
  - Low furnace operating temperature
  - Staged combustion

Special Constructional Features of CETHAR CFB Boiler

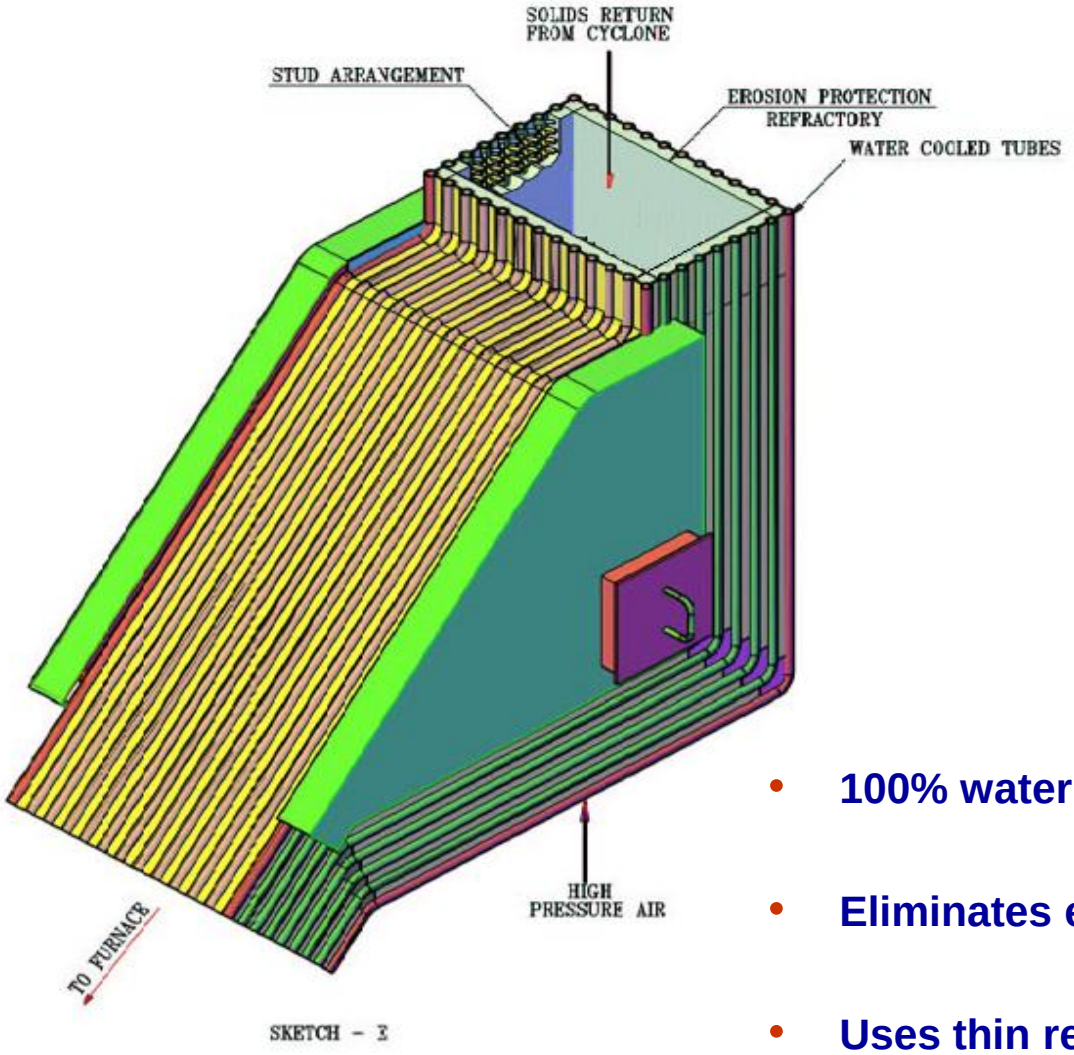
- Water cooled “hot Loop“ cyclone separator
- Entire recirculation loop is made of water cooled membrane panel
- Elimination of expansion joints
- Specially designed non-mechanical Loop Seal
- Non-mechanical flow control for regulation of bed ash removal
- Minimum Refractory usage
- Completely gas tight membrane panel construction
- Simple fuel feeding system / lesser feed points
- Minimum in-furnace heating surface
- Well proven / time tested grid nozzles

Water Cooled Cyclone



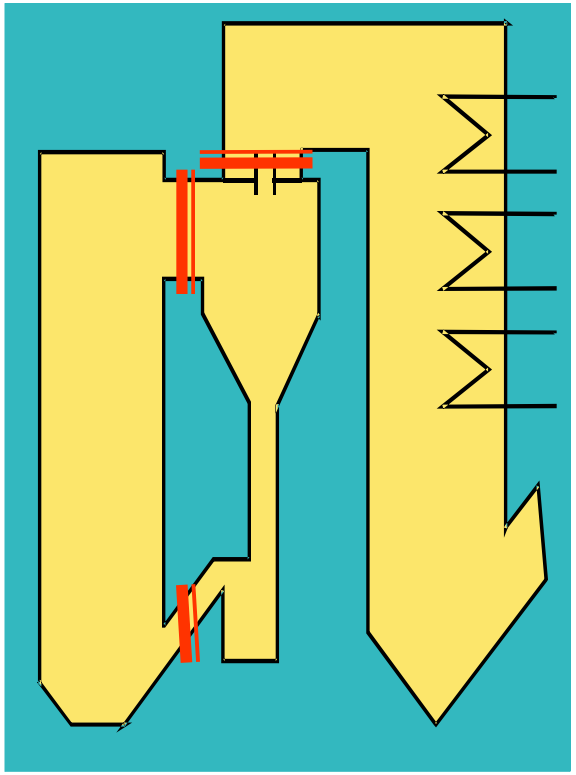
- Traditional ‘classic’ design
- Needs only conventional fabrication techniques
- Easy to integrate with furnace
- Reduces high temperature zone refractory
- Eliminates expansion joints since water cooled
- Small space requirements
- - Less foot print
- - Less weight
- Less heat storage in refractor
  - No slagging
  - Reduced start up/shut down times
- Maintenance and availability problems due to furnace/cyclone expansion joints eliminated

Loop Seal



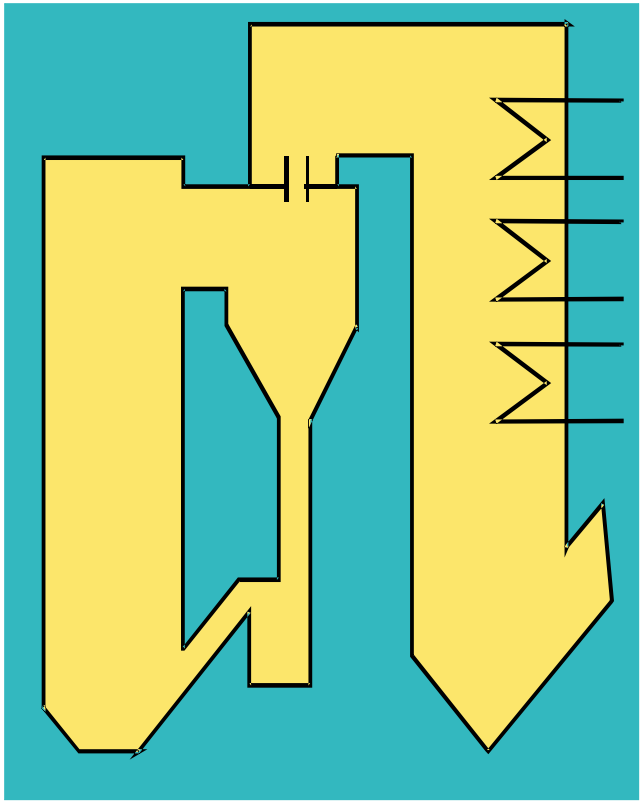
- **100% water cooled design**
- **Eliminates expansion joints**
- **Uses thin refractory**
- **Membrane construction eliminating air ingress**

Elimination of Expansion Joints



1980

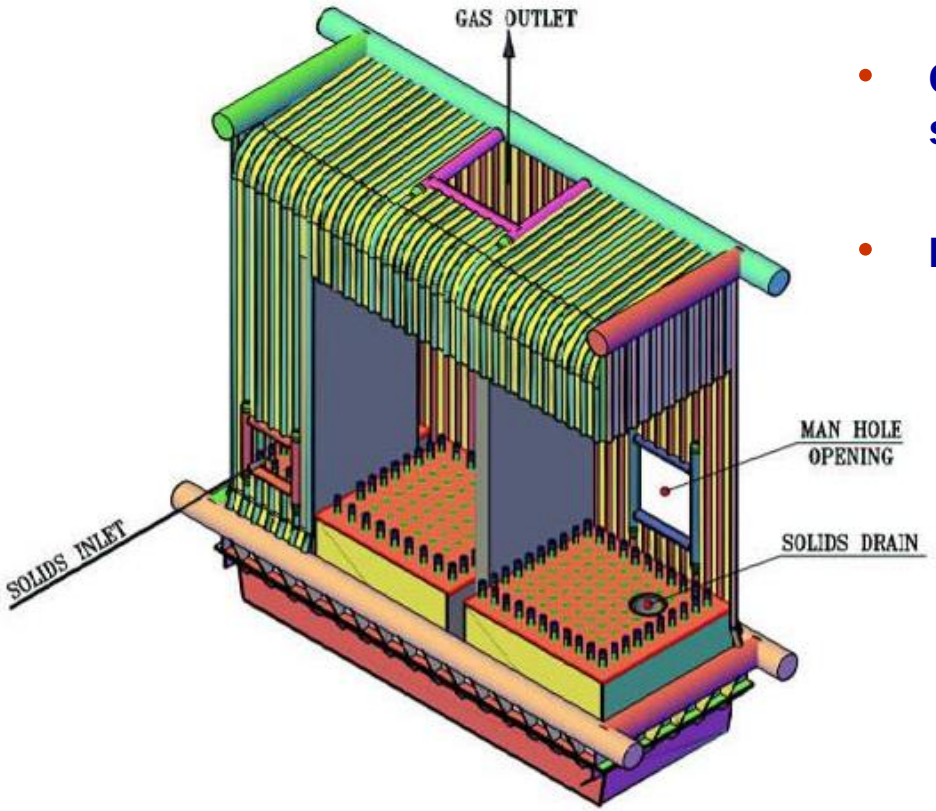
Uncooled cyclone



2007

Water cooled cyclone

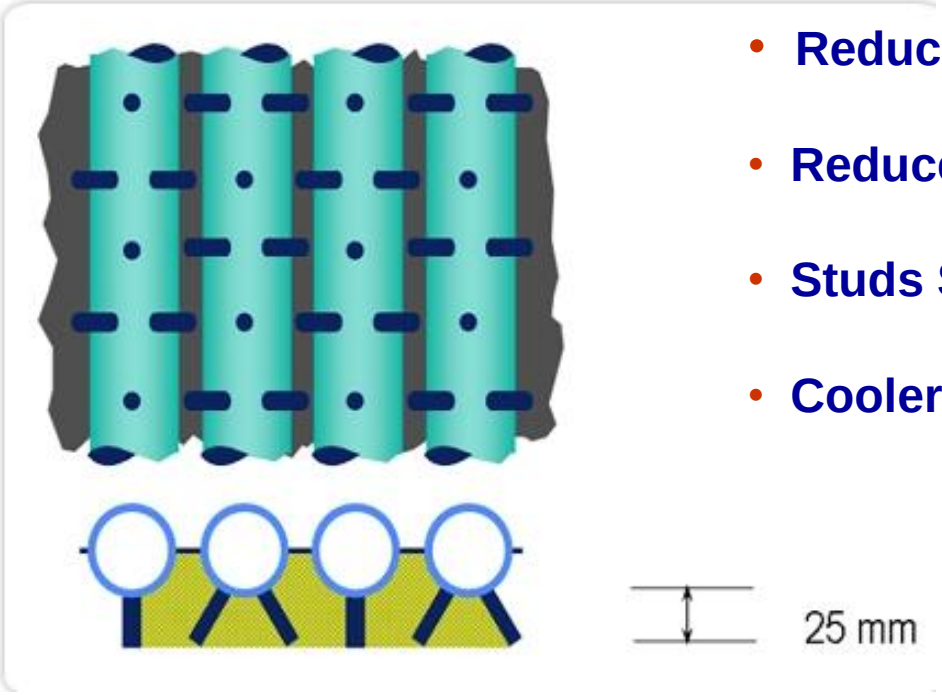
Bed Ash Cooler



SKETCH - I

- No hot mechanical screws
- No moving parts in the hot temperature zone
- Gain in efficiency possible by recovering sensible heat in the ash
- Less maintenance

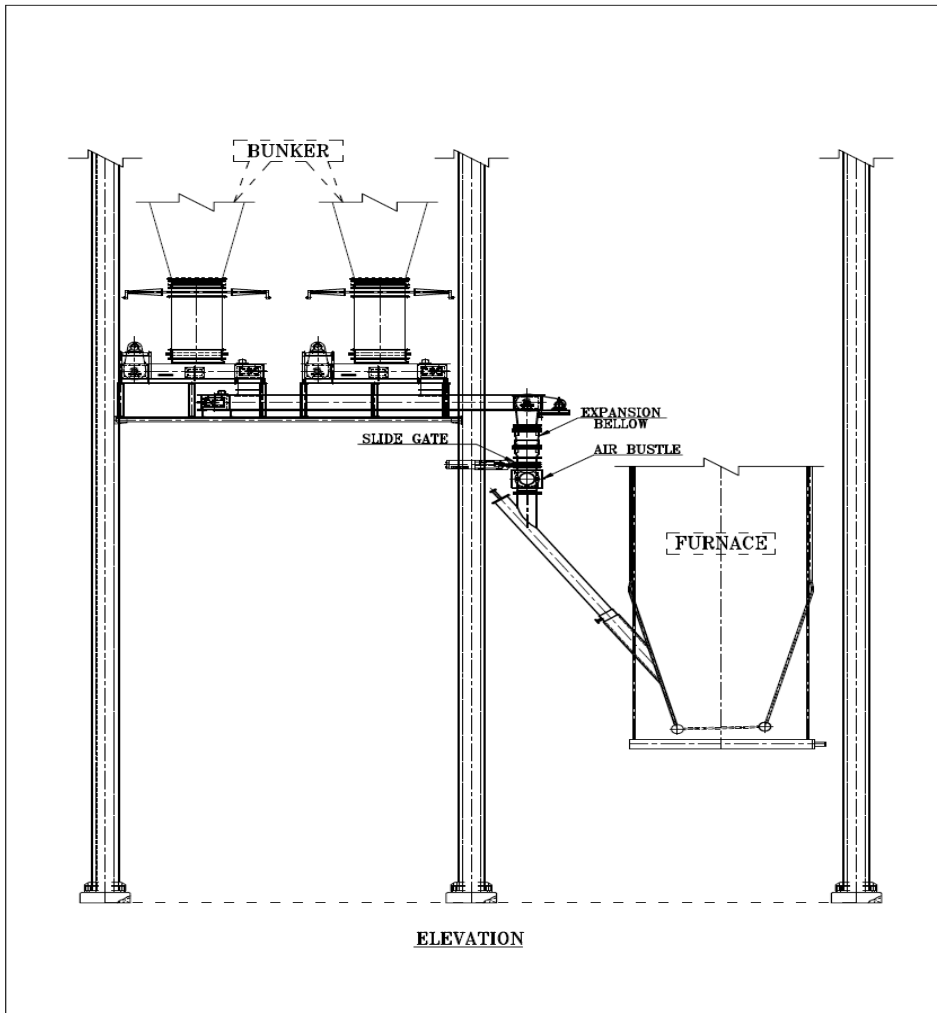
Minimized Refractory Usage

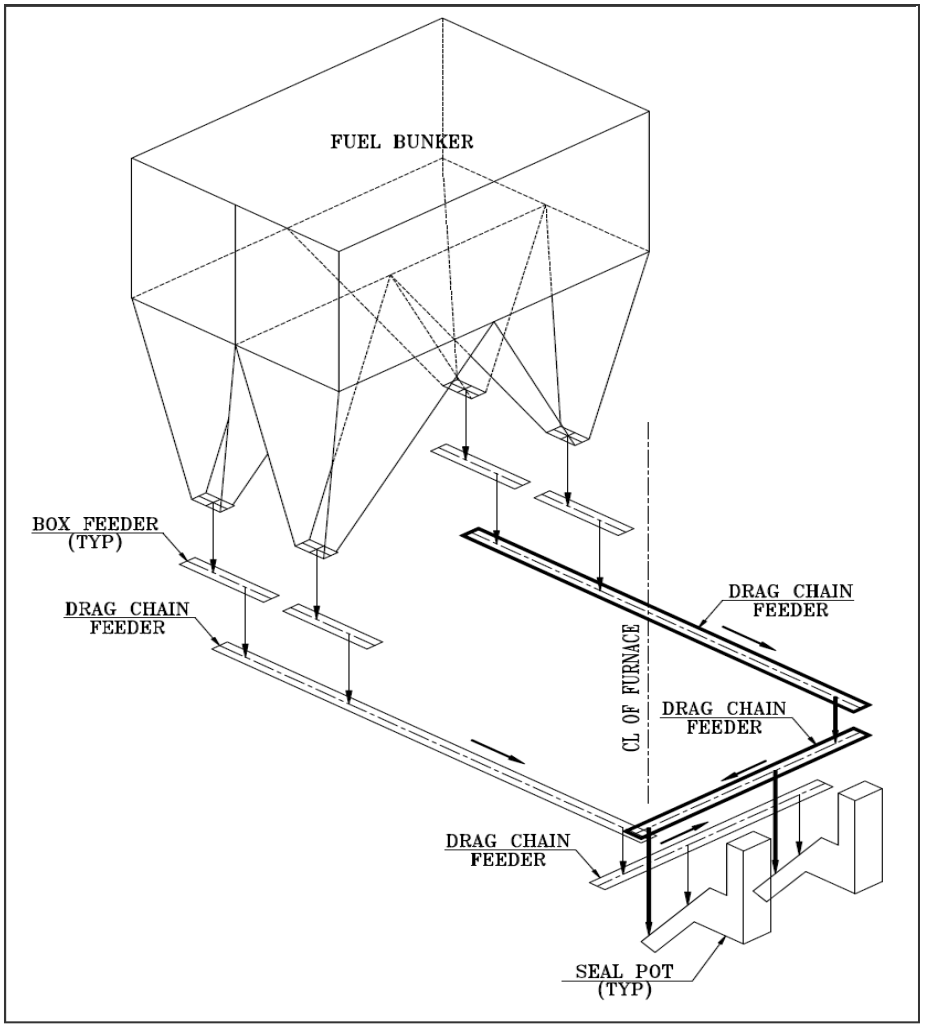


Thin Studded Refractory Lining Provides:

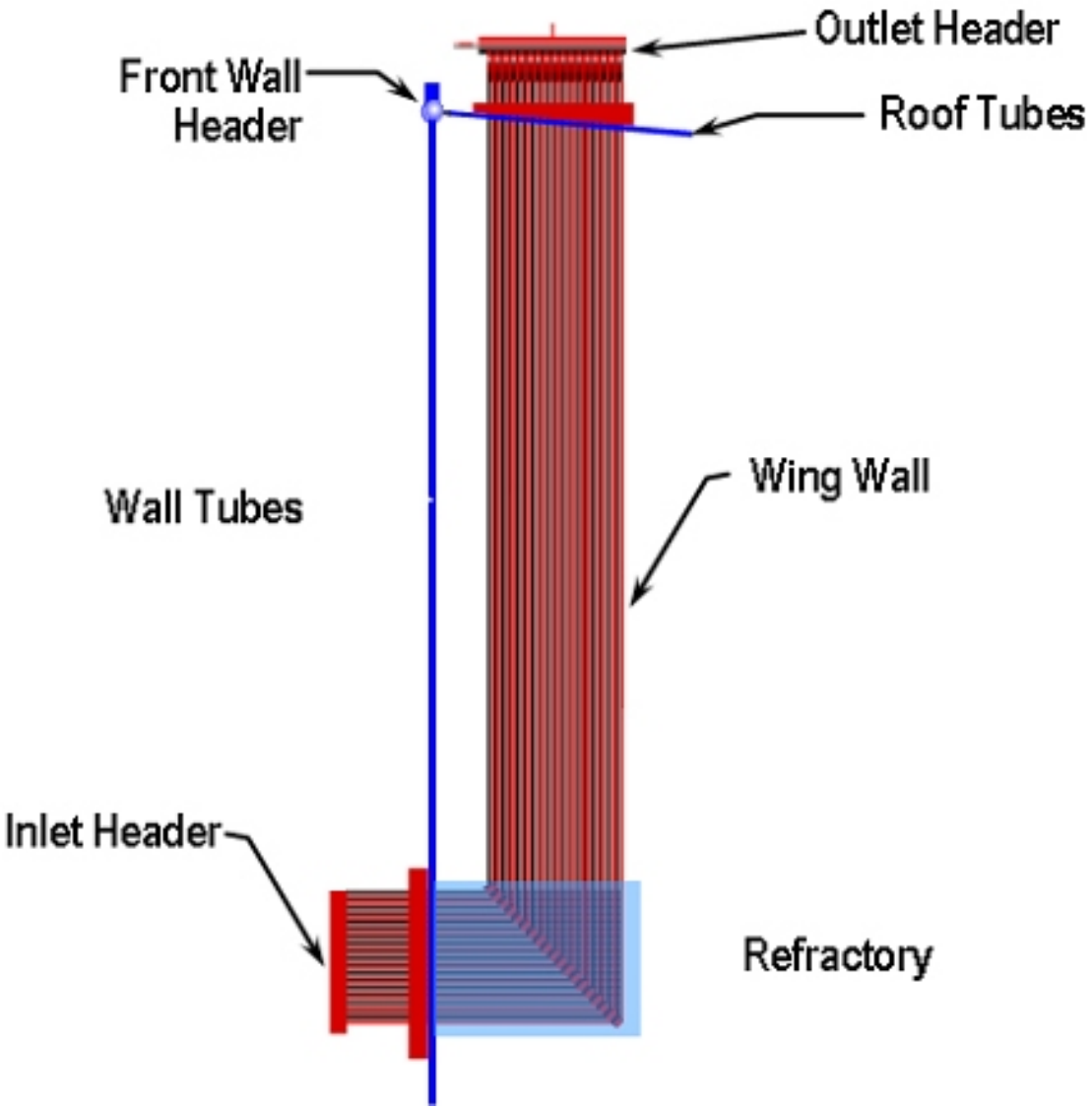
- Reduced Weight
- Reduced Maintenance
- Studs Stabilize Refractory
- Cooler Refractory Reduces Erosion Rates

Fuel Feeding System

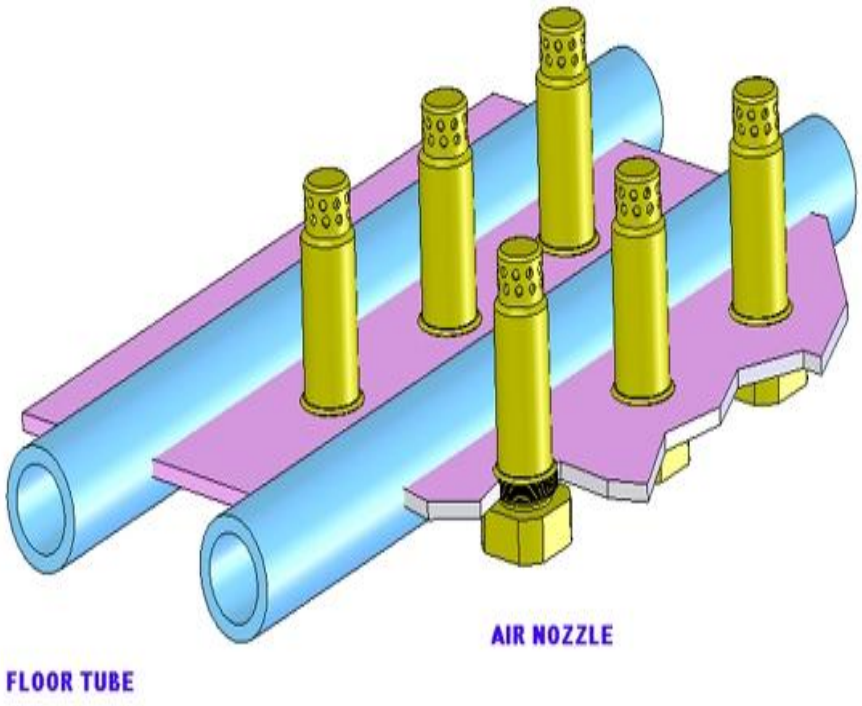




Vertical Superheater / Evaporator Panels Resist Erosion



Grid Nozzles



- Well Proven and Time tested Grid nozzles
- Almost nil / very less back shifting of solids at lower loads

CFB Availability – Problems & Solutions

S. No.	Factors Affecting CFB Availability	CETHAR's Technical Solution
1	Erosion Problems - In Refractory Transition Area - In Radiant SH - Use of Gas Dampers / Mechanical valves / screws etc - Convection Heat Exchangers	- Special 'Back Bump' design - Positioning of SH & Conservative design - No moving parts in high temperature zone - Optimized gas velocity according to fuel type
2	Refractory Problems	- Heavily minimized by cooled cyclone design - Single layered, less thick and easy to apply refractory
3	Failure of hot Expansion Joints	- Completely avoided with water cooled cyclone designs
4	Improper Auxiliary Selection - Fuel feeders - Fans & Motors - Bottom Ash Handling system	- Dimensioning based on vast experience - Selection of appropriate type, size & make - Selection based on Service availability - Maintaining adequate redundancy
5	Gradual & undetected Wear & Tear of boiler parts	- Periodically planned O&M Services
6	Operator Errors	- Enhanced training to customers' operators - Maximized automation of boiler controls
7	Design Faults	- Bench marking with feed back of vast fluid bed operating experience

CETHAR CFB offers Fuel Flexibility

- Coal
- Anthracite
- Bituminous
- Sub-bituminous
- Lignite

- Waste Coal
- Bituminous Gob
- Anthracite Culm

- Petroleum Coke
- Delayed
- Fluid

Agriculture Waste
- Wood waste
- Rice Husk
- Bagasse Pith

Refinery Bottoms
Peat
Tires
Sludge
Refuse Derived Fuel
Distillery Effluent
Bio-gas
Oil Shale
Oil
Natural Gas
Blast Furnace Gas

CFBC – Reference List

S.No	CUSTOMER NAME	CAPACITY KG/HR	PRESSURE KG/SQ.CM	STEAM TEMP. DEG.C	FUELS	STATUS
01.	ARYAN COAL BENEFICATION LIMITED (135 MW Reheat design)	451,000	142	540+/-5	Washery Rejects / High Ash Indian Coal	Engineering Stage
02.	SHRI RAMRUPAI BALAJI STEELS LTD, DURGAPUR,W.B.	170,000	86	515+/-5	Char(GCV-1700 Kcal/Kg with 70% Ash) + BF Gas.	Under Commg.
03.	VANDANA VIDHYUT LTD.	150,000	87	520+/-5	50% Indian coal + 50% Washery rejects	Under execution
04.	ORIENT CEMENT, DEVAPUR, ANDHRA PRADESH	114,000	88	520 +/- 5	Coal Middling Dry cake + Rice Husk / Wood Chips.	Refractory application in progress
05.	ORIENT CEMENT, DEVAPUR, ANDHRA PRADESH	114,000	88	520 +/- 5	Coal Middling Dry cake + Rice Husk / Wood Chips.	Refractory application in progress
06.	SAKTHI SUGARS LTD, TAMILNADU.	110,000	108	510 +/- 5	Bagasse + Coal + Distillery effluent.	Under execution
07.	ACC LIMITED, WADI	110,000	67	485+/-5	Coal Middling & Coal	Under execution
08.	ACC LIMITED, WADI	110,000	67	485+/-5	Coal Middling & Coal	Under execution
09.	BINANI CEMENT LTD, SHIROHI, RAJASTHAN.	92,000	87	510+/-4	Barmer Lignite Pet coke, Indian Coal Imported Coal	In operation since March 2008

U.E – UNDER EXECUTION

CFBC – Reference List

S.No	CUSTOMER NAME	CAPACITY KG/HR	PRESSURE KG/SQ.CM	STEAM TEMP. DEG.C	FUELS	STATUS
10.	BINANI CEMENT LTD, SHIROHI, RAJASTHAN.	92,000	87	510+/-4	Barmer Lignite Petcoke, Indian Coal Imported Coal	In operation since June 2008
11.	SHREE CEMENTS LTD, BEWAR, RAJASTHAN.	85,000	88	520+/-5	Petcoke Residue (Fly ash from AFBC)	In operation since March 2008
12.	SHRI RAMRUPAI BALAJI STEELS LTD, DURGAPUR,W.B.	85,000	86	515+/-5	Char(GCV-1700 Kcal/Kg with 70% Ash) + BF Gas.	In operation since March 2008
13.	ACC LTD, BARGARH.	67,000	67	485+/-5	Coal Middling	Refractory application in progress
14.	ACC LTD, BARGARH.	67,000	67	485+/-5	Coal Middling	Refractory application in progress

U.E – UNDER EXECUTION

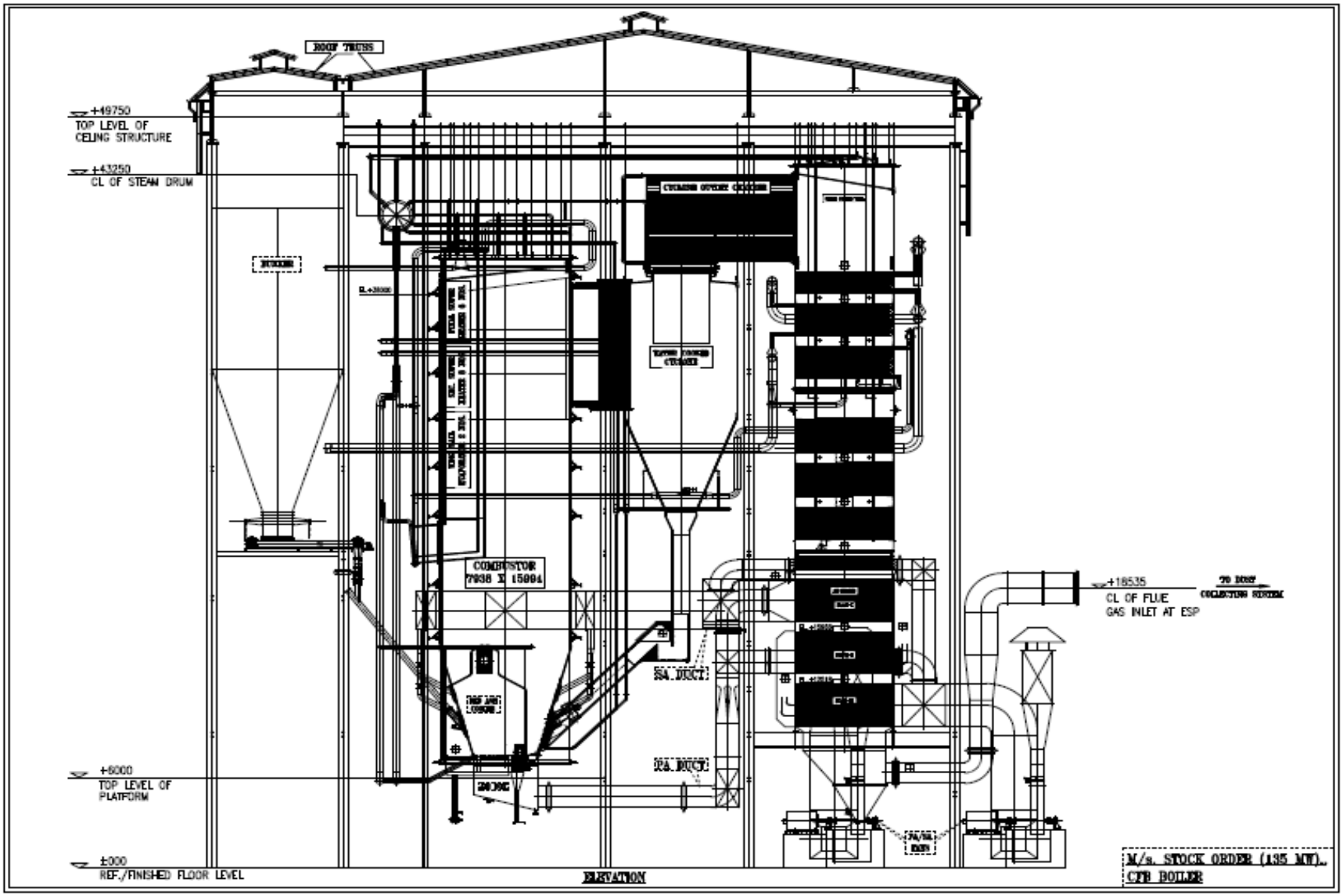
Fuels Considered for CETHAR CFB Boilers

- 100 % Char (GCV =1750 Kcal/kg)
- 100% Petcoke (GCV=7850 Kcal/kg & 10% sulphur)
- 100% Washery rejects (ash=70%)
- 100% Lignite (M=50% max)
- 100% Indian Coal
- 100% Imported Coal

Other Fuels (Partial)

- Bagasse
- Fly ash residue from BFBC boilers
- Distillery Effluent
- Blast furnace gas
- Wood chips
- Paper Sludge
- Rice Husk

135 MW CFBC – General Arrangement – Elevation



220 MW CFBC – General Arrangement – Elevation