EXPERIENCE ON OPERATION AND MAINTENANCE OF CFBC BOILER AT KLTPS- KUTCH GUJARAT

TOPICS COVERED

- DESIGN AND CONSTRUCTION FEATURES OF CFBC BOILER.
- MAJOR PROBLEM FACED DURING O&M OF CFBC BOILER.

CFBC BOILER AT KLTPS- KUTCH GUJARAT

- Type - Natural Circulation, Balance Draught, CFB Combustion, Water Wall Tube Boiler
- Total No. of Boilers – 01
- Designer - BHEL
- Design Fuel - Lignite
- Start Up Fuel - LDO and up to 30% of BMCR
- Sorbent - Limestone
- Inert Material – Bed Material

DETAILS OF BOILER WATER VOLUME.

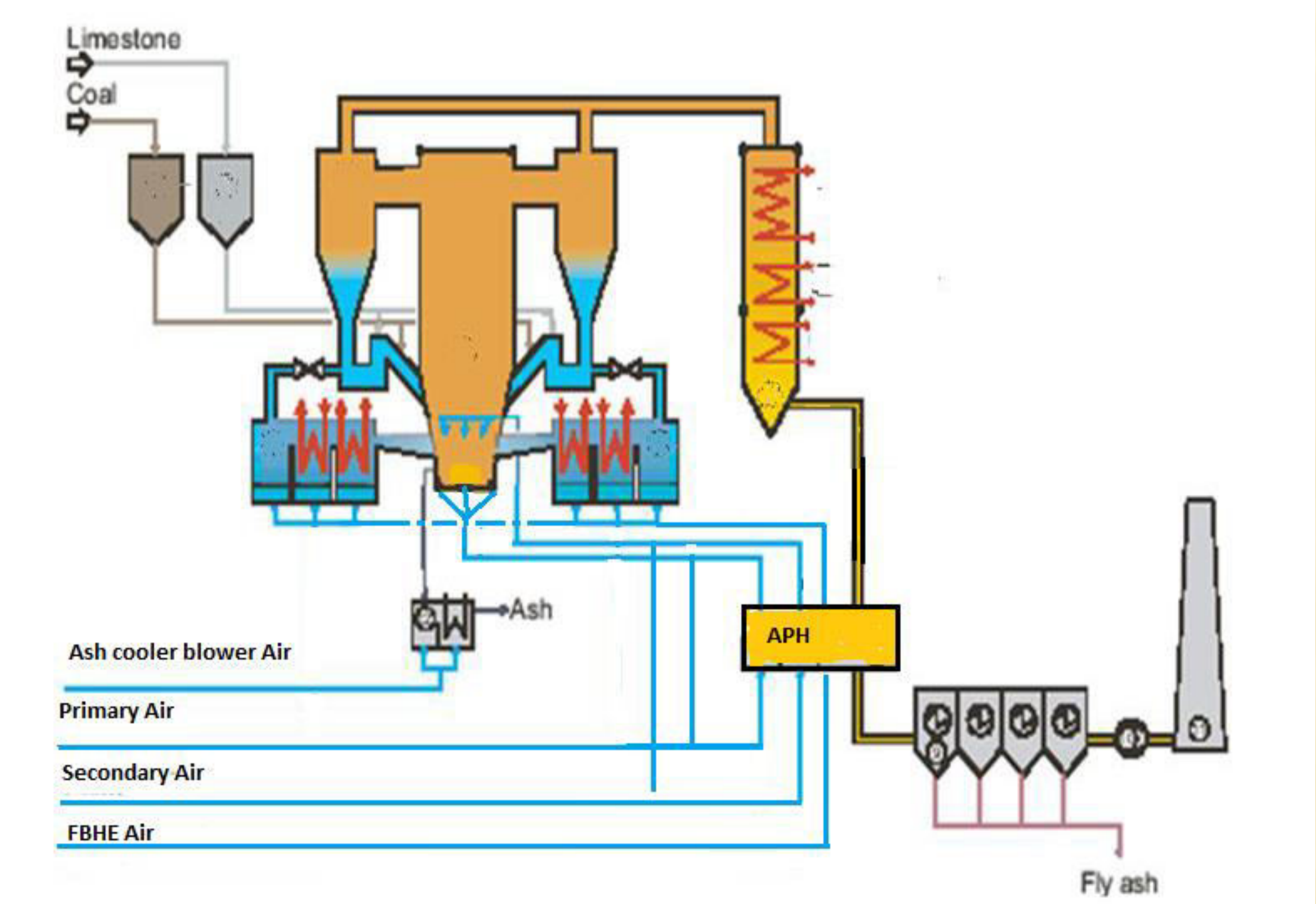
- 1. Economizer m3 37.8
- 2. Super heater m3 38.9
- 3. Combustor water walls m3 27.0
- 4. Back pass water walls m3 9.5
- 5. Drum m3 10.4
- 6. Headers m3 14.0
- 7. Piping m3 50
- Total m3 187.6
- Water volume with 5% reserve m3 200.0

MAIN DESIGNED PARAMETERS

Parameters	Unit	BMCR
Ambient Temp.	^{0}C	36
Main stem at Boiler MSSV outlet		
Flow	TPH	315
Pressure	Kg/Cm2	94
Temperature	^{0}C	540
Feed Water Temp.	^{0}C	237.3
Predicted Coal factor @ 100% BMCR		< 1
Predicted Limestone Consumption @ 100% BMCR	TPH	<18*

* Actual consumption of limestone varies based on limestone reactivity and boiler operating condition.

CFBC BOILER AT KLTPS- KUTCHH GUJARAT

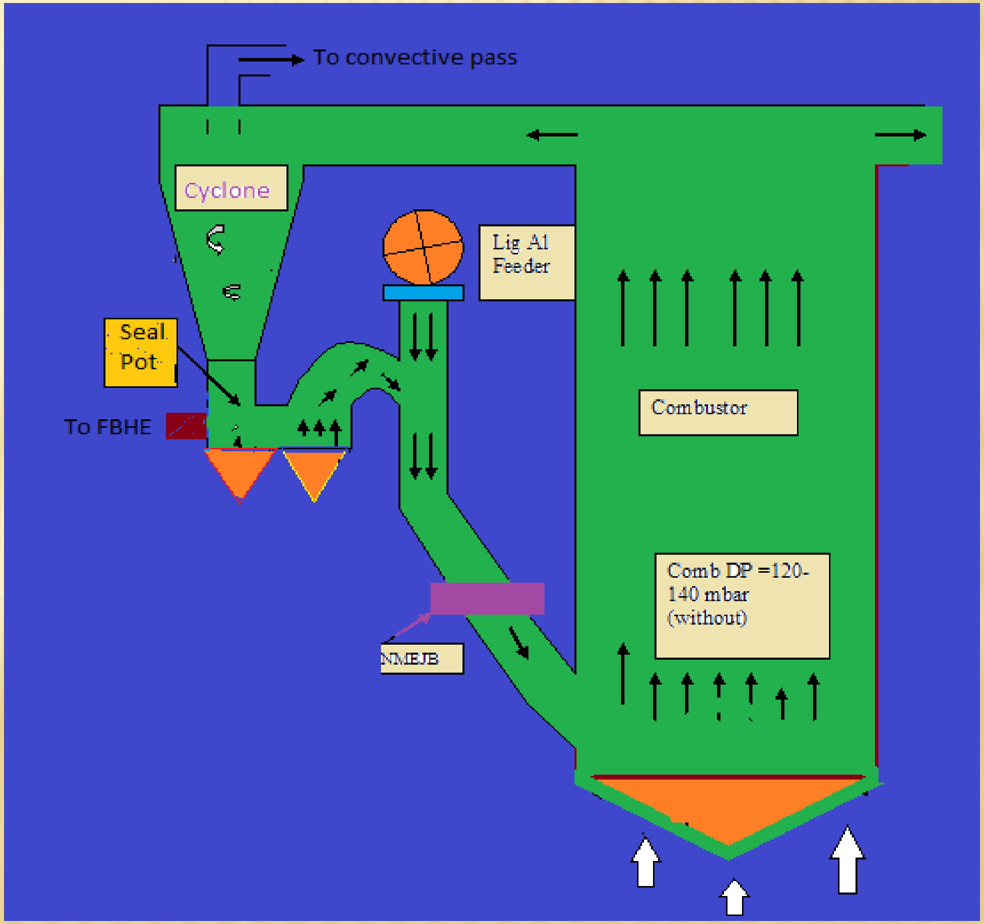


OVERALL DIMENSIONS

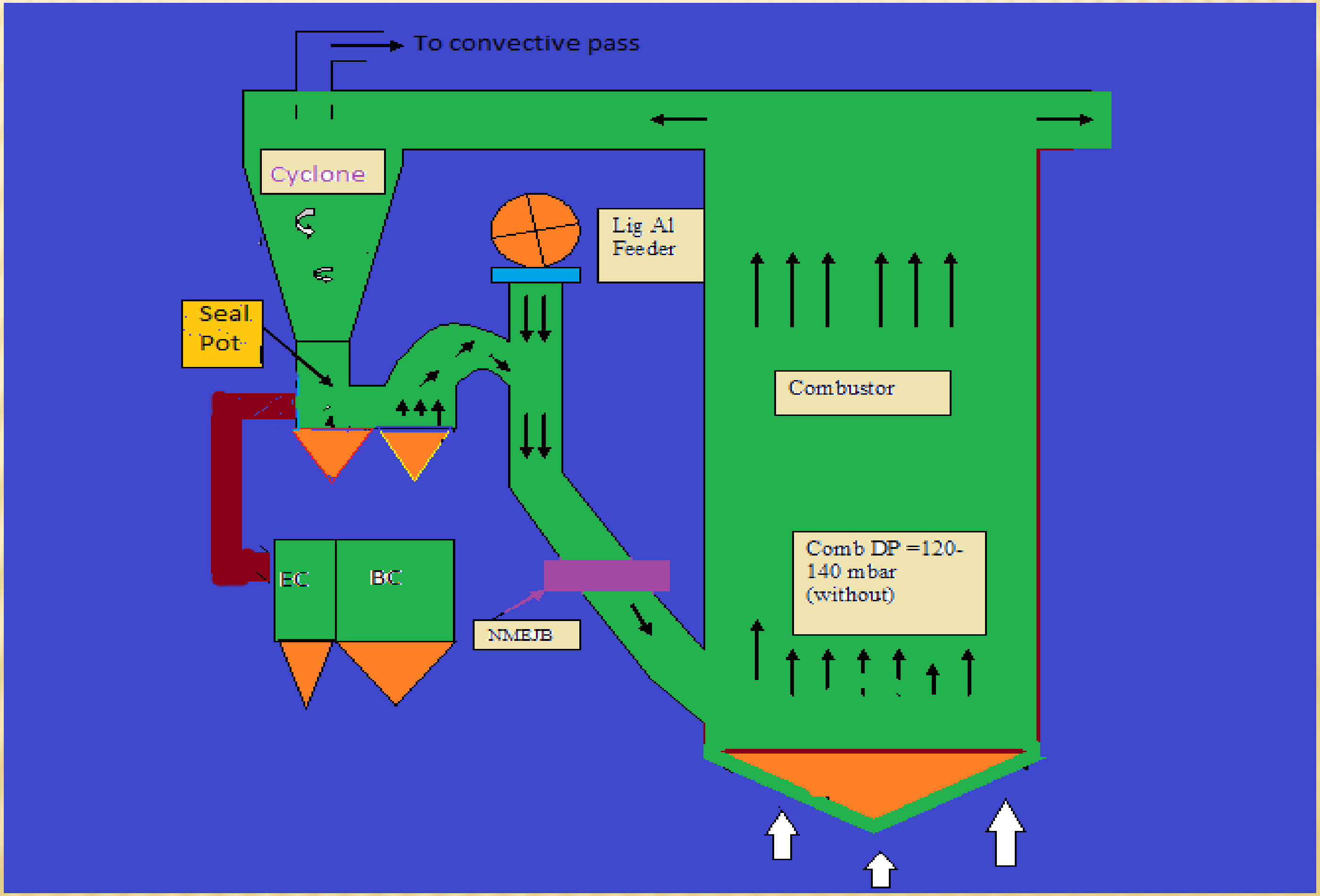
- Combustor
- • Width (m) -6.88
- • Depth (m) -11.52
- • Height (Nozzle to drum)(m) – 39
- Cyclone
- • Diameter(ID) (m)- 7.3
- • Height (m)- 16.8
- Convective Pass
- • Width (m) – 9.7
- • Depth (m) – 5.6
- • Height (m) -- 32

CFBC – CIRCULATION LOOP

- The circulation loop consists of
- Combustor
- Cyclone
- Standpipe
- Loop Seal

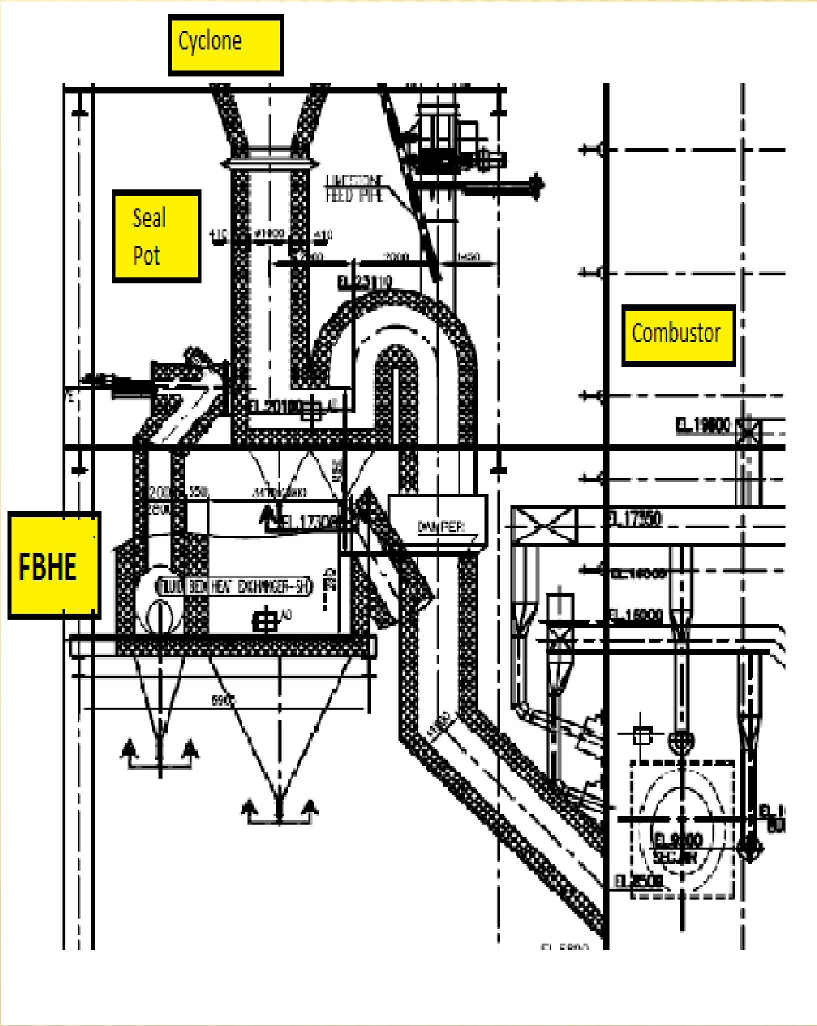


COMBUSTION CONTROL UTILIZING FBHE WITH SPIESS VALVE.



SEAL POT & FBHE DIMENSIONS

- **Seal Pot**
- Number of seal pots: 2
- Cross sectional area: D1.1 m
- Type: Refractory lined walls
- Fluidized Bed Heat Exchanger
- Number of FBHEs: 2
- empty chamber: 2
- evaporator bundle chamber: 1
- Super heater bundle chamber: 1
- Type: Refractory lined walls
- Control device: Spiess valve
- Dimensions: 6.52x4.89mx6.747m



BOILER COMMISSIONING STEPS FOLLOWED

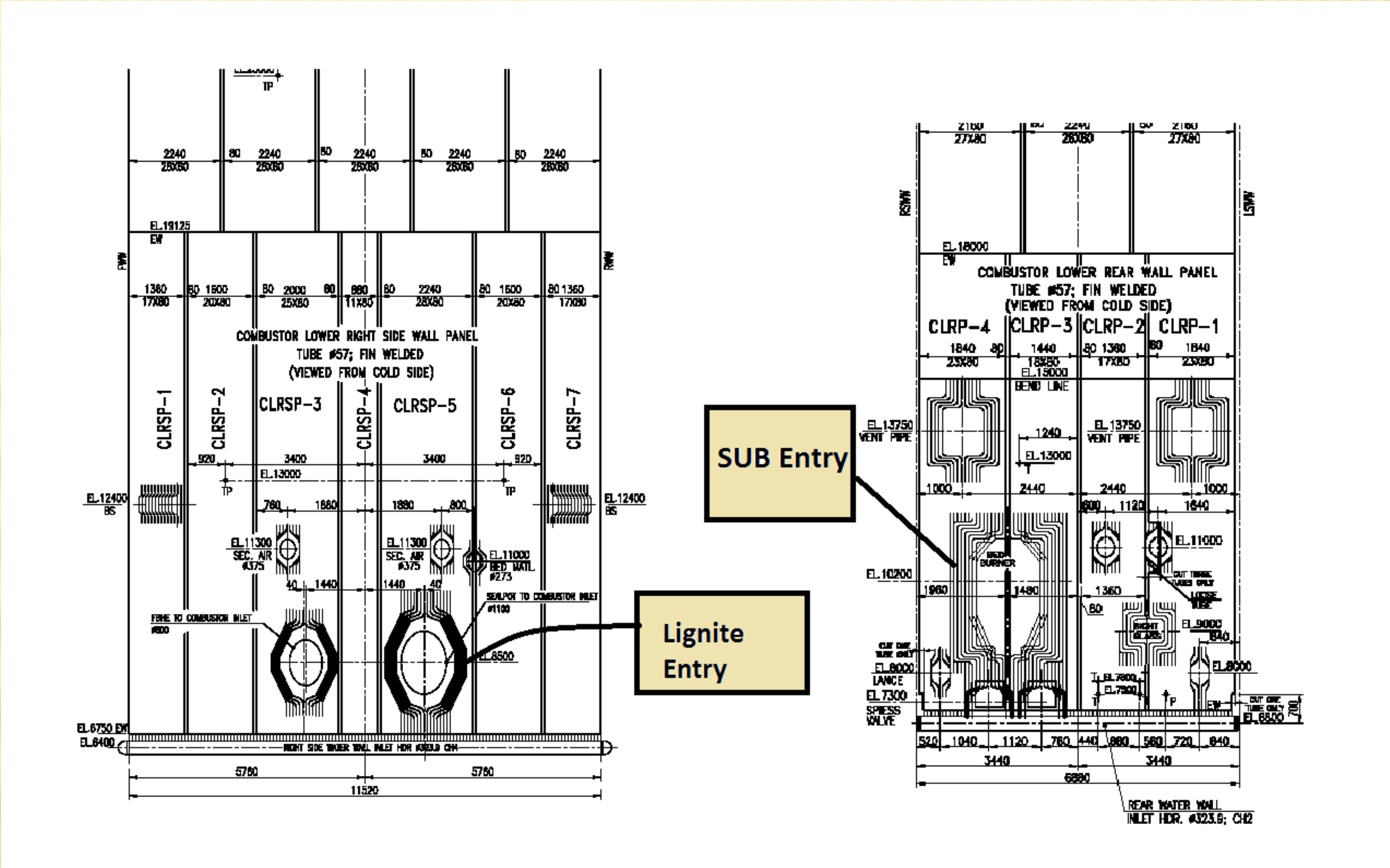
- Mechanical Completion
- Check Listing
- Pre-Commissioning
- Commissioning
  - Refractory Dry Out
  - Lit-up with Liquid Fuel
  - Alkali Boil Out
  - Steam Blowing
  - Safety Valve Floating
  - Solid Fuel Firing (Lignite)

COD: 20.12.2009

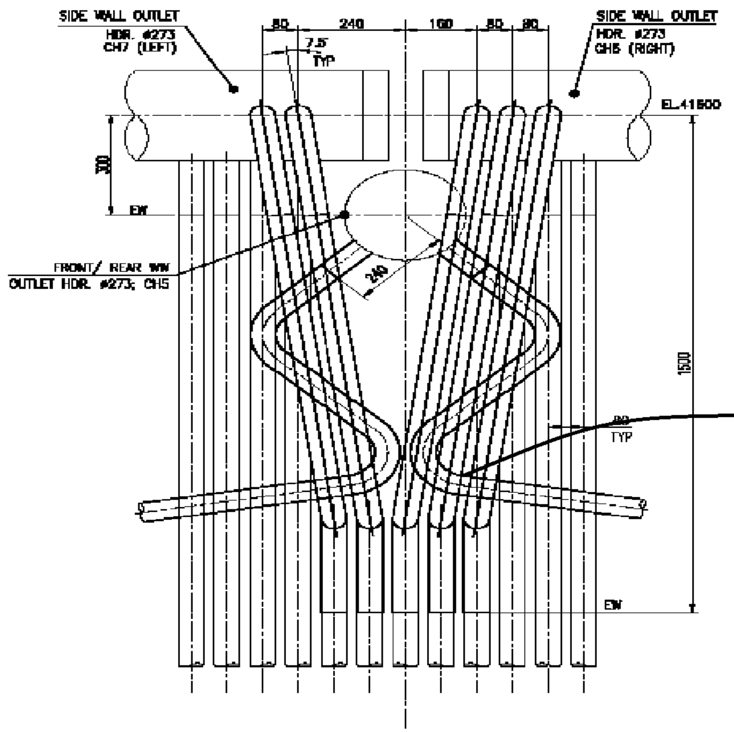
MAJOR PROBLEMS FACED IN CFBC BOILERS

- Water Walls Tube Failures (near lignite & SUB entry and penthouse area)
- NMEJ Damages.
- Clinker Formation.
- Refractory Damages.
- APH tubes Chock-up.

WATER WALLS TUBE FAILURES (NEAR LIGNITE & SUB ENTRY AREA)



WATER WALLS TUBE FAILURES (AT PENT HOUSE AREA)



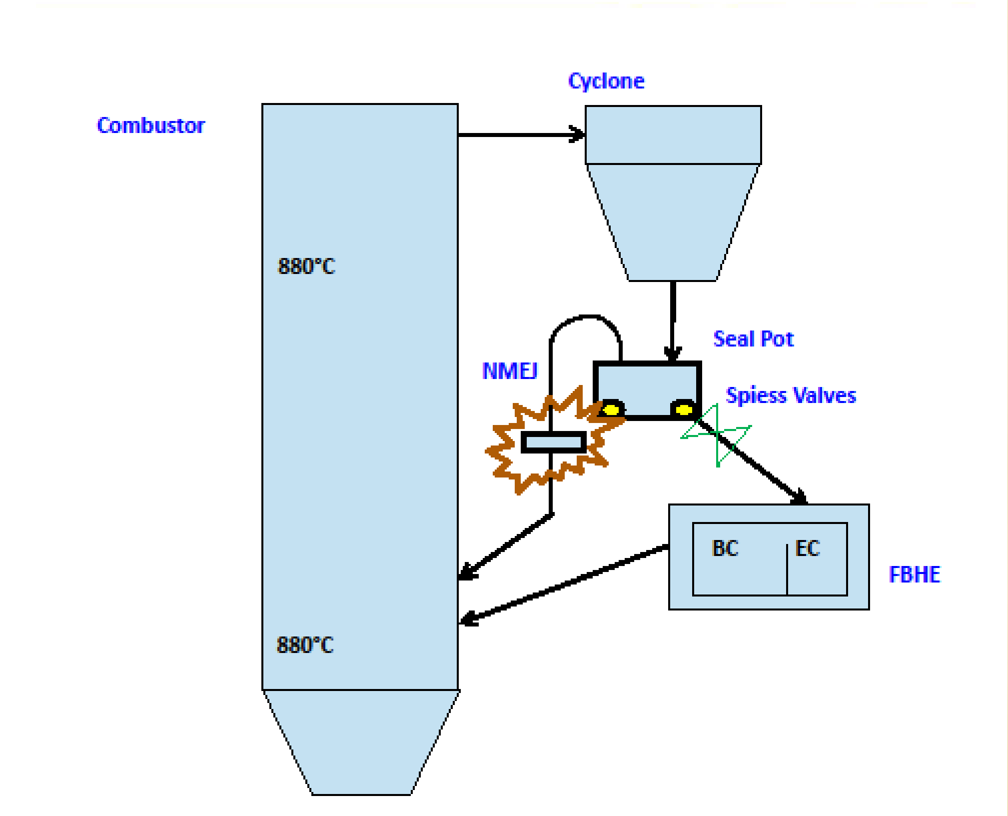
Tube Failure Due to Accumulation of high temp. Bed material.Because leakage at roof sealing

TUBE FAILURES

- Main causes for tube failures were:
- Maximum tube failures occurs at Lignite and SUB entry area due to refractory damages at the entry of the lignite and SUB.
- Tube failures occurs at pent house due to accumulation of bed material in pent house of combustor
- Accumulation of bed material in pent house due to damages in sealing of combustor at roof
- Remedial actions :
- Thickness of refractory and numbers of anchors welded are increased at Entry of Lignite and SUB.
- Material of sealing at combustor roof changed from MS to SS and refractory poured at empty area on sealing plate.

NMEJ DAMAGES

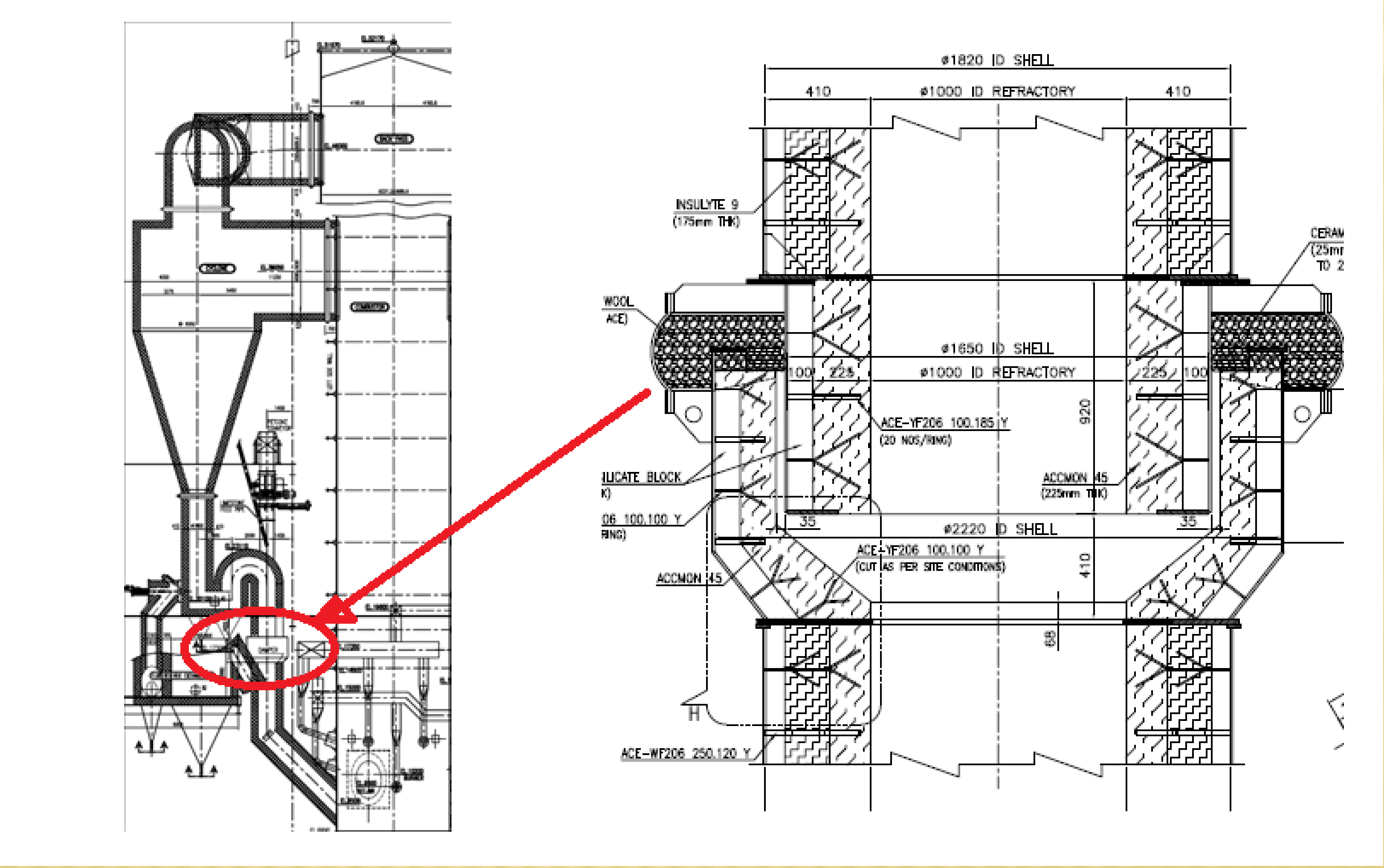
- Frequently damages of NMEJ



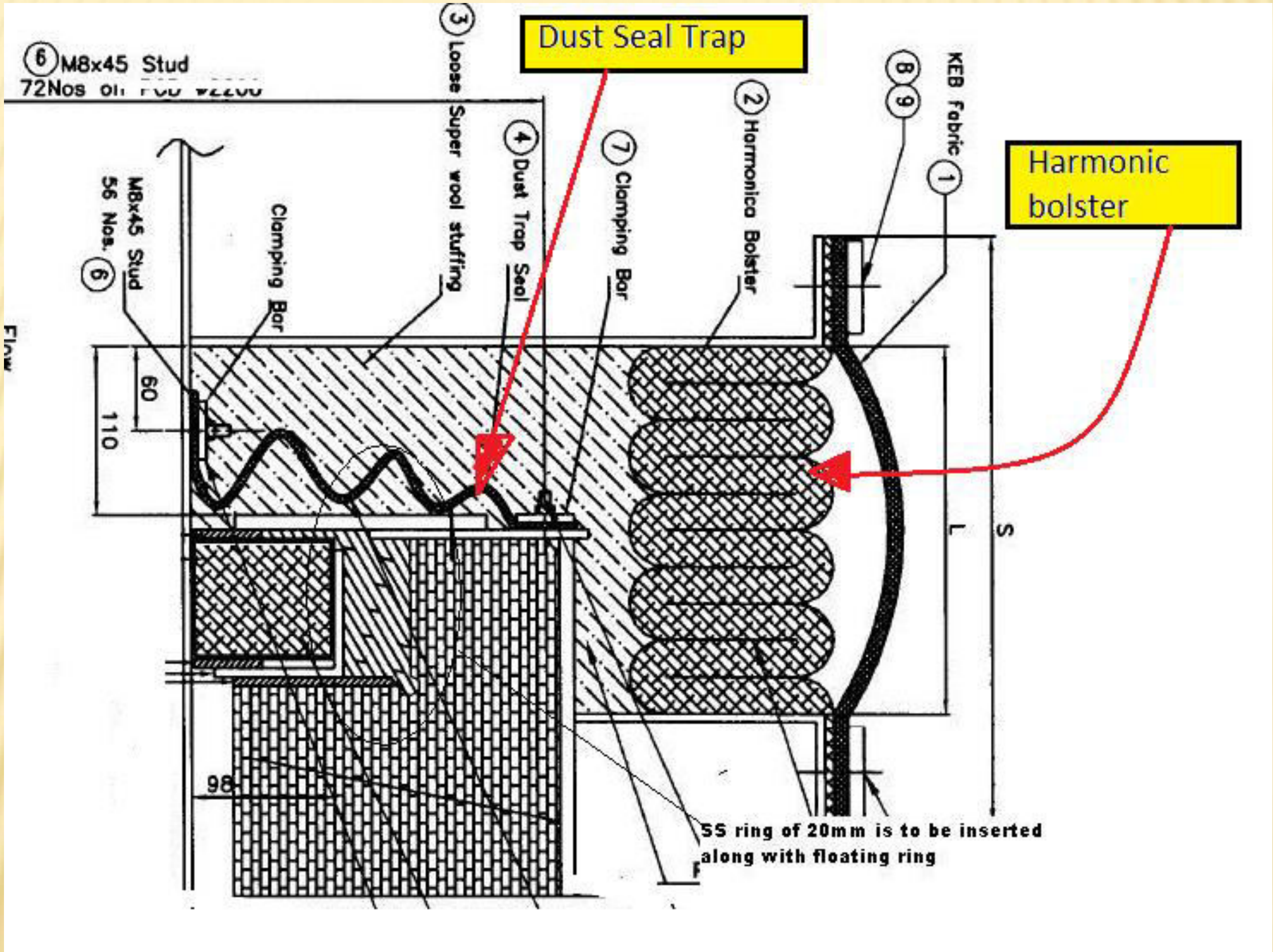
NMEJ FAILURES

- NMEJs at flue gas path are critical in nature and failure of which leads to Boiler shutdown
- Problem:
  - Failure of Seal Pot to Combustor NMEJ frequently
- Root Causes:
  - High sealing gap between male & female duct
- Remedial Action Taken:
  - Changes in design of NMEJ(Harmonic layer)
  - Sealing gap was reduced
  - Dust Trap provided

SEAL POT TO COMBUSTOR NMEJ

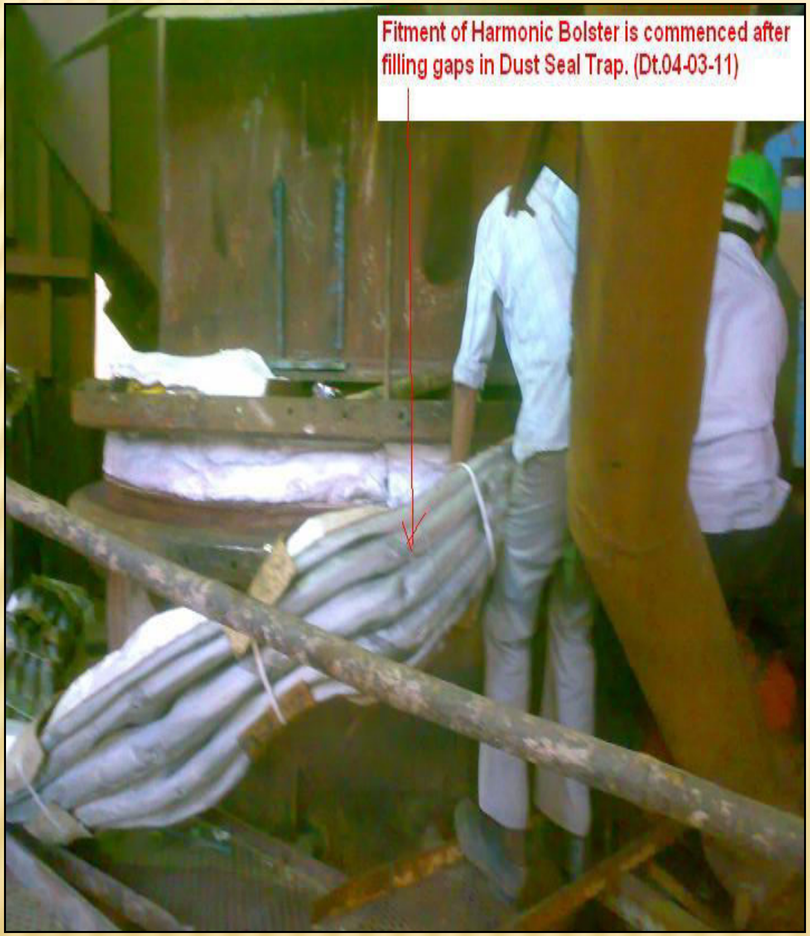


DETAILED DRAWING OF NMEJ



FITTING OF DUST SEAL TRAP

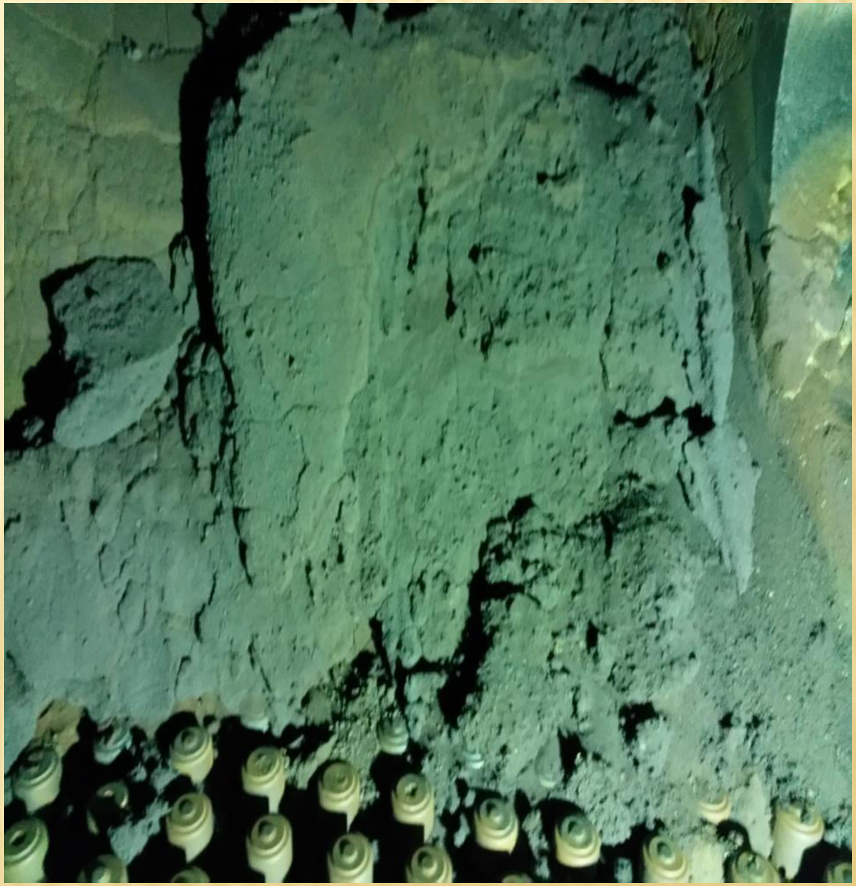
FITTING OF HARMONIC BOLSTER



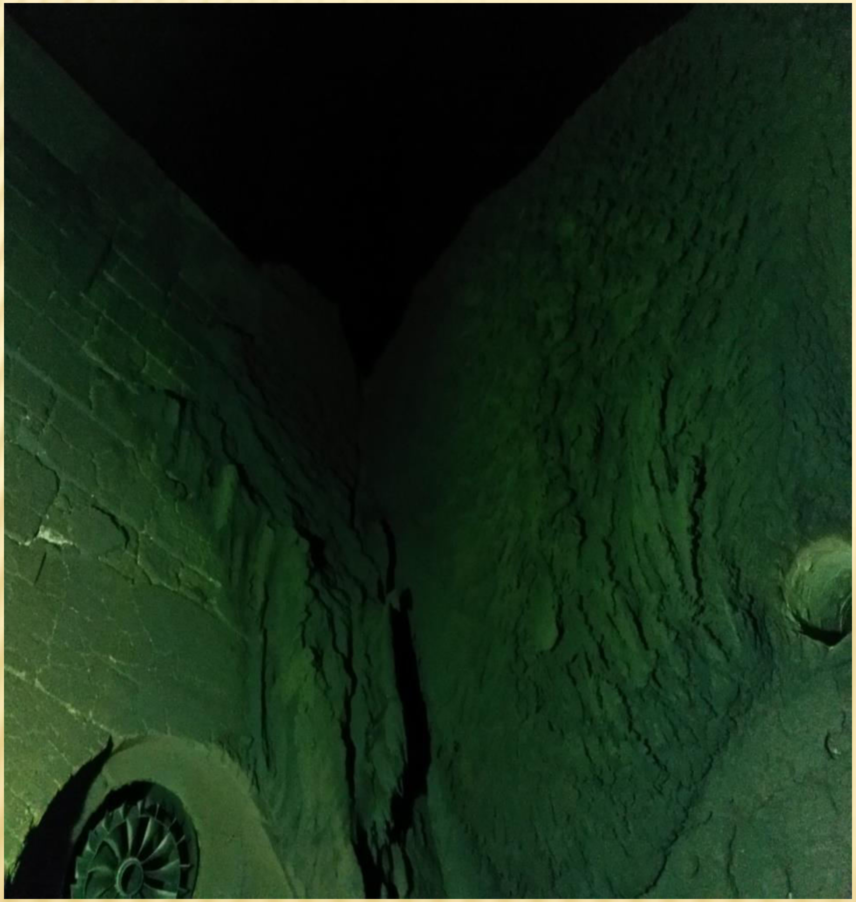
CLINKER FORMATION.

- **Main cause of Clinker**
- Clinker Formation at low combustor temperature < 700 deg C during mixed fuel (solid + oil) operations .
- Oversize of the lignite.

CLINKER NEAR PA FAN NOZZLES



CLINKER FORMATION NEAR SUB AREA



REMEDIAL ACTIONS TAKEN:

- Restricted Operations on mixed fuel .
- Maintaining Combustor temp. during very high fluctuation on load.
- Resized the lignite as per designed value.

- Type Of Fuel
  - Solid Fuel: Coal
  - Liquid Fuel : LDO

REFRACTORY DAMAGES

Areas of major refractory damages :

- Combustor Area
  - SUB Area
  - Lignite entry area
- FBHE Area
  - Partition Wall
  - Side Wall
- Cyclone Areas
  - target area
  - bull nose area
  - seal pot

REFRACTORY DAMAGES AT CYCLONE AREA

- **Problem:**
  - Frequent failures of refractory at Target area, Bull Nose Area
- **Causes:**
  - Use of low abrasion resistance refractory material
- **Actions taken:**
  - Refractory (Alumina Content – 80%) was introduced in cyclone bull nose area, Target Wall Area in place of existing dense refractory (Alumina Content – 45%)

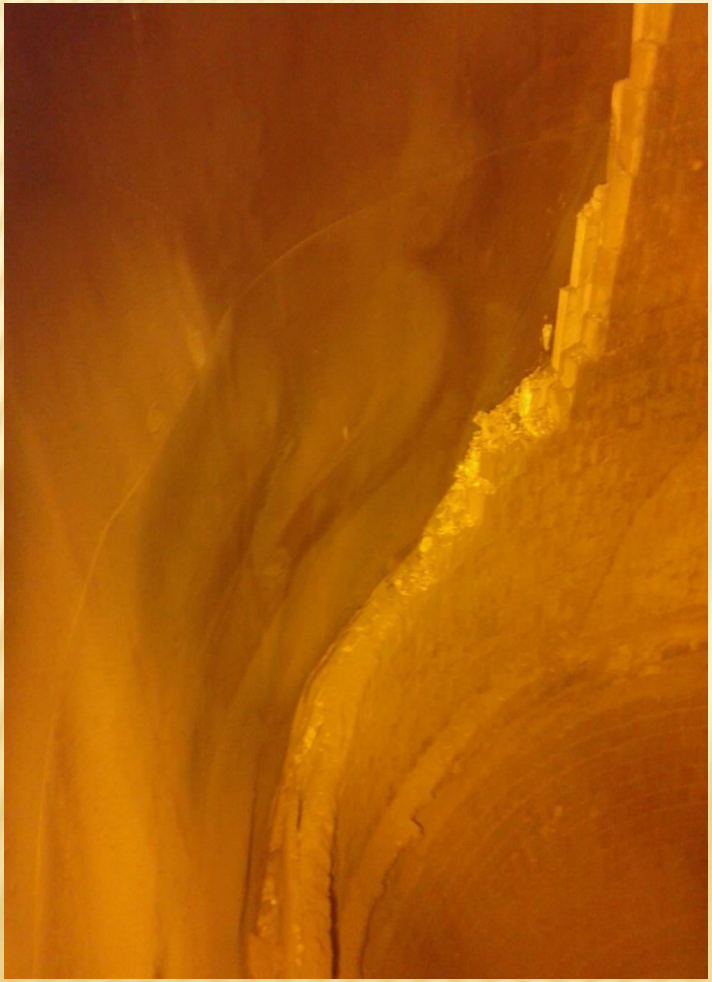
CYCLONE DUCT IN RED HOT CONDITION

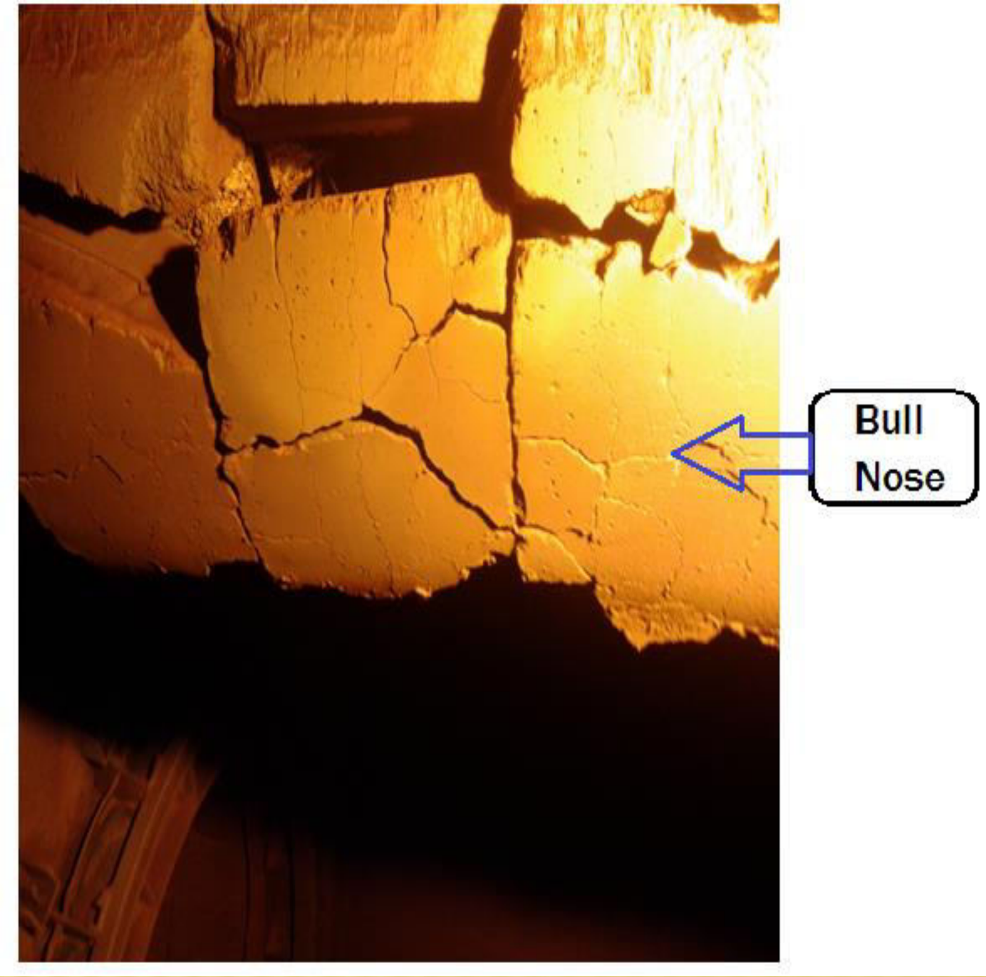
REFRACTORY DAMAGES IN COMBUSTOR TO CYCLONE DUCT

REFRACTORY DAMAGES IN COMBUSTOR TO CYCLONE DUCT

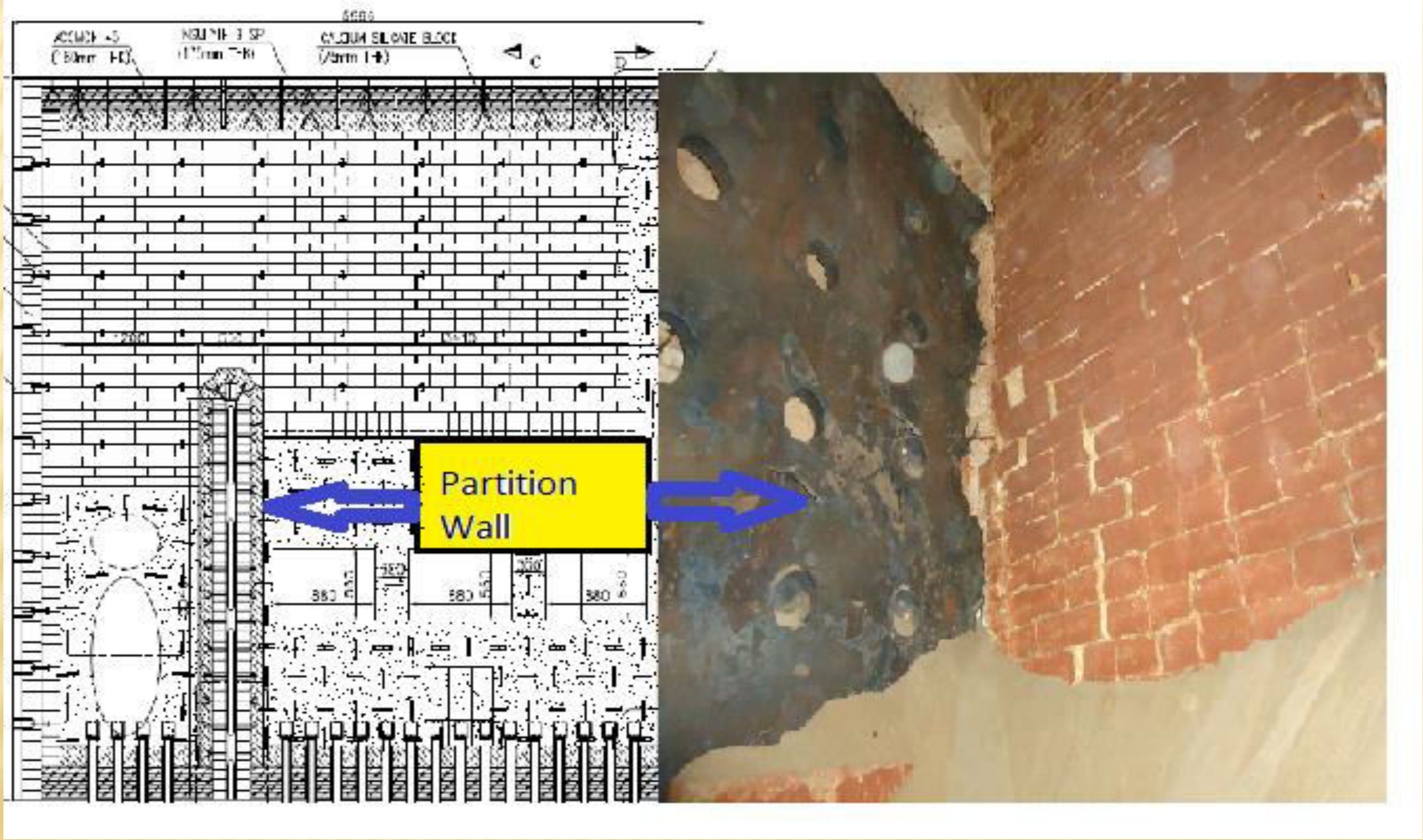
REFRACTORY DAMAGES IN CYCLONE.

REFRACTORY DAMAGES IN CYCLONE.



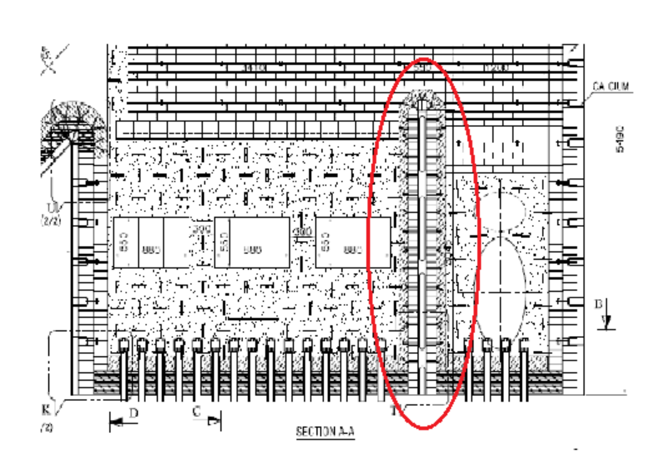


REFRACTORY DAMAGES AT FBHE AREA



REFRACTORY DAMAGES AT FBHE AREA

- Problem:
  - Failures of refractory at partition wall & Empty Chamber side walls
- Causes:
  - Use of low abrasion resistance refractory material
- Actions taken:
  - Castable refractory of high alumina content
  - (high abrasion resistance) introduced in place of existing castable Refractory
  - Numbers of Anchors are increased



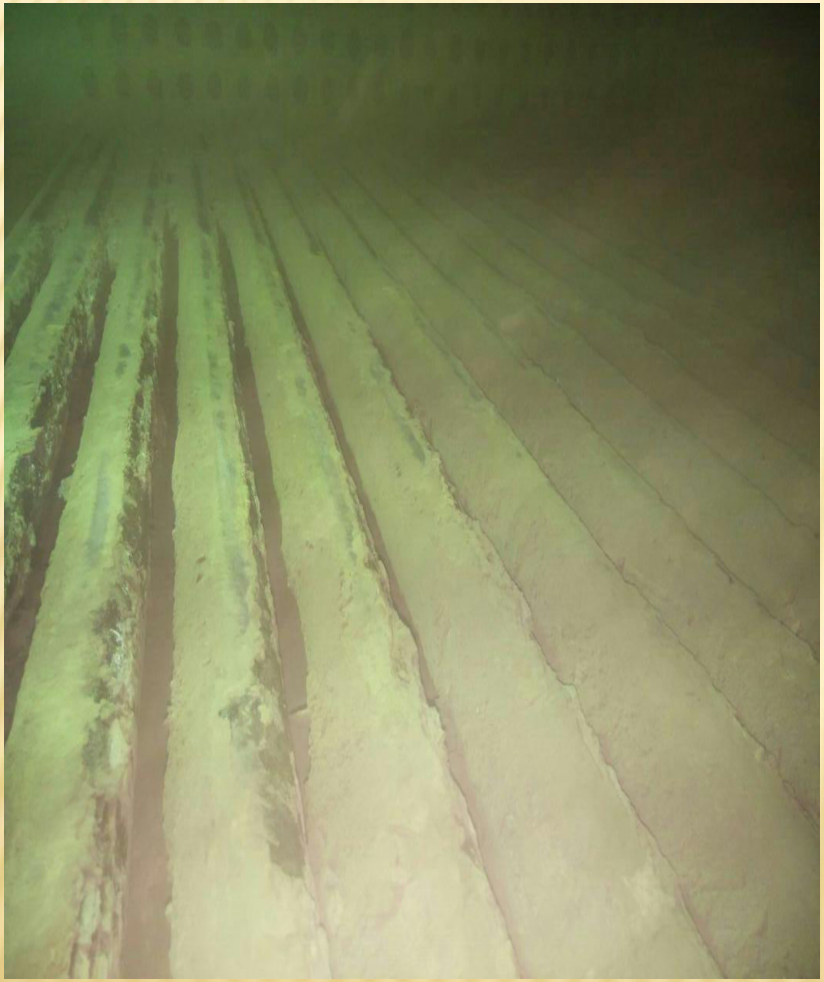
REFRACTORY FAILURES AT START-UP BURNER & LIGNITE ENTRY AREA

- **Problem:**
  - Failure of refractory at Start-Up Burners (SUB) & lignite entry area
- **Causes:**
  - Soft insulating material below the dense castable refractory at SUB area
  - Poor refractory Application & heat curing procedure
- **Action Taken:**
  - Modification of burner profile to increase the thickness of refractory
  - More numbers of anchors provided.
  - Refractory Dry Out with external burners

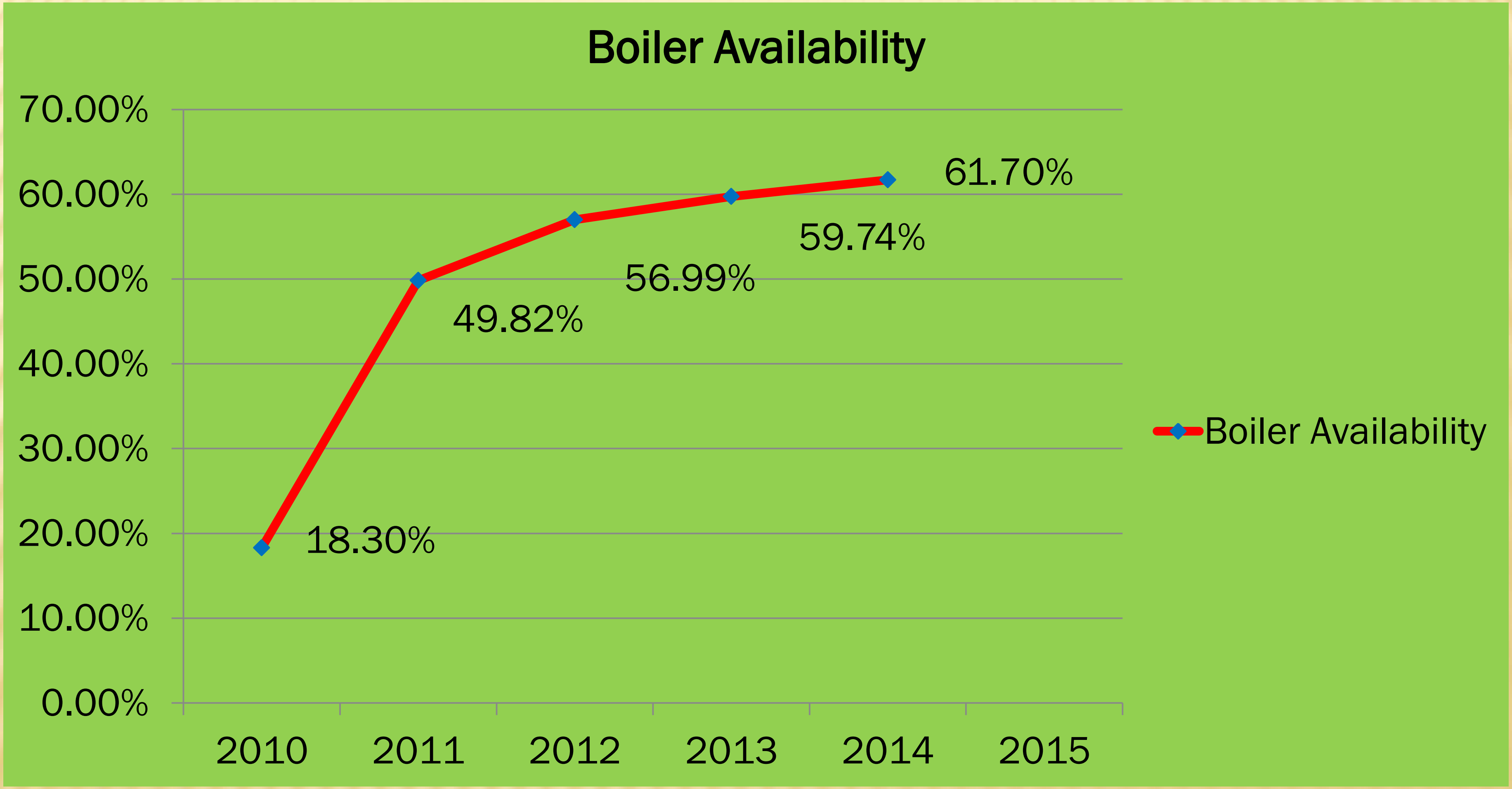
CHOCK-UP IN APH

- Currently we are facing problem of chock-up of APH. Which leads the suction pressure of ID fan very- very low ie. Upto -35mbar. Hence machine is compelled to run at reduced load. Hence there is still question that how to overcome this problem.

CHOCK-UP IN APH



BOILER AVAILABILITY



THANK YOU

BACK UP SLIDE

DISADVANTAGES

- Auxiliary consumption is higher ie. 17% at full load and 19% at reduced load 19% as compared to PF boilers.
- Boiler Down time is higher as compared to PF boilers.

SIZE OF LIGNITE AND LIME STONE SPECIFICATION

Fuel Sieve Analysis & Limestone Specification

Fuel Size:

100 %	< 15 mm
85 %	< 10 mm
50 %	< 1 mm

Limestone analysis, % By Weight:

$CaCO_3$	80.6
$MgCO_3$	3.0
SiO_2	6.02
Moisture	2.0
Others	8.38

Limestone Size

Maximum lump size	1 mm
Average size d50	0.16 mm
d80	<0.20 mm
d90	>0.04 mm

Bulk density 1000 –1200 kg/m^3

Moisture max 2 %

BED MATERIAL SPECIFICATION

BED MATERIAL REQUIREMENT

1.	Material Handled	Crushed Refractory Grog / Bed Ash
2.	Size: **	
	100%	less than 1 mm
	80%	less than 180 to 200 Micrometer
	50%	less than 150 to 170 Micrometer
	3% (max)	less than 63 Micrometer
3.	Bulk Density **	1500 to 1800 kg/m^3
4.	Chemical Composition (% by weight) As Per IS 1355	
	Al_2O_3	30 to 40 %
	SiO_2	50 to 60 %
	Alkalis (Na_2O+K_2O)	Not more than 3 %
	Iron Oxide	Less than 3.5 %
	Moisture (H_2O)	Less than 1 %
	Initial Deformation Temp	Greater than 1300°C As per ASTM D 1857 / 1968
5.	Quantity required for initial fill	185 tonnes
6.	Qty. recommended for stocking by the Customer	370 tonnes

BENEFITS OF A CFBC BOILER OVER A PC BOILER

SR. NO	Description	CFB Boiler	PC-Fired Boiler	Benefits of CFB
1	Fuel Size	<15 mm	> 70% < 75 microns	crushing cost is reduced
2	Fuel range (ash + Moisture)	Up to 75%	Up to 50%	Accepts wide range
3	Sulfur Capture	Limestone Injection	FGD Plant required	Less expensive SO2 removal system
4	Auxiliary Fuel Support (Oil or Gas)	Up to 20 - 30%	Up to 45%	Less Oil / Gas Consumption
5	Auxiliary Power Consumption	Slightly Higher	Lower	If FGD is used in PC, CFB power is lower
6	Emissions			
a	SO2, ppm @ 6% O2	< 100	< 200 with FGD	Lower emissions in process, less expensive
b	Nox, ppm @ 6% O2	< 50	< 100 with SCR	No SCR (or SNCR) system required
7	Boiler Efficiency, %	Same	Slightly Higher	-
8	O&M cost	5 - 10% Lower	5 - 10% Higher	Lower because of less rotary equipment
9	Capital Cost	5 - 10% Higher	5 - 10% Lower w/o FGD & SCR	......
		8 - 15% Lower	8 - 15% Higher w / FGD & SCR	......

IMPORTANCE OF CFBC TECHNOLOGY TO ADDRESS THE CHALLENGES FACED BY THERMAL POWER SEGMENT

In India 57% of power generation is from coal, though India has a large coal reserve but most of the Indian Coal is having high ash (15 to 45 %) and low calorific value 2600Kcal/Kg.

Major challenges in coal based thermal power plants are,

- Availability
- Efficiency
- Emission
- Fuel Shift

AVAILABILITY

- Boiler availability Depends upon;
  - Fuel
  - Technology & Design
  - Construction Quality
  - Maintenance practice

EFFICIENCY

- Boiler efficiency Depends upon;
  - Fuel Properties
  - Combustion technology
  - Furnace Design
  - Design of Auxiliaries
  - Operation Philosophy

EMISSION

- Depends upon;
  - Fuel Properties
  - Combustion technology
  - Operation Philosophy
  - Use of Additives for emission control

FUEL SHIFT

- Indian IPP owners face recent challenges in terms of Fuel availability in local market and more duties in Imported coals resulting in higher power generation cost and disrupting the profit margins.
  - Recently there is major shift seen in dependency in fossil fuels to Refinery waste fuel Petroleum coke (Petcoke) due to higher calorific value, better availability, ease of handling and crushing.
  - CFBC technology will be most appropriate considering requirement of high residence time & Better sulfur capture efficiency.