

# LMB's experience of Supercritical Plants



Aug 31, 2015  
By S. K. Chakraborty

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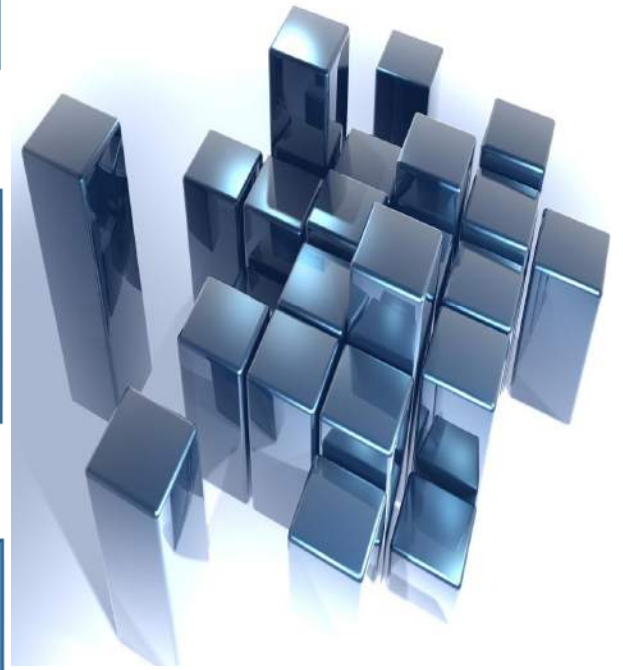
# Presentation Flow



**Overview of L&T - MHPS Boilers**

**Projects under execution**

**Supercritical Plant Experience**



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# Overview of L&T-MHPS Boilers (LMB)

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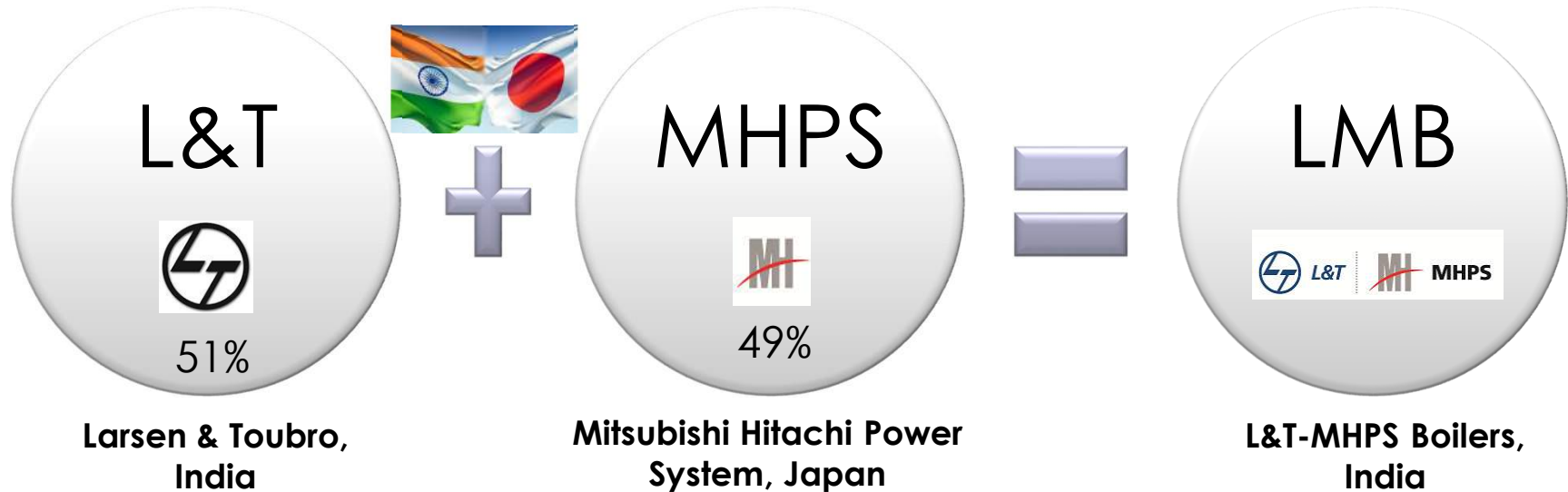
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**L&T-MHPS BOILERS**

# Joint Venture of L&T and MHPS



## Incorporation

L&T-MHPS Boilers  
was incorporated  
on  
April 18, 2007  
(20 Years Term)

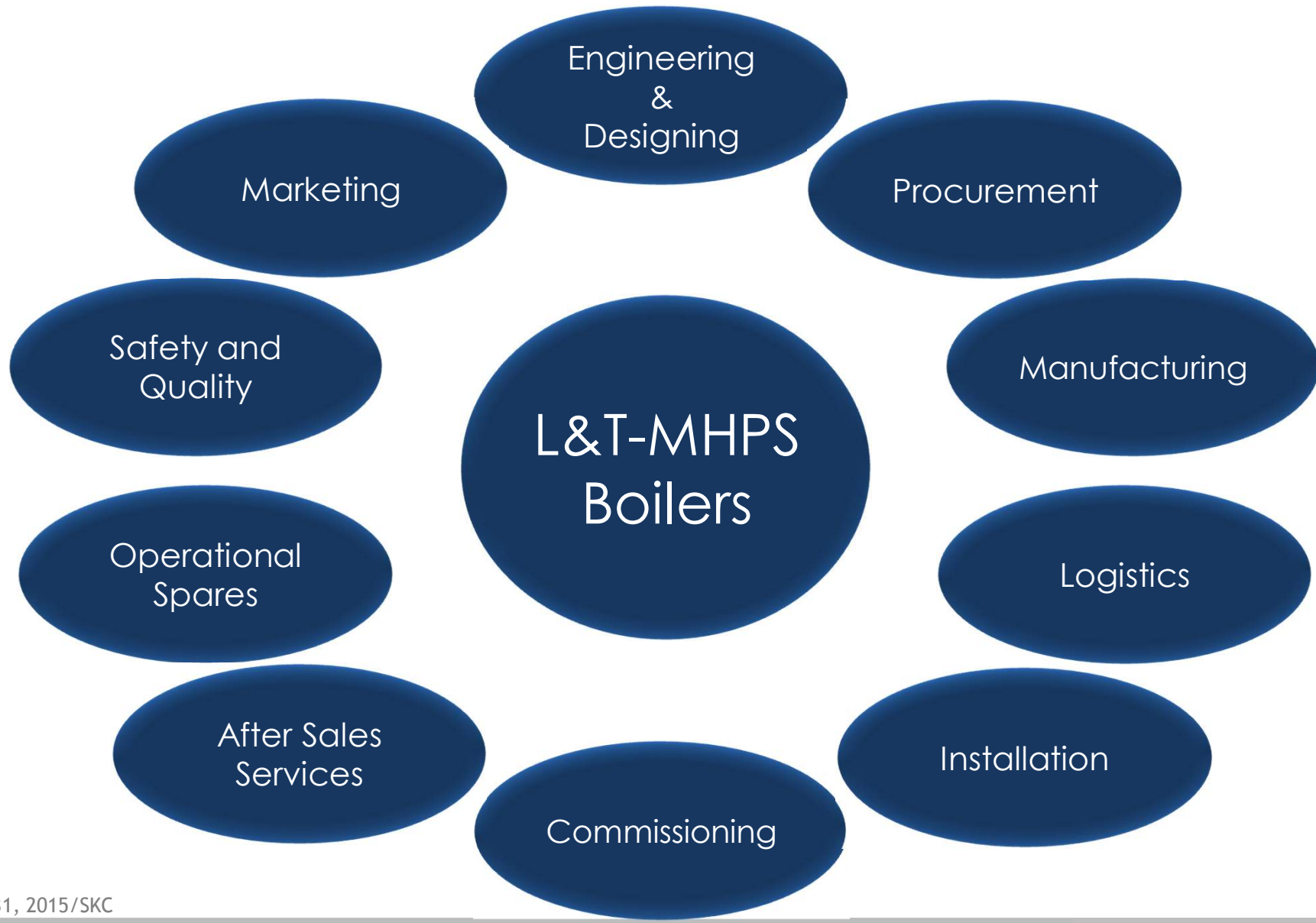
## Scope

Complete  
Technology  
Transfer of  
Supercritical  
Boilers

## Product Range

Supercritical  
Boilers of 500 MW  
and above  
including  
Pulverizer

# LMB's Scope of Business



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# Projects Under Execution

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**L&T-MHPS BOILERS**

# Projects Under Execution – Domestic Orders



## Steam Generator and Associated Auxiliaries

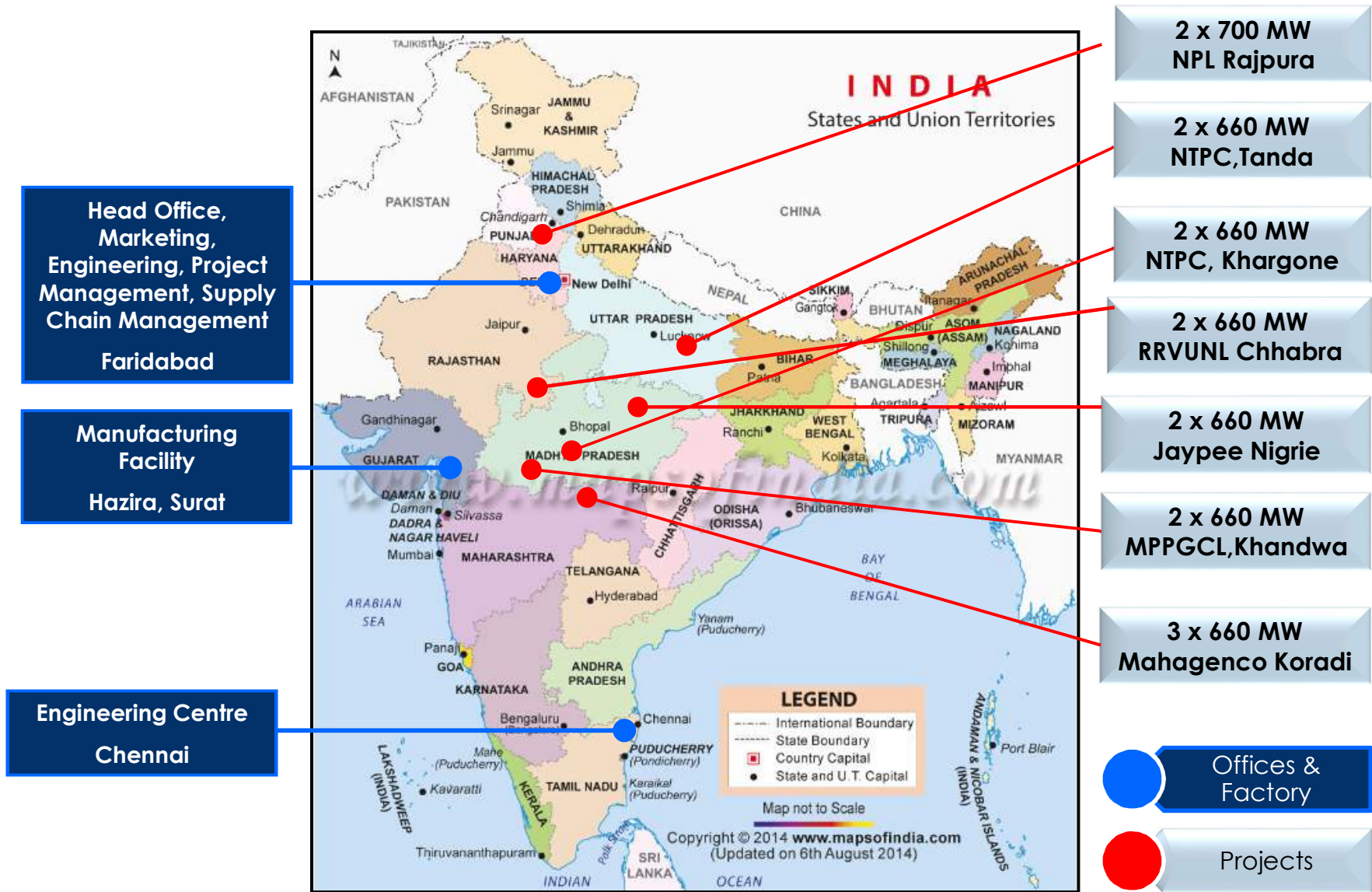


COD of Rajpura U-1 & 2 & Jaypee U-1&2 has been Achieved.

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# Offices, Manufacturing Facility & Project Sites Location



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# NPL Rajpura Plant Experience

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**L&T-MHPS BOILERS**

# Plant as viewed from a distance



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**L&T-MHPS BOILERS**

# Some Facts

- L&T-MHPS Boilers Pvt. Ltd. has successfully commissioned two units of supercritical boilers for 2 x 700MW Rajpura Thermal power project.
- Both units have achieved commercial operation from January 2014 and June 2014 respectively.
- First supercritical unit operating commercially fully designed and manufactured by a domestic Boiler manufacturer (L&T-MHPS).

# SALIENT INFORMATION

Customer Name	Nabha Power Limited.
Owner's Consultant	Tata Consulting Engineers Limited.
Plant Gross output / Unit	700 MW
Boiler Type	Once through, Super Critical, Sliding pressure, Vertical Wall, Two Pass design
Firing System	Twin Fire Vortex, 8 Corner, CCF, APM Burner (Low Nox)
Steam Condition	SH outlet: 2,322 tph, 25.12 Mpa(g), 568 deg. C RH Outlet: 1,886 tph, 5.93 Mpa(g), 596 deg. C
Fuel	Main Fuel: Indian Coal, GCV: 4,400 kcal/kg, Ash:33% Start up Fuel: HFO - 30%, LDO - 10% heat output
Pulverizer	Model No: MVM 32R, 6 Nos, Front Mill arrangement
Actual Project Schedule Unit #1	NTP: 18-01-2010, COD: 30-01-2014 (17-01-2014)
Actual Project Schedule Unit #2	NTP: 18-05-2010, COD: 09-06-2014 (17-05-2014)

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# COAL ANALYSIS

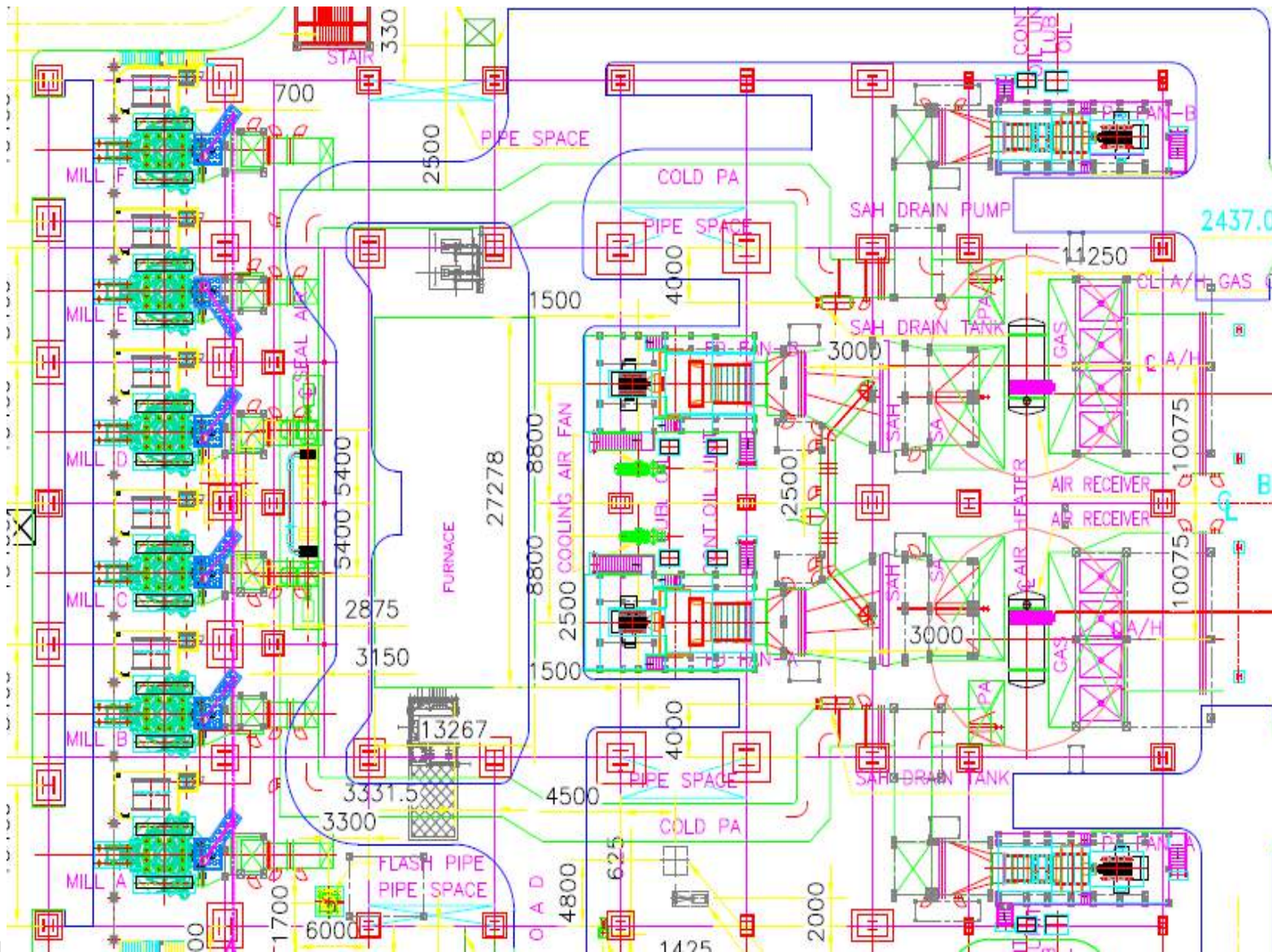
INDIAN COAL		DESIGN COAL	WORST COAL
<b>PROXIMATE ANALYSIS (wt % AR)</b>			
INHERENT MOISTURE	%	-	-
TOTAL MOISTURE	%	10.5	14.0
ASH	%	33.0	34.0
VOLATILE MATTER	%	22.0	20.0
FIXED CARBON	%	34.5	32.0
GCV	kJ/kg	4400	3860
HGI	-	55	50
<b>ULTIMATE ANALYSIS (wt % AR)</b>			
CARBON	%	45.5	40.0
HYDROGEN	%	2.75	2.70
OXYGEN	%	6.21	7.65
NITROGEN	%	1.2	1.2
SULPHUR	%	0.4	0.45
MOISTURE	%	10.5	14
ASH	%	33.0	34.0
CARBONATE + PHOSPHOROUS	%	0.44	-

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# Boiler General Arrangement (Plan)



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# Special Feature - Vertical Water Wall

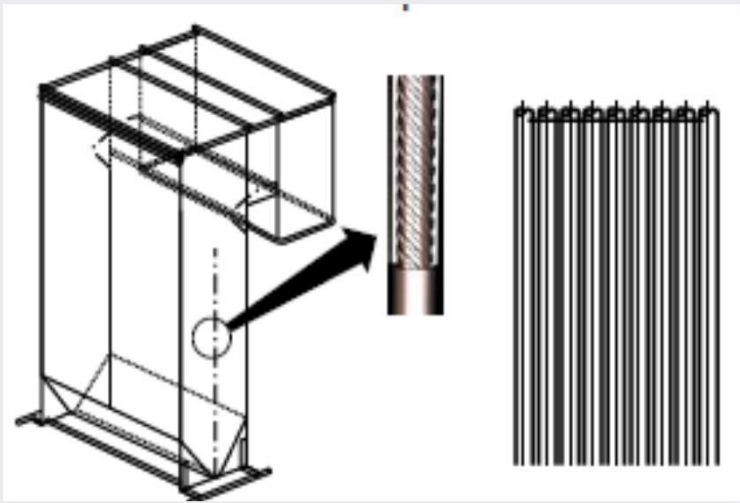
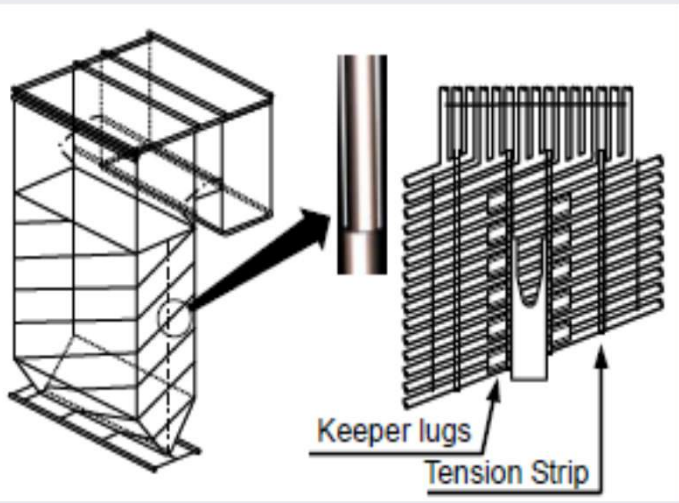
- First of its kind in Indian supercritical Boiler industry with latest and advanced technology features such as
  - ❖ Vertical water wall technology
  - ❖ Twin fire vortex with eight corner circular firing (CCF)
  - ❖ Low NOx burners suitable for the sub-bituminous Indian coal.
- An optimized rifled tube geometry which has superior hydrodynamic and heat transfer characteristics has enabled the use of lower mass flux.



# Special Feature - Vertical Water Wall

- A vertical wall furnace has many advantages over a spiral furnace especially in the manufacture and supporting philosophy. It also results in a lower pressure drop in the furnace circuit.
- Orifices are installed in the inlet to the water walls in order to ensure uniform enthalpies at the lower furnace outlet.

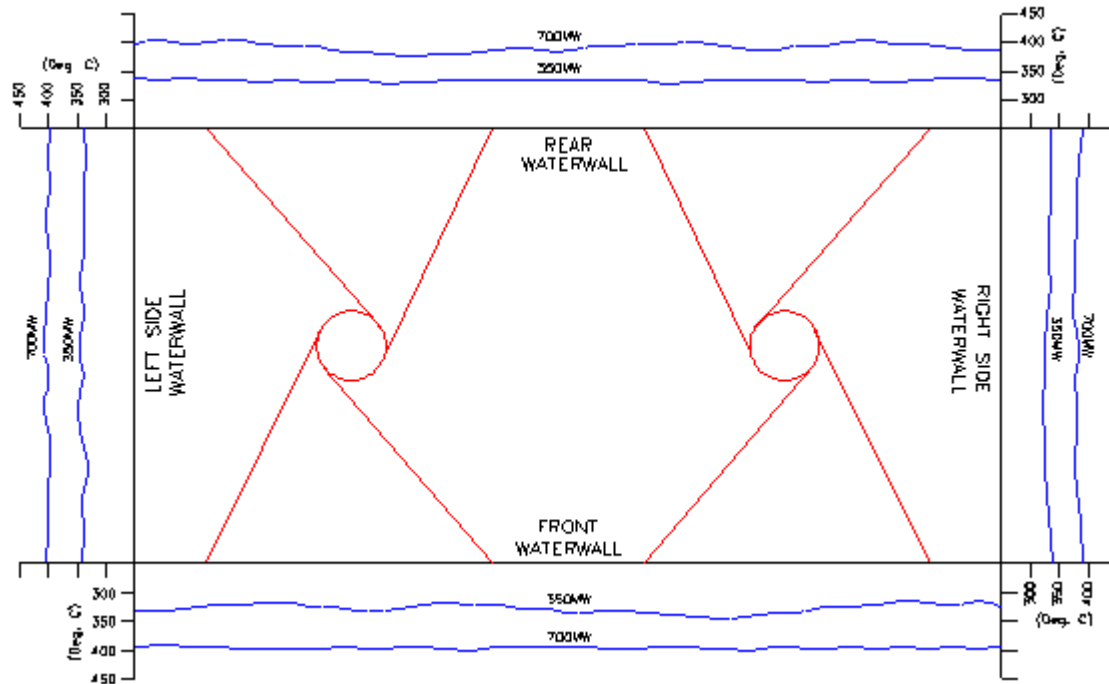
# Special Feature - Vertical Water Wall (contd.)

Item	Vertical Waterwall Furnace	Spirally Wound Furnace
Furnace Structure	Simple	Base
		

# Special Feature - Vertical Water Wall (contd.)

Description	Vertical waterwall Supercritical Boiler	Spiral wound waterwall Supercritical Boiler
Mass Velocity at Rated load.	1,300 ~1,900 kg/m <sup>2</sup> s	3,000 kg/m <sup>2</sup> s
Waterwall Tube Type	Rifled Tube	Smooth Tube
Metal Temperature	Low	Base
Flow Stability	Better	Base
Flow Dynamics		
Flow Characteristics	Better	Base
Temperature Unbalance	Small	Large

# Special Feature - Vertical Water Wall (contd.)



Furnace waterwall temperature profile (Rajpura Unit #1)

Furnace Waterwall	Front		Rear		Right Side		Left Side	
Description	350 MW	700 MW	350 MW	350 MW	350 MW	350 MW	350 MW	350 MW
Load								
Temperature Difference	15	14	6	12	8	9	11	7

Boiler Furnace Waterwall Tube Temperature (Rajpura Unit#1)

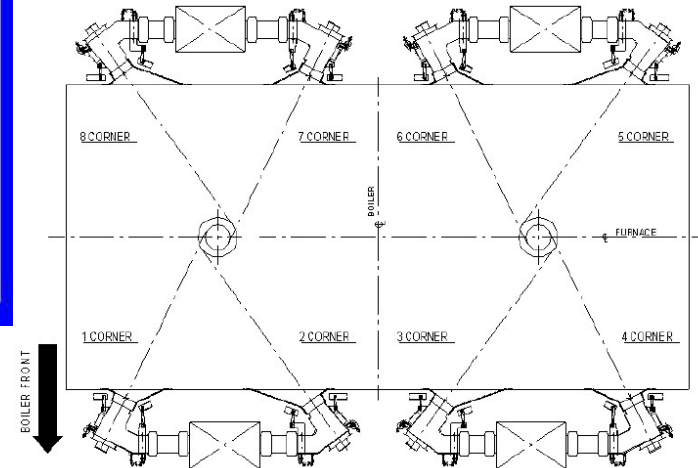
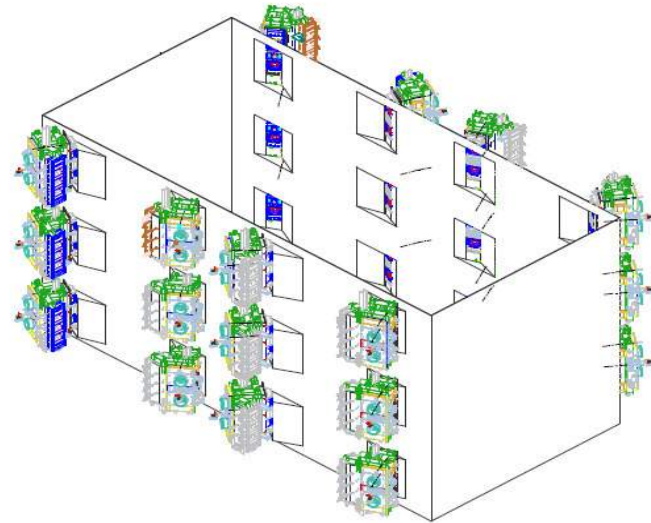
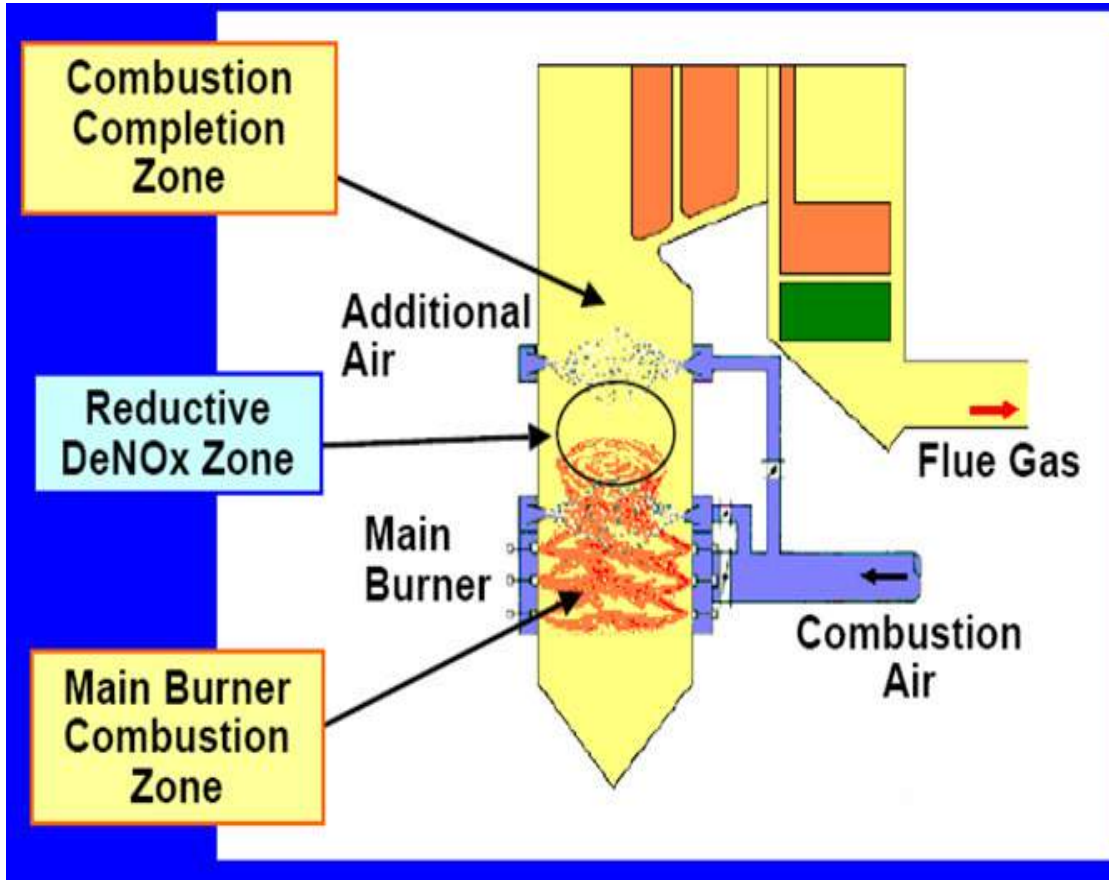
# Special Feature - Circular Corner Firing System

- Circular corner firing (CCF) system is adopted in Rajpura project as per L&T-MHPS design, which is first of its kind in the Indian boiler industry.
- Eight burners are arranged at each elevation by creating eight corners. This arrangement creates two fire vortex in the furnace at each plane.
- All eight burners at each elevation are feed by one pulverizer.

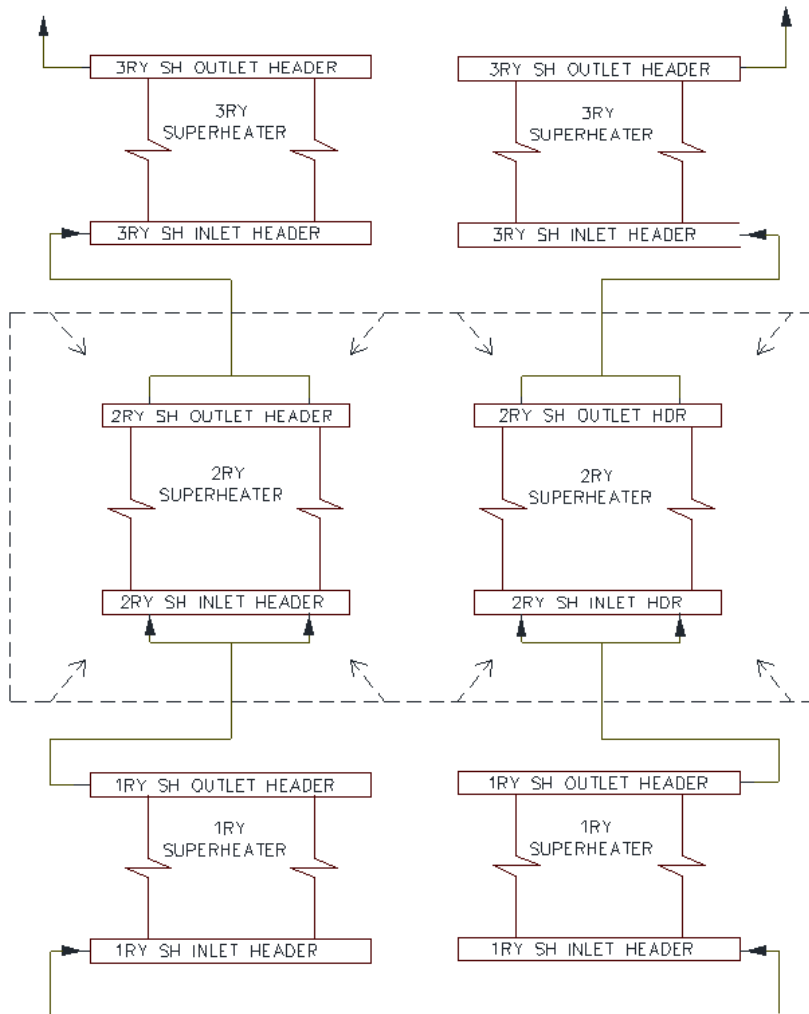
# Special Feature - Circular Corner Firing System

- With this CCF system and two fire vortex (clockwise / counter clock wise) design, the flue gas distribution in the furnace is almost uniform and distributed throughout the entire furnace plane.
- The twin fire vortex eliminate the need for a criss - cross arrangement of SH & RH, which is normally adopted in the typical single fire vortex design or in wall fire design.

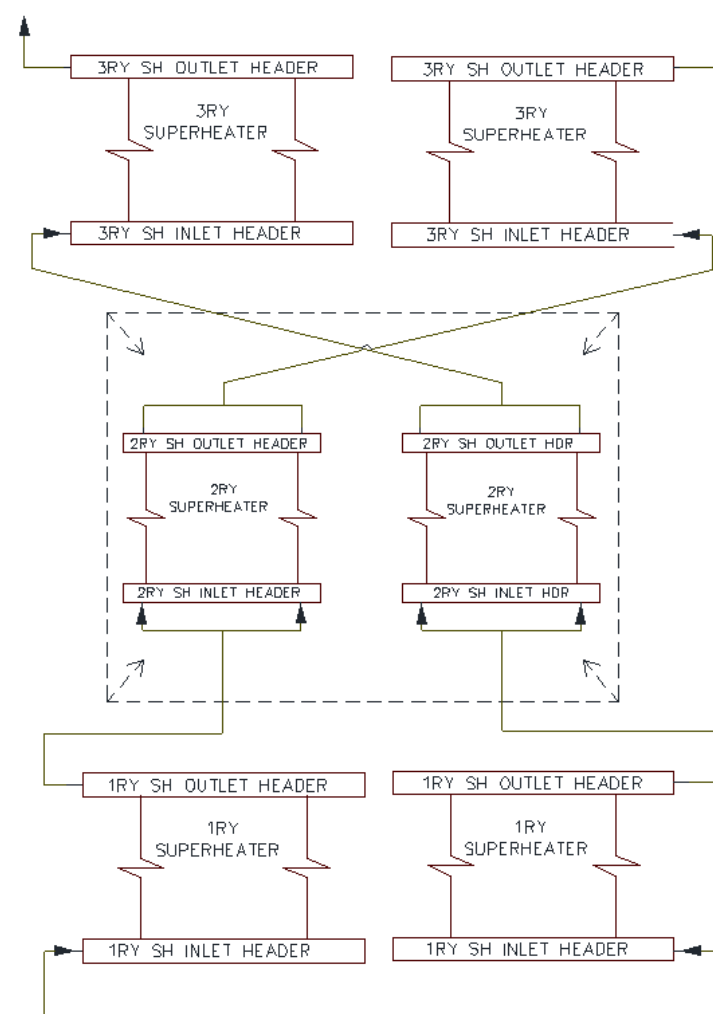
# BURNER ARRANGEMENT



# Special Feature - Circular Corner Firing System (contd.)



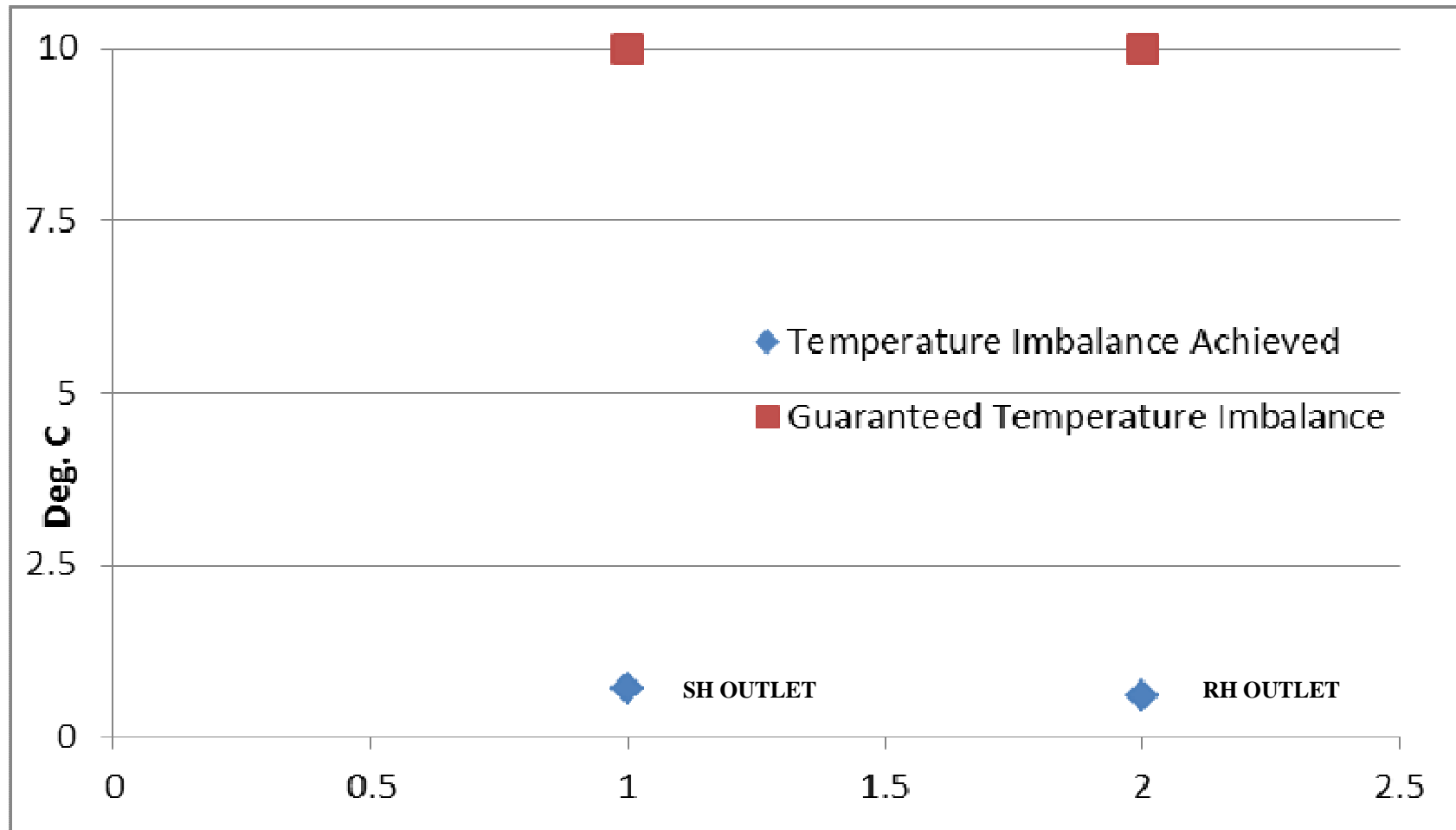
**Without Criss-Cross Arrangement**



**With Criss - Cross Arrangement**



# Special Feature - Circular Corner Firing System (contd.)

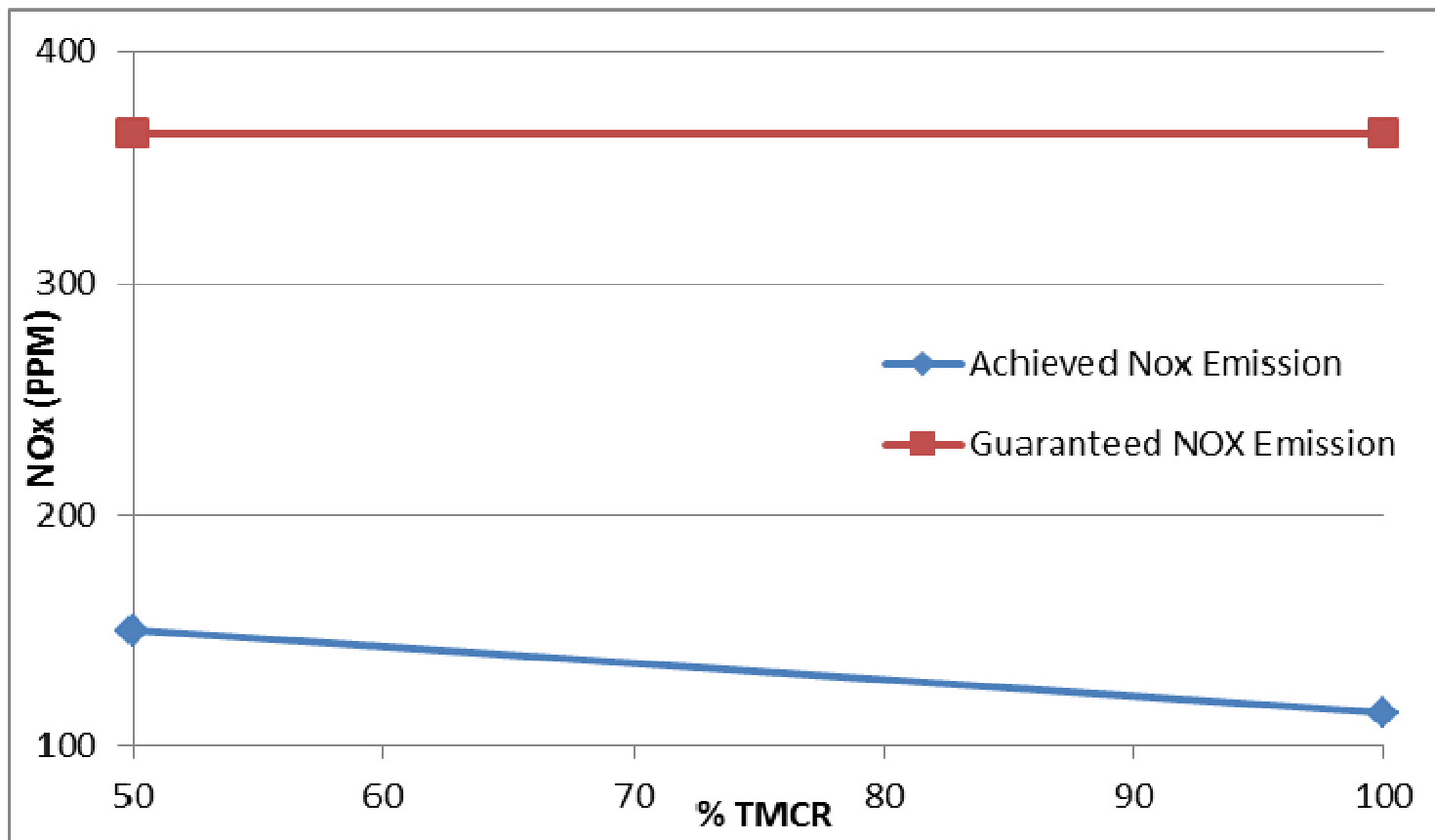


SH & RH outlet Pipe steam temperature Imbalance (Rajpura Unit#1)

# Special Feature - Advance Combustion system

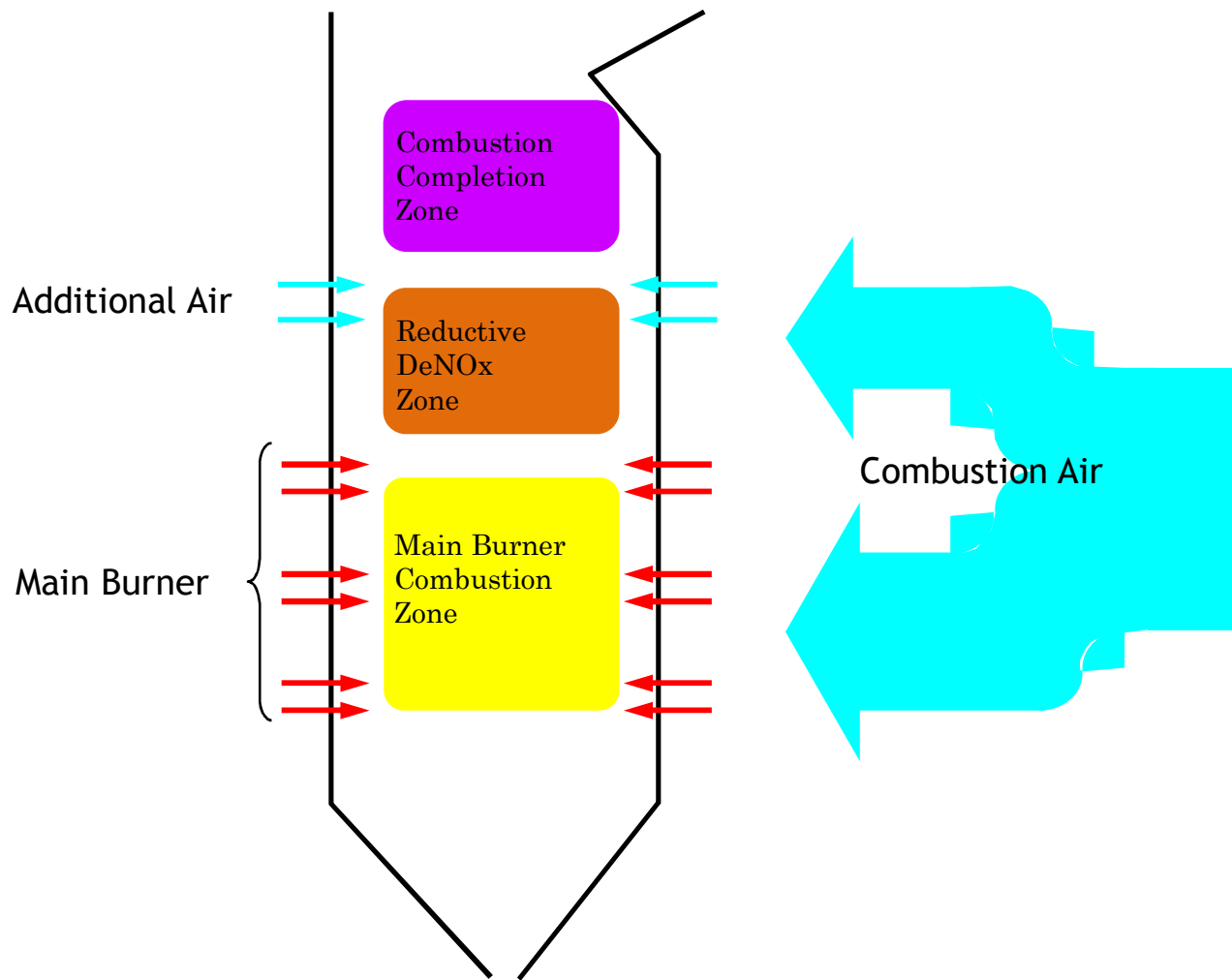
- MHPS's advanced low NOx combustion system is adopted in this boiler even though there is no stringent requirement of NOx emission guarantee.
- **A-PM (Advanced-Pollution Minimum) burner - Advantages**
  - ❖ Reduced NOx further promoting concentrated and lean combustion compared with a conventional continuous wind box type PM burner.
  - ❖ Better maintainability, reliability and durability of the system
- The NOx emission achieved during the plant operation is about 115 ppm as against the guaranteed NOx emission was 365 ppm with 6% O<sub>2</sub>.

# Special Feature - Advance Combustion system (contd.)



NOx Emission Level (Rajpura Unit#1)

# Special Feature - Advance Combustion system (contd.)

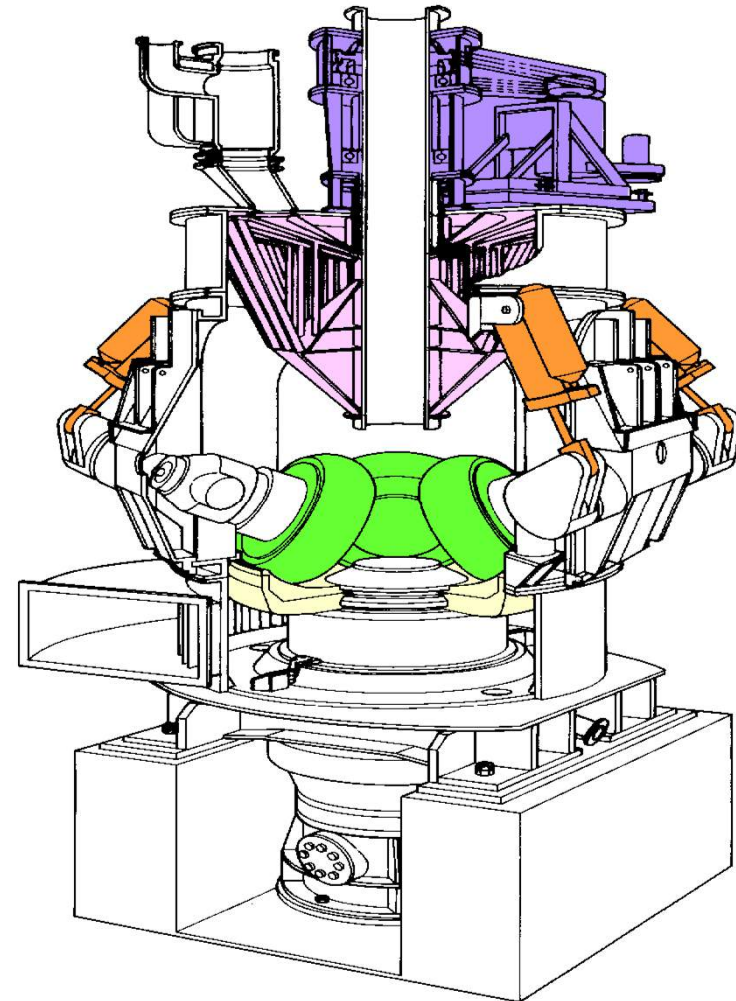


In-furnace NOx System (A-MACT)

# Special Feature - Advance Combustion system (contd.)

## ➤ High fineness MRS (Mitsubishi Rotary Separator) Pulverizer

- ❖ High fineness characteristics could be obtained by using a rotary separator, thereby realizing further reductions in NO<sub>x</sub> emissions and unburned combustibles.



MRS Pulverizer

# Highlights of Boiler operating Performance at Rajpura

- The boiler efficiency achieved is higher than that of the guaranteed data.
- The Boiler was designed with 15% excess air ratio, however during the combustion tuning it is also observed that the Boiler has given excellent performance even with 12% excess air ratio.
- Boiler rated condition can be achieved without any heating surface modification even through there are several input changes from the design condition.

# Highlights of Boiler operating Performance at Rajpura

- It is experienced that the main fuel as coal is introduced at 10% TMCR (70 MW) load. The introduction of coal at lower load is possible due to the high efficient A-PM burner.
- As the main fuel can be introduced at lower load, the Fuel oil consumption for entire life cycle of the plant can be reduced considering the number of startup.
- The control of RH outlet temperature is done with the gas biasing damper.
- The RH spray flow is maintained zero from entire control range of the Boiler (60% BMCR to 100% BMCR).

# BOILER PERFORMANCE SUMMARY

Parameters	Guaranteed	Achieved_Unit#1	Achieved_Unit#2
Excess Air (%)	15	13.3 (-1.7)	12.1 (-2.9)
Boiler Efficiency (%)	88.7	90.03 (+1.33)	90.20 (+1.50)
Aux. Power Consumption (kW)	13,850	13,210 (-640)	12,270 (-1580)
Nox Emission @ 6% O2 (PPM)	365	115 (-250)	115 (-250)
Steam Condition	SH outlet: 568 deg. C RH outlet: 596 deg. C	SH outlet: 568 deg. C RH outlet: 596 deg. C	SH outlet: 569 deg. C RH outlet: 597 deg. C
Steam Temperature Imbalance	SH outlet: 10 deg. C RH outlet: 10 deg. C	SH outlet: 0.7 deg. C RH outlet: 0.6 deg. C	SH outlet: 0.2 deg. C RH outlet: 1.6 deg. C
RH Spray (%)	0	0	0
BMCR Flow (tph)	2,322	2,332	2,352
Furnace Water wall Temp. Difference	-	35 to 50 deg. C	35 to 50 deg. C

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# Project Schedule and Achievements

- Project schedule monitoring, engineering, manufacturing, construction and commissioning has key importance for completion of any project on time.
- The Rajpura project was completed ontime due to close co-ordination with L&T-Power as EPC contractor, world class manufacturing facility with latest machinery, manufacturing methodology at Hazira and advance construction technology (Block lifting).
- The plant commissioning activity and commercial operation was declared on the due date.

Unit No.	NTP	COD Planned	COD Achieved
Unit #1	January, 2010	January, 2014	January, 2014
Unit #2	May, 2010	May, 2014	June, 2014



**L&T**



**MHPS**

