A Maharatna Company.

A

PROJECT REPORT ON

"BOILER MAINTENANCE"

(PRESSURE PARTS & ROTATING MACHINES)

In NTPC – Ramagundam (R.S.T.P.S)

Submitted by

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UNDER ESTEEMED GUIDANCE OF

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NTPC LIMITED

R A M A G U N D A M S U P E R T H E R M A L P O W E R S T A T I O N

C E R T I F I C A T E

This is to certify that the project work entitled "BOILER MAINTENANCE PRESSURE PARTS & ROTATING MACHINES" is the bonafide record of a project carried out by

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the students of Department of Mechanical Engineering, Gokaraju Rangaraju Institute of Engineering and Technology, under the guidance and supervision at NTPC LIMITED-Ramagundam, during the period of 16th December 2015 to 30th December 2015 and is the proof a bonafide work done by them.

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ACKNOWLEDGEMENT

We are delightful to have undergone training here at NTPC Limited. This report is an embodiment of the efforts of the several persons to whom we would like to express our gratitude.

We would like to express our sincere thanks to Sri. K.J.Reddy ,AGM(BMD), Sri.V.Nagaraju, AGM (BM-RM) Sri CH.M.M.RAO AGM-(BM-PP), who extended his support and acceptance to our proposal of carrying out the mini project work on"BOILER MAINTENANCE -PRESSURE PARTS & ROTATING MACHINES".

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Mr. P.M.G.V.Srinivas, DGM (HR-EDC) and other staff of EDC for providing us an opportunity to do project work in this organization.

We are very thankful to management employee of NTPC Limited Ramagundam, for their cooperation and guidance in completing of my project work.

NTPC VISION

To Be the World's Largest and Best Power Producer, Powering India's Growth.

RAMAGUNDAM VISION

To be a world class Power Station actualising NTPC Vision.

Core Values

Business Ethics

Environmentally & Economically Sustainable

Customer Focus

Organizational & Professional Pride

Mutual Respect and Trust

Motivating Self & Others

Innovation and Speed

Total Quality for Excellence

Transparent & Respected Organization

Enterprising

Devoted

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ABSTRACT

Power plants are the main sources for large-scale production of electrical energy. Availability of coal leads to implementation of thermal power plant. Raw material used in thermal power plant is coal, water, oil & air. Thermal power plant uses a dual phase cycle to enable the working fluid (water) to be used again & again. The cycle includes superheated steam, regenerative feed water heater & reheated steam known as the modified Rankine cycle

The Ramagundam Super Thermal Power Station - NTPC Ltd., having an installed capacity of 2600MW comprising of 3 Stages (3*200MW, 3*500MW &1*500MW). This is a sub-critical power station running with the help of boilers.

The main objective behind our project is to study the boiler and Boiler maintenance. Boiler is the most crucial part of a powerplant.The Efficiency of a powerplant is mainly depended on the effective functioning of the boiler.So,the boiler is maintained properly and checked regularly. Boiler maintenance is divided into two parts first part is “pressure parts” and the second is “Rotating machinery.” Flaws or defects occurring in both the parts are addressed, repaired or replaced as fast as possible depending upon the type of defect occurring and the part at which the defect occurs. Hence we selected the project
"Study of Boiler and Boiler maintenance."

INTRODUCTION

Power is one of the major factors that determine the growth of the nation. For industrialization there is huge requirement of power, for that we require a power plant which is efficient in operation.

Power developed in India began in 1897 when a 200kw hydro station was first commissioned at Darjeeling in 1899.First steam station is at Calcutta of 100kw.There are various sources of energy in India .The power developed in the country was not in systematic and planned manner .Therefore in order to achieve objectives of promoting in India development and rationalization of generation, transmission and distribution of electricity on regional basis throughout the country.

But the plans are unfortunately not implemented in meant of collection of monitory aspects as much as possible and successfully.

State electricity boards were constituted in various states of country under the provisions of electricity supply act 1948. There Sub's were it enjoys the monopoly in the respect of generation. The utilization of existing installed capacity is low.

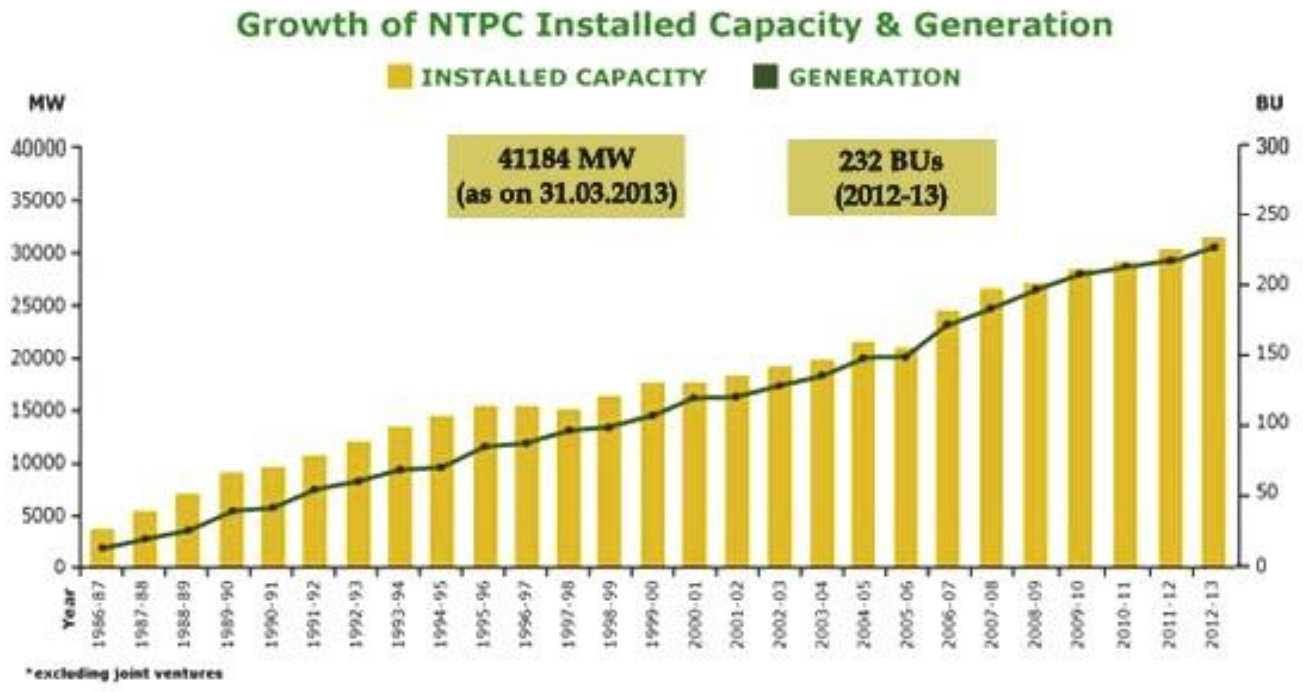
India has a margin development programmed in which thermal power generation is expected to continue to play a dominant role. **NTPC** has played a vital role in producing power .It has absorbed latest technology in this field from all over the world and has created unique technical organization which is well on the road to attain total in house capability for engineering and construction of large thermal power station with 500 mw s units and EHU transmission system both Ac &DC.

NTPC, a front runner in Indian power sector and one of the largest and best utilities in the world. It contributes 27% of total power production in India. Total power generating capacity of NTPC is 43,128MW including joint ventures.

NTPCLIMITED
(RAMAGUNDAMSUPERTHERMALPOWERSTATION)

National Thermal Power Corporation Limited (NTPC) is the largest thermal power generating company of India.A public sector company ,it was incorporated in the year 1975 to accelerate power development in the country as wholly owned company of the Government of India.The Forbes global 2000 ranking for 2014 ranks it as the 424thleading company in the world .It Is a public listed (Bombay Stock Exchange)Indian public sector company ,with majority shares owned by Government Of India. At present,Government of India holds 75% of the total equity shares of the company and the balance by other public sector organizations .NTPC ranks amongst top five companies, interms of market capitalization. Within a span of 31 years, NTPC has emerged as a truly national power company ,with power generating facilities in all the major regions of the country. NTPC, Ramagundam is considered as one of the best in the nation. Around 25% of the power generated is provided to the state of Andhra Pradesh. Seventh unit was added with an additional capacity of 500 MW in 2004 and also solar power generation system of 10MW introduced in 2013.NTPC decided to add 2units of capacity 660MW in Ramagundam within possible short time.

Recognizing its excellent performance and vast potential ,Government of India has identified NTPC as one of the jewelsof public sector '***Maharatnas'*** -a global potential giant .Inspired by its glorious past and vibrant present ,NTPC is well on its way to realize its vision of being "A World class integrated power major, powering India's growth, with increasing global presence".



PROJECTS OF NTPC IN INDIA

Thermal-Coal based

Sr. No.	Project	State	Capacity	Units	Status
1	Singrauli Super Thermal Power Station	Uttar Pradesh	2,000	5x200 MW, 2x500 MW	All units functional
2	NTPC Korba	Chhattisgarh	2,600	3x200 MW, 4x500 MW	All units functional
3	NTPC Ramagundam	Telangana	2,600	3x200 MW, 4x500 MW	All units functional
4	Farakka Super Thermal Power Station	West Bengal	2,100	3x200 MW, 3x500 MW	All units functional
5	NTPC Vindhyachal	Madhya Pradesh	4,260	6x210 MW, 6x500 MW	All units functional
6	Rihand Thermal Power Station	Uttar Pradesh	3,000	6x500 MW	All units functional

Sr. No.	Project	State	Capacity	Units	Status
7	Kahalgaon Super Thermal Power Station	Bihar	2,340	4x210 MW, 3x500 MW	All units functional
8	NTPC Dadri	Uttar Pradesh	1,820	4x210 MW, 2x490 MW	All units functional
9	NTPC TalcherKaniha	Orissa	3,000	6x500 MW	All units functional
10	Feroze Gandhi Unchahar Thermal Power Plant	Uttar Pradesh	1,050	5x210 MW	All units functional
11	Talcher Thermal Power Station	Orissa	460	4x60 MW, 2x110 MW	All units functional
12	Simhadri Super Thermal Power Plant	Andhra Pradesh	2000	4x500 MW	All units functional
13	Tanda Thermal Power Plant	Uttar Pradesh	440	4x110 MW	All units functional
14	Badarpur Thermal Power Station	Delhi	705	3x95 MW, 2x210 MW	All units functional
15	Sipat Thermal Power Plant	Chhattisgarh	2980	2x500 MW, 3x660 MW	All units functional
16	Mauda Super Thermal Power Station	Maharashtra	2320	2x500 +2x660MW	Two units functional [13]
17	Barh Super Thermal Power Station	Bihar	1980	3x660	(1x660 MW) Running, two more units of 660 MW under construction

Sr. No.	Project	State	Capacity	Units	Status
18	Kudgi Super Thermal Power Project	Karnataka	2400 MW	3x800 MW	Under construction. One unit is expected to be commissioned by 2015 December.[15]
19	NTPC Bongaigaon	Assam	750 MW	3x250 MW	Under construction. One unit is expected to be commissioned in 2014.[16]
20	LARA Super Thermal Power Project	Chhattisgarh	4000 MW	2x800+3x800(Stage-I +Stage-II) MW	Under construction. One unit is expected to be commissioned by 2015 December.
21	Solapur Super Thermal Power Station	Maharashtra	1320 MW	2x660(Unit-I + Unit-II) MW	Under construction.
22	Gadarwara Super Thermal Power Plant	Madhya Pradesh	3200 MW	4×800(Unit-1 + Unit-2 + Unit-3 + Unit4) MW	Under Construction

Coal Based (Owned through JVs)

Sr. No.	Name of the JV	Location	State	Inst.Capacity in Megawatt
1	NSPCL. Joint venture with SAIL.	Durgapur	West Bengal	120
2	NSPCL. Joint venture with SAIL.	Rourkela	Orissa	120
3	NSPCL. Joint venture with SAIL.	Bhilai	Chhattisgarh	574
4	Nabinagar Power Generating Co. Pvt. Ltd. NPGC.Joint venture with Bihar State Electricity Board.	Aurangabad	Bihar	1980
5	Muzaffarpur Thermal Power Station (MTPS). Joint venture with Bihar State Electricity Board.	Kanti	Bihar	110

Sr. No.	Name of the JV	Location	State	Inst.Capacity in Megawatt
6	Bhartiya Rail Bijlee Company Limited. Joint venture with Indian Railways.	Nabinagar	Bihar	1000
7	Aravali Power CPL JV with HPGCL & IPGCL	Jhajjar	Haryana	1500
8	NTECL JV with NTPC & TNEB	Chennai		1500
9	Meja Thermal Power Station JV with NTPC & UPRVUNL	Meja, Allahabad	Uttar Pradesh	1320
	Total			6904

Gas based

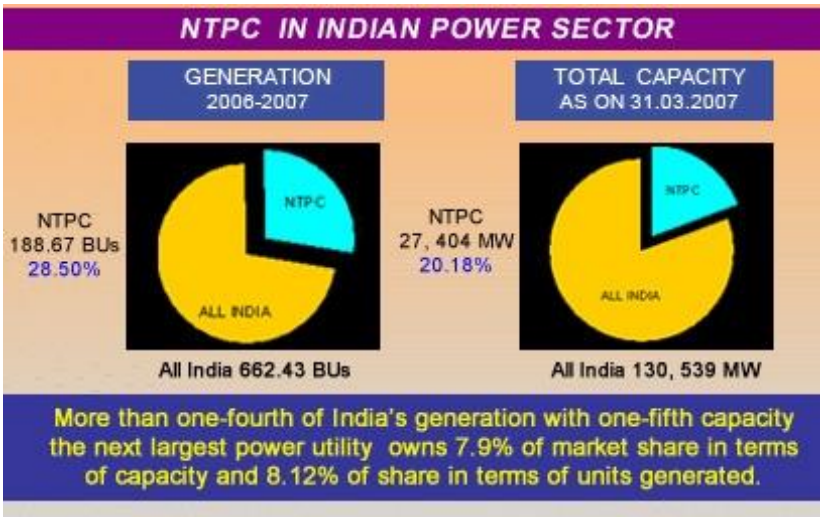
Sr. No	Project	State	Installed Capacity in Megawatt
1	NTPC Anta	Rajasthan – Baran	413
2	NTPC Auraiya	Uttar Pradesh	652
3	NTPC Kawas	Gujarat	656
4	NTPC Dadri	Uttar Pradesh	817
5	NTPC Jhanor	Gujarat	648
6	NTPC Kayamkulam	Kerala	350
7	NTPC Faridabad	Haryana	430
8	RGPPL (JV)	Maharashtra - Ratnagiri	1940

Sr. No	Project	State	Installed Capacity in Megawatt
Total			5895

Hydel

The company has also stepped up its hydroelectric power (hydel) projects implementation. Some of these projects are:

1. Loharinag Pala Hydro Power Project by NTPC Ltd: Loharinag Pala Hydro Power Project (600 MW i.e.150 MW x 4 Units) is located on river Bhagirathi (a tributary of the Ganges) in Uttarkashi district of Uttarakhand state. This is the first project downstream from the origin of the Ganges at Gangotri. Project was at advance stage of construction when it was discontinued by Government of India in August 2010.
2. TapovanVishnu gad 520MW Hydro Power Project by NTPC Ltd: In Joshimath town. The project is under construction.
3. LataTapovan 130MW Hydro Power Project by NTPC Ltd: is further upstream to Joshimath. This project is under environmental revision.
4. Koldam Dam Hydro Power Project 800 MW in Himachal Pradesh (130 km from Chandigarh)this project is under advanced stage of construction.
5. RupasiyabagarKhasiabara HPP, 261 MW in Pithoragarh, Uttarakhand State, near China Border. This project is yet to be given investment approval.



PROFILE OF RAMAGUNDAM SUPER THERMAL POWER STATION (RSTPS)

- Station →Ramagundam Super Thermal Power Station
- Installed capacity → 2600 MW
- Unit size → 7(3-stages)

<u>Stage – I : 3 x 200 MW</u>

Unit 1 – 27th Oct 1983

Unit 2 – 29th may 1984

Unit 3 – 13th de

Stage – II: 3 x 500 MW

Unit 4 – June 1988

Unit 5 − March 1989

Unit 6 – Oct 1989

Stage –III: 1 x 500 M

Unit 7 – Aug 2004

- Transmission system on → 2400 CKT km – 400 KV
- Source of coal → South Godavari coal field of Singareni collieries

➢ COOLING WATER:

a) Source of cooling water →Sri Ramsagar project, Godavari river
b) Method of cooling → Cooled cycle with Cooling towers
c) Cooling water requirements → 200 cusecs

➢ Beneficial States→Andhra Pradesh,Tamilnadu, Kerala, Karnataka, Goa, Pondicherry
➢ Approved investment → 1702.18 crore
➢ Coal consumption→ 13 million T/Yr
➢ Water consumption→250 cusecs per annum
➢ Coal transportation →Merry Go Round System of 22.4 Km

£ Total land →10,000 acres

Reservoir area →5000 acres

Man power requirement → 1600

Height of chimney →Stage I-- 225 mts

Stage II-- 250 mts

Stage III-- 275 mts

Daily production →62.5 Mu

GEOGRAPHY

- Plant area : 1200
- Ash dump : 1650
- Colony area employee township : 700
- Balancing reservoir power canal : 483
- MGR and railway sliding : 680
- Hearth in soil : 726
- Others : 455

DAM

Storage capacity	:	77*10^6m
Dead storage capacity	:	15*10^6m
Approx rain water added per year	:	2*10^6m

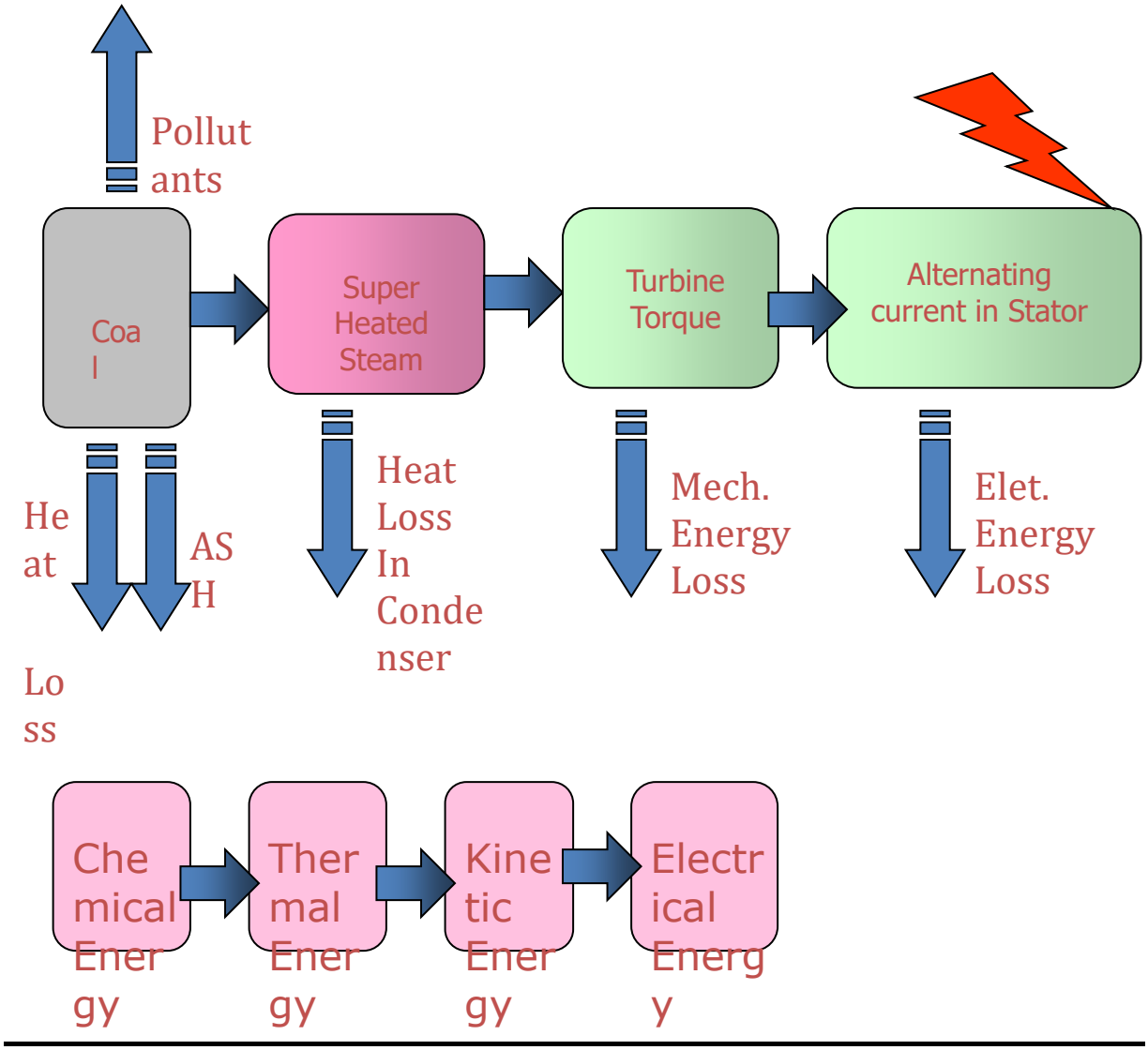
DISTRIBUSTION OF ELECTRICITY:- Total capacity of the RSTPS is 2600MW. NTPC is distributing electricity in MW to the following states

1. TELANGANA
2. ANDHRA PRADESH
3. TAMIL NADU
4. KARNATAKA
5. KERALA
6. MAHARASTRA

PRINCIPLE OF POWER GENERATION

A thermal power station is a power plant in which the prime mover is steam driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine, the steam is condensed in a condenser and recycled to where it was heated; this is known as a Rankine cycle. The greatest variation in the design of thermal power stations is due to the different fuel sources. Some prefer to use the term energy center because such facilities convert forms of heatenergy into electricity.[1] Some thermal power plants also deliver heat energy for industrial purposes, for district heating, or for desalination of water as well as delivering electrical power. A large part of human CO_2 emissions comes from fossil fueled thermal power plants; efforts to reduce these outputs are various and widespread.

POWER PRODUCTION PROCEDURE AT COAL BASED POWER PLANT



In the process of generation of power, following conversions take place before the chemicalenergy in the form of coal finally gets converted to electrical energy.

Coal - **Chemical energy**

Chemical energy - **Heat energy**

Heat Energy - **Mechanical energy**

Mechanical energy - **Electrical energy**

PRINCIPLE OF COMBUSTION

The main function of oil and coal burning system is to convert chemical energy into heat energy, which is utilized by the components of the boiler to convert water into the steam, which drives the turbine. The combustion element of fuel consists of carbon, hydrogen and small amount of sculpture. The exhaust gases released after combustion

contains CO2, SO2 and CO, etc. When the coal is burnt with oxygen following reaction takes place and large amount of heat is released.

$$C + O_2 \rightarrow CO_2$$

$$S + O_2 \rightarrow SO_2$$

$$C + O_2 \rightarrow 2CO$$

The average composition of air is

79% nitrogen and 21% oxygen by volume

77% nitrogen and 23% oxygen by weight.

- During combustion process nitrogen does not burn but passes through the chimney.
- The amount of air to burn is known as theoretical air. If this quantity is not sufficient for complete combustion process then extra amount of air is supplied, known as excess air.
- In combustion process, turbulence, time, temperature and combustion efficiency are the important parameters to be considered.
- The maximum combustion efficiency depends on
    1. Design of boiler
    2. Fuel used
    3. Skill in obtaining combustion within the minimum amount of excess air.

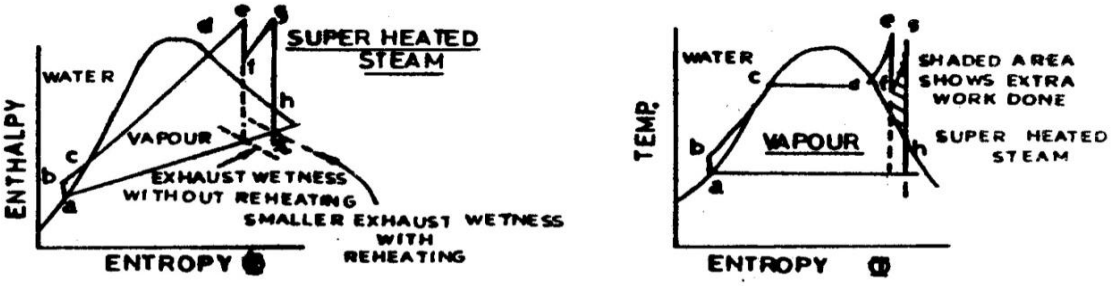
BOILER GENERAL DESCRIPTION

The type of steam generator is Babcock& Wilcox design, Natural circulation, Dry bottom, Front Fired, Balanced Draft, and Convective Reheat with direct fired

pulverized coal firing. The primary mode of RH temperature control is done by baffle bypass dampers arranged in convection path.

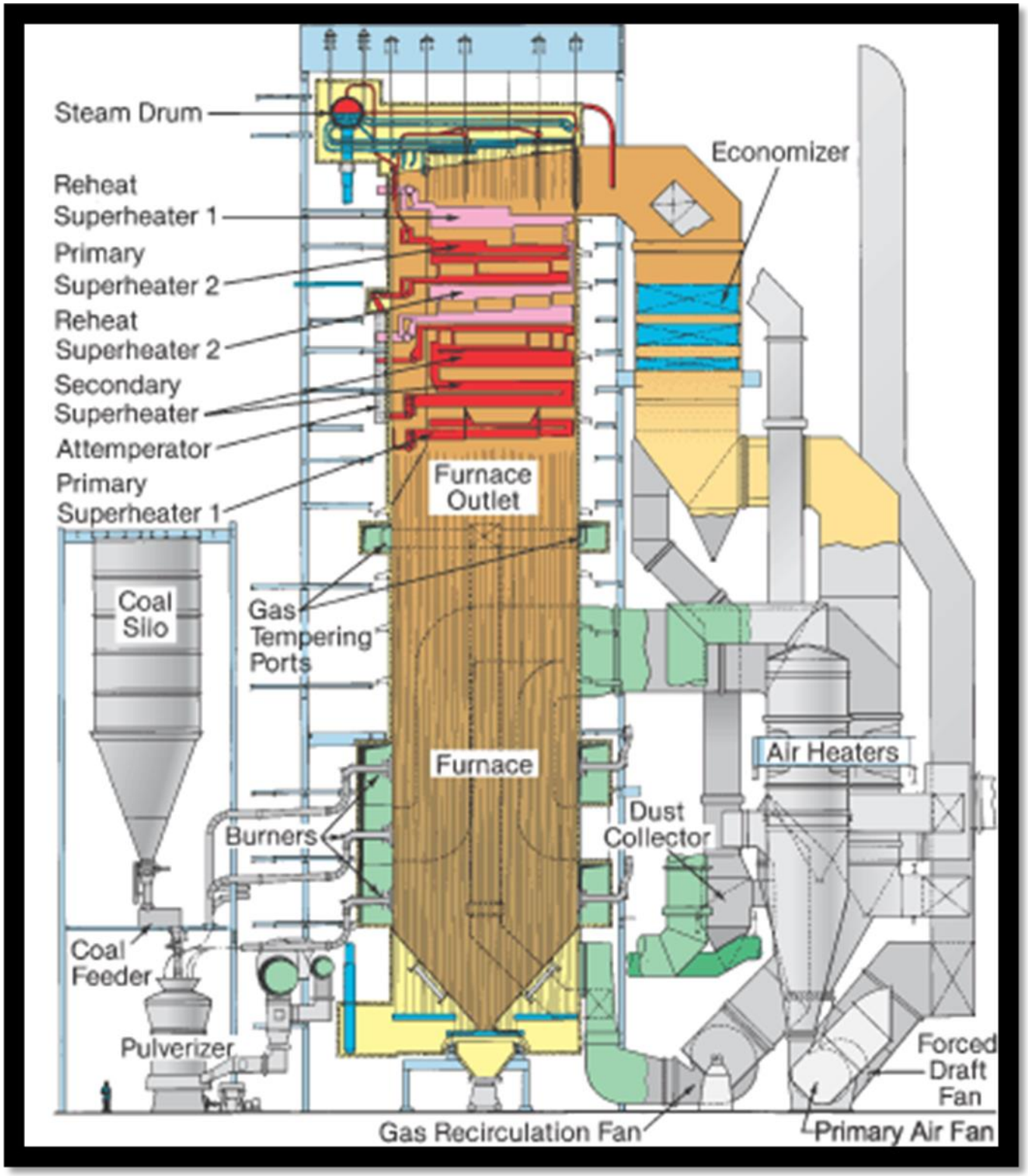
WATER AND STEAM CIRCUITS:

The water and steam circuits of the boiler consist of economizer, drum, and water walls, superheated and reheater. The water enters the boiler through the economizer and flow to drum. From there water flows down due to gravity through down comers and enters water walls through. Then water flows up through the water walls and picks up heat from furnace and converts into steam. The circulation of the water takes place due to difference in density between water and steam and this is termed as natural circulation. This mixture of the water and steam enters the drum. The steam and water are separated in the drum by the cyclone separators situated inside the drum. The separated water joins the water coming from economizer and cycle continues. The separated steam comes out of the drum through the driers as saturated steam and enters the super heater



bcde	-	HEATING AT CONSTANT PRESSURE
ef	-	IDEAL EXPANSION AT CONSTANT ENTROPY BEFORE REHEATING
fg	-	REHEATING AT CONSTANT PRESSURE
ghi	-	IDEAL EXPANSION AT CONSTANT ENTROPY AFTER REHEATING
id	-	EXTRACTION OF LATENT HEAT IN CONDENSER
db	-	IDEAL PRESSURE INCREASE AT CONSTANT ENTROPY IN FEED PUMP

Fig No.- 1-A Affect of Reheating



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The super heater is divided into three zones. They are primary, secondary and tertiary super heater.The primary super heater has two sections, one low temperature super heater (LTSH) and a platen coil. LTSH is located in the convective zone (second pass). The platen coil is located at the top of the furnace. The steam after passing through the LTSH enters the platen SH. The steam then enters the secondary SH.

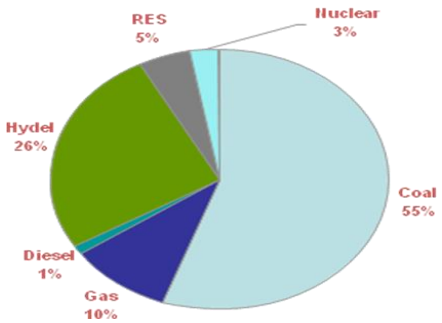
The secondary super heater is located at the top of the furnace. This is also a platen coil. The steam from SH2 enters the tertiary SH. This is located above the goose neck area of the furnace. The steam coming out of the SH3 is superheated steam and is called as the main steam and it goes to HP turbine.

The steam after expanding in HP turbine is brought back to the boiler for further heating in the reheater. There are two reheater coils, one is horizontal and other is vertical. These are located in the second pass and horizontal pass of boiler. The main steam temperature is controlled by spraying the water in two stages. First stage spraying is done in between platen SH 1 and platen SH 2 and second stage spraying is done between platen SH 2 and Final SH (pendant). The reheat steam temperature is controlled by regulating the SH & RH dampers and by spraying water in the steam before entering horizontal RH inlet.

COAL HANDLING PLANT:

Fuel (Coal) is fed from mines to the boiler through the fuel feeding plant commonly known as "Coal handling plant". Selection of proper methods of coal supply from the coal mines to the power station depends upon the system capacity in tones /hour; location of available outsides storage and overhead coal bunkers. The transfer of coal takes place by "Merry Go Round" system in which loading and unloading will take place within the 12 –20minutes. Coal is crushed to the size of 25 mm in crusher house before it is fed to bunkers of individual units. The coal from CHP is transferred to the bunkers through conveyor belts via turning points. The storage capacity of bunkers in terms of time is 14hrs.

The coal from the bunkers enters coal mills through the coal feeders by gravity action. The quantity of coal reaching the coal mill is controlled by feeders by altering the speed of DC motors as per the requirements of the unit.

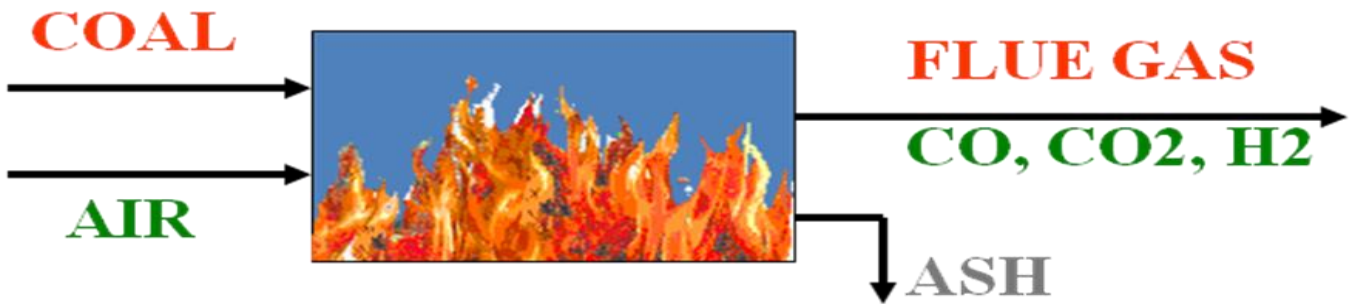


Advantages of Coal Fuel

- Abundantly available in India
- Low cost
- Technology for Power Generation well developed.
- Easy to handle, transport, store and use

Shortcomings of Coal

- Low Calorific Value
- Large quantity to be Handled
- Produces pollutants, ash
- Disposal of ash is Problematic
- India's Coal Reserves are estimated to be 206 billion tonnes. Present consumption is about 450 million tonnes.
- Cost of coal for producing 1 unit of electricity (Cost of coal Rs 1000/MT)is Rs 0.75.
- Cost of Gas for producing 1 unit of electricity (Cost of Gas Rs 6/SMC)is Rs 1.20.
- Constituents of coal (%)
  - Carbon 36.54
  - Volatile matter 21.6
  - Moisture 10
  - Ash 32
  - Sulphur 0.38



BOILER:

Boiler is a sealed vessel in which water is converted into steam

The amount of steam that can be generated depends on

- the rate of combustion
- the efficiency of heat transfer

Boilerorthesteamgeneratoristhemainpartinthepowergenerationprocess.

Boileractsasamediuminwhichwaterisconveyedintosteambyusingtheheat releasedintheprocessofcombustions ofcoalinthepresenceofoxygen.

A **water tube boiler** is a type of boiler in which water circulates in tubes heated externally by the fire. Fuel is burned inside the furnace, creating hot gas which heats water in the steam-generating tubes. In smaller boilers, additional generating tubes are separate in the furnace, while larger utility boilers rely on the water-filled tubes that make up the walls of the furnace to generate steam.

The heated water then rises into the steam drum. Here, saturated steam is drawn off the top of the drum. In some services, the steam will reenter the furnace through a superheater to become superheated. Superheated steam is defined as steam that is heated above the boiling point at a given pressure. Superheated steam is a dry gas and therefore used to drive turbines, since water droplets can severely damage turbine blades.

Cool water at the bottom of the steam drum returns to the feedwater drum via large-bore 'downcomer tubes', where it pre-heats the feedwater supply. (In 'large utility boilers', the feedwater is supplied to the steam drum and the downcomers supply water to the bottom of the waterwalls). To increase economy of the boiler, exhaust gases are

also used to pre-heat the air blown into the furnace and warm the feedwater supply. Such water tube boilers in thermal power station are also called *steam generating units*.

FURNACE:

Thefurnacetakescoalfromcoalmill,oilfromoilgunsandairfromFD fansrespectivelyfortheprocessofcombustion.Thefurnacehasfourwalls.The windboxwhichallowsairin tothefurnace,coalinlets,oilgunsareallarrangedat thefourofthewallsofthefurnace.Thereareigniters,whichareatthecorners igniteheoilandairmixturebyproducingahighvoltagespark.Thefirefromthe four corners is made tangential to the fire ball.

The furnace is formed by the 4 walls of the water wall cooled combustion chamber. Secondary and tertiary Superheaters are suspended above the furnace.

SPECIFICATIONS

Furnacewallheight:39.4 mts

Furnace width	:	17.13 mts
Furnace volume	:	4352 cubic mts

BOILER ACCESSORIES:

BOILER DRUM

It isthemainpartoftheboiler,inwhichsteamandwater separates. Insidetheboilerdrum,saturatedsteamisseparatedfromwaterand thendirectedintosuperheatingtubesforfurthertemperatureincrease.Water separatedfromsteamwillcombinewiththeincomingboilerfeedwaterandthen re-enterthedowncomerstorepeatthecycle.Thustheboilerdrumactsasasteam separator.

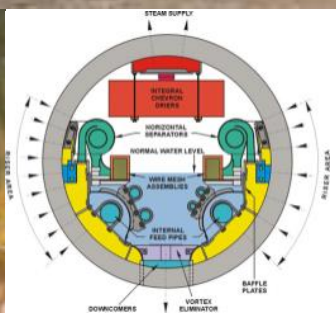
Boiler drum in 200MW unit is situated at 46.4 MT elevation of boiler and is suspended from the structural steelwork ceiling by means of two tie rods formed at the end of the drum

Boiler drum is provided with welded stubs for connection of valves, various instruments, down comers, return tubes, steam outlet tubes to primary super heaters, feed water tubes and for the inlet of reagents and continuous drainage. The drum

contains the diaphragms, cyclones, scrubbers, steam separators, drilled tubes for feed water distribution, steam and water sampling, system and the continuous blow down system

- It is an enclosed Pressure Vessel
- Heat generated by Combustion of Fuel is transferred to water to become steam
- Process: Evaporation

Steam volume increases to 1,600 times from water and produces tremendous force



Drum serves two main functions

- Separating steam from the mixture of water and steam.
- It houses all equipments used for purification of the steam after being separated from water.

Boiler Drum

SPECIFICATIONS 500MW

- Material : CARBON STEEL
- Length : 22070 MM
- OD : 2130 MM
- ID : 1778 MM
- Design pressure : 204 KSC
- Weight(INT) : 246 TONNES
- cyclone separators : 96

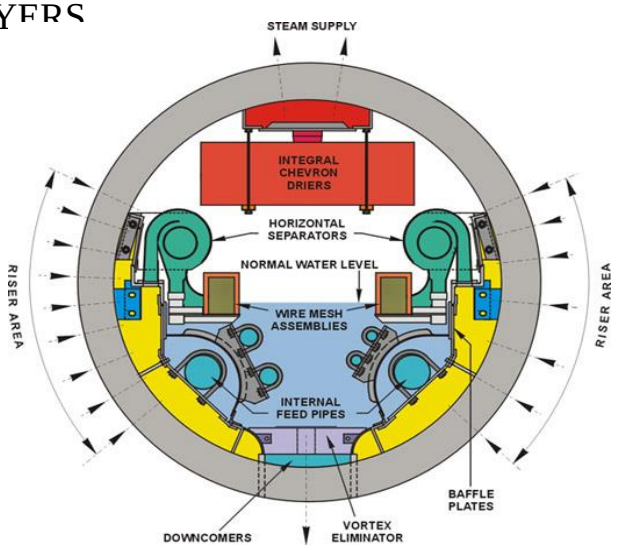
200MW

- Designed Pressure : 182 Ksc
- Designed temperature : 356^0C
- Length : 21344 MM.
- Cyclone separators : 96

- ❖ Thickness : 110 MM.
- ❖ Material : AM6O

.**DRUM INTERNALS**

- ➢ PRIMARY SEPERATORS – Consists of baffle arrangement devices which change the direction of flow of steam and water mixture
- ➢ SECONDARY SEPERATORS- Separators employing spinning action
- ➢ SCREENING DRYERS



DOWNCOMERS

- ➢ There are six down comers in (500 MW) which carry water from boiler drum to the ring header.
- ➢ They are installed from outside the furnace to keep density difference for natural circulation of water & steam.

WATER WALLS:

Water Walls are the water carrying tubes which get converted to steam by absorbing heat. Almostallmodernpowerboilersare equippedwithwaterwalls.Inlarge boilerswaterwallscompletelycoverthe interiorsurfacesof thefurnace.Water wallsservesastheonlymeansofheatingandevaporatingthefeedwatersupplied totheboilerfromthe economizer.Waterwallsusuallyconsistoftangential verticaltubesandareconnectedatthe topandbottomtoheaders.Thesetubes receivewaterfromtheboilerdrumbymeansofdowncomersconnectedbetween drum and

water walls lower headers. In a boiler the water walls absorbed approximate50%ofheatreleasedbythecombustionofthefuelinthefurnace. Heatsoabsorbedbythewaterwallsusedintheevaporationofwatersuppliedto boiler.Themixtureofsteamandwaterisdischargedfromthetopofwaterwall tubesintotheupperwallheaderandthenpassesthroughrisertubestothesteam drum.Herethesteamisseparatedandtheaccompanyingwatertogetherwiththe incoming feed water is returned to the water walls through the down comers.

It is used to completely cover interior surface of the furnace providing practically complete elimination of refractory surface.Its function is to heat and evaporate the feed water supplied to the boiler from economizer.

SPECIFICATIONS:-

Heating Surface : 1642 sq.mts

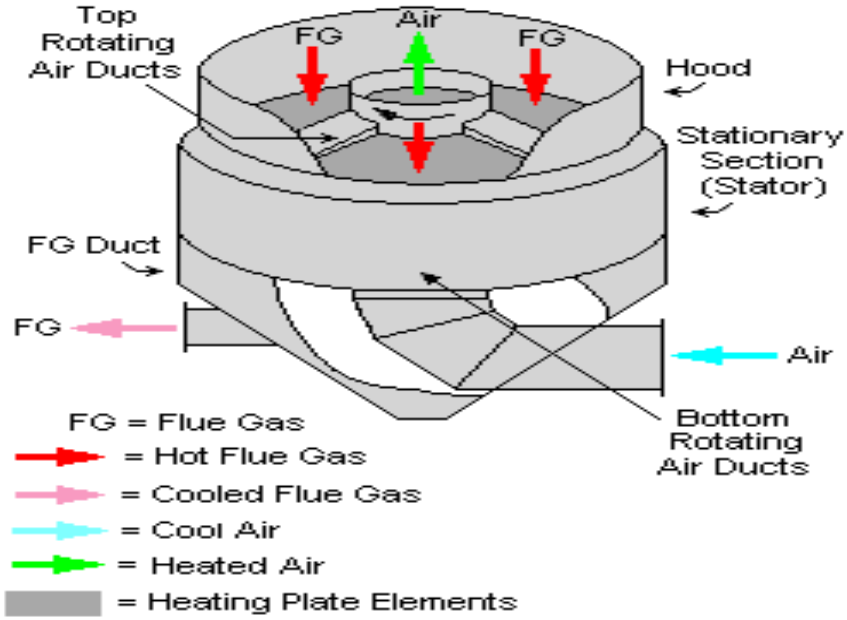
Material : A 106.B

Outerdiameter:51mm

Pitch : 63.5mm

Designedthickness:7.1mm

AIR PREHEATER (Tubular Type):



Typical Stationary Plate Air Preheater

• Waste heat recovery device in which the air to on its way to the furnace is heated utilizing the heat of exhaust gases

• The function of air pre-heater is to increase the temperature of air before enters the furnace.

• It is generally placed after the economizer; so the flue gases passes through the economizer and then to the air preheater.

• An air-preheater consists of plates or tubes with hot gases on one side and air on the other.

• It preheats the to be supplied to the furnace. Preheated air accelerates the combustion and facilitates the burning of coal.

Degree of Preheating depends on:

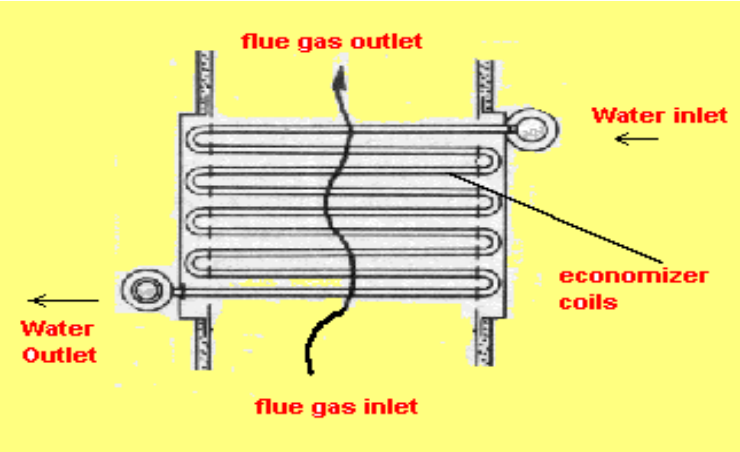
(i) Type of fuel, (ii) Type of fuel burning equipment, and (iii) Rating at which the boiler and furnaces are operated.

There are three types of air preheaters:

1. Tubular type
2. Plate type
3. Storage type.

ECONOMISER:

Boiler Economiseris feed-water heaters in which the heat from waste gases is recovered to raise the temperature of feed-water supplied to the boiler.



Thefunctionoftheeconomizeristopreheattheboilerfeedwaterflow beforeitisintroduceintothesteamdrumbyrecoveringsomeoftheheatofflue gas leaving the boiler. The economizer is located in the boiler back pass.

Thefeedwaterafterheatedgoesintotheboilerdrum.Theeconomizer isusedforimprovingtheefficiencyoftheboileranditistheoneoftheimportant for the accessories for the boiler.

- The economizer preheats the feed water by utilizing the residual heat of the flue gas.
- It reduces the exhaust gas temperature and saves the fuel.
- Modern power plants use steel-tube-type economizers.
- Design Configuration: divided into several sections : 0.6 – 0.8 m gap

ADVANTAGES OF ECONOMISER

- 22^0 C reduction in flue gas temperature increases boiler efficiency by 1%
- 6^oC raise in feed water temperature, by economizers corresponds to a 1% saving in fuel consumption

SPECIFICATIONS:-

Type : none steaming

OD of tubes (MM) : 51

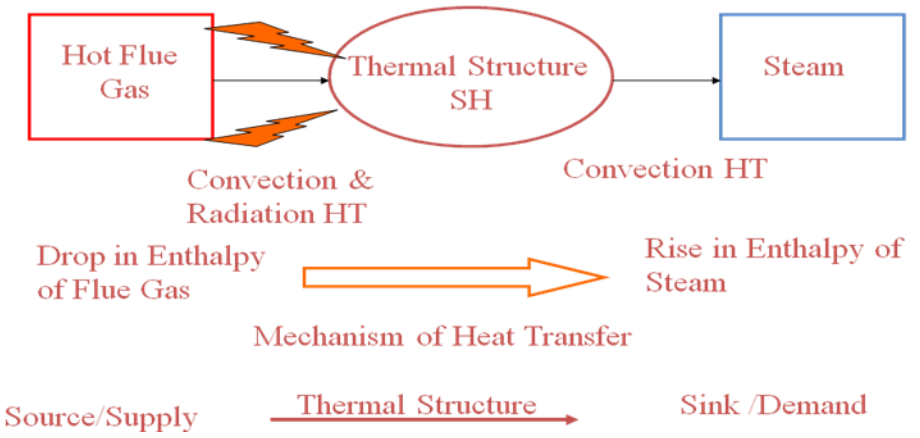
Watersideeffectiveheatingsurfacearea :9425

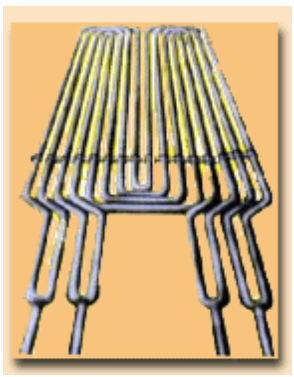
Gas side effective heating area : 12833

SUPER HEATER

A super heater is a device which heats steam to high temperatures .A super heater consists of group of tubes made of special alloys such as chromium -molybdenum derivatives. These tubes are heated by heat of flue gases during their journey from the furnace to chimney .The steam produced in the boiler is led to the super heater where it is heated to super temperatures by the heat of flue gases

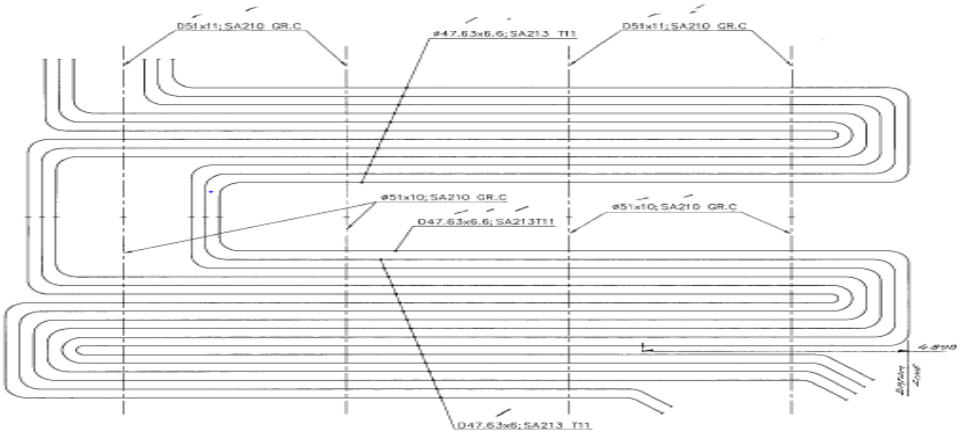
Thewetsteamfromtheboilerdrumentersintothesuper heaterandgets heateduptoatemperatureof535^{0}cenandpressureof170kg/sqcmbygaining heatfromthefluegasesleavingthefurnace. Thesteamenteringthesuper heater andthenthesecondarysuperheatedtothetertiarysuper heater.Thusthesteamis superheatedinthreestages.Thesuperheatedsteamleavesthroughthesuper heater outlet header to the highpressure turbine.**TRANSFER OF ENERGY**





SUPER HEATER TEMPERATURE CONTROL:

- Basically the temperature control is to protect the super heater by preventing the metal temperatures reaching a dangerously high level reducing mechanical strength and leading to failure. Water flowing through a tube conducts heat away much more effectively than steam due to its higher specific heat capacity. This means that tubes carrying water have a metal temperature much closer to the fluid passing through it.
- Superheat temperature control is therefore fitted to ensure superheat
- temperature does not exceed design limits.



	STAGE I	STAGE II	STAGE III
No of tubes	708	444	456
OD (mm)	51	51	54
Joining	Butt	Butt	Butt
Max steam temp	366(H) 467(P)	488	558
Max gas temp	482(H) 512(P)	548	628
Max operating pressure	188.2	188.2	188.2
Design pressure	204	204	204
Weight Kgs	223000	223000	223000

RE-HEATER:

The function of re-heateristoincreasethetemperatureofthesteam leavingtheHPTagainto540degCand the pressure up tothe42kg/cm^2.

There-heatersteamtemperatureisachievedbygainingtheheatfromthe wastefluegasleavingtheboiler.Thefluegasflowissplitintotwoparts respectivelyforheatingthesuper heaterandthere-heater.Thesteamthengoesto theintermediatepressure turbine(IPT).Thisisthepartoftheboiler,which receivessteambackfromtheturbineafterithasgivenupsomeoftheheatenergy atthehighpressuresectionintheturbine.

	STAGE I	STAGE II
Max operating pressure	46.7	45.8
Design pressure	56.2	56.2
Max steam side mts	397	566
Max gas side mts	460	612
OD(mm)	60.3	54.0
No of tubes	248+254	644+92
Joining	Butt	Butt
Weight Kgs	117800	117800

BURNERS:

200 MW boiler is a front fired boiler having 24 burner assemblies i.e. 6 burner assemblies at 4 different elevations. The burner front is the vital part of the Boiler where the Fuel firing system is installed.

Each burner assembly consists of one coal inlet pipe with impeller arrangement, one oil gun assembly (steam/air hose connection and HFO/LFO oil hose connection), one *igniter* oil assembly, one steam purge valve assembly and one set of air register assembly. The HFO control station, LFO control station and atomizing steam control stations are installed on the burner floor.Also one set of burner valve assembly,

changeover valves assembly and igniter valve assembly is installed separately near the burner assembly. In addition to the above the burner assembly is provided with IR/UV flame monitoring devices and view glasses.

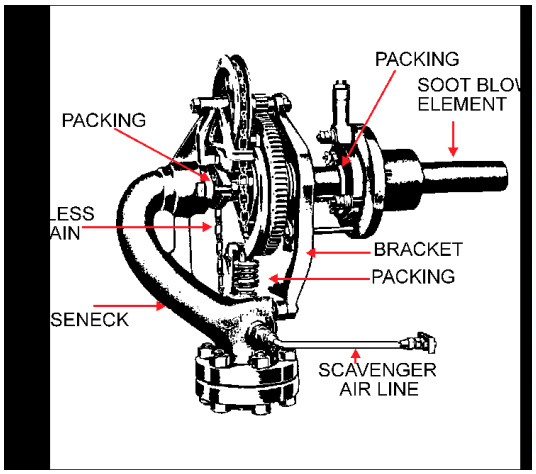
- Arranged in four corners.
- 32 Coal Burners & 16 Oil Burners
- Coal nozzles can be tilted to +20 to -20 deg.
- Burners can be tilted to+30 TO -30 deg.

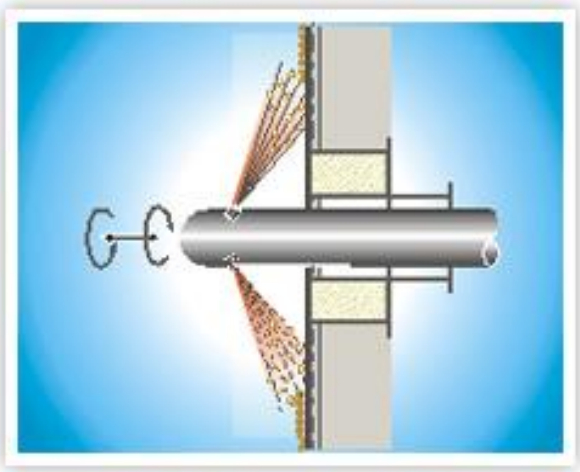
SOOT BLOWER:

A Soot blower is a system for removing the soot that is deposited on the furnace tubes of a boiler during combustion.

Types of soot blower:

1. Wall Blower.
2. Long Retractable Soot Blower (LRSB)
3. Air Heater Blower.





Steam Blowing Medium: 1. Steam 2. Air

Steam is normally used as a medium for blowing away the soot since capital cost of steam pressure reducing equipment and drain is less than the cost of compressor, motors and controls of air system.

PROBLEMS CAUSED BY SOOT BLOWERS:

1) Reduced efficiency Soot deposited on the heating surfaces of a boiler acts as a heat insulator. The result is that less heat is transferred to the water to raise steam and more heat is wasted up the chimney. This leads to higher fuel consumption and/or poor steaming.

2) Soot fires

A soot fire can be damaging to a boiler because it can cause localized hotspots to occur in the tubes. These hotspots may reach temperatures that weaken the materials of the tubes. Soot blowers reduce the risk of soot fires and their resulting damage.

3) Operation

A sootblower may be operated manually or by a remotely controlled motor. The soot, which is removed from the heating surfaces, will be blown out with the flue gases. If the boiler is equipped with a dust collector, it will trap the soot. Otherwise, the soot will be ejected into the outside air through the chimney stack.

METHODS OF FUEL FIRING:

There are many ways of firing the coal in furnace. They are:

a) Front firing

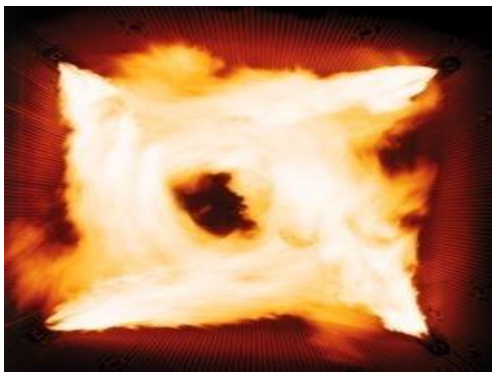
b) Corner or tangential Firing.

FRONT FIRING:

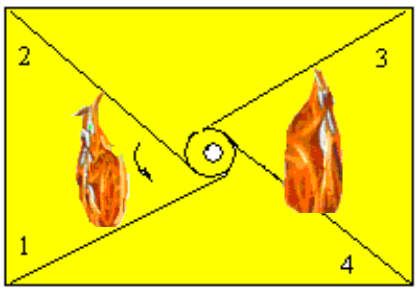
Horizontal firing with the turbulent type of burner is set up usually in the front or rear walls of the furnace. This burner consists of an inner cone for primary air and fuel which is given a rotary motion as it passes through the burner. This mixes with a stream of rotating secondary air before burning.

CORNER OR TANGENTIAL FIRING:

In this system, burners are set at each corner of the furnace and are directed to strike the outside of an imaginary circle in the centre of the furnace. Because the streams of fuel so strike each other, extremely good mixing is obtained since the body of the flame produced is given a rotary motion it leads to a longer flame travel and gases spread put and fill the combustion chamber.



FURNACE PLAN



ASH HANDLING SYSTEM:

After combustion of mixture of pulverized coal and fuel oil gives large quantity of ash. To deal with ash, ash-handling system is employed in NTPC. Ash is collected in large quantity from furnace bottom ash hopper at a rate of 11000 kg/hr. The ash so produced forms in to large sized particles, which are needed to be crushed. For this reason grinders were employed which grinds the large size particles in to powder after which water is added to it to form slurry. This slurry is either dumped into ash pond. Safely with the help of ash slurry pumps at a rate of 80 m3/hr. Horizontal centrifugal single

stage with non clog impeller as the ash contains cement characteristics, it can be used in bricks manufacturing, refractory bricks and other construction material. Sometimes it is also used as raw material for cement manufacturing.

ELECTOSTATIC PRECIPITATOR:

The Electro static precipitating system or the ESPS consist of alternative plates and windings, which carry positive charges respectively. The positive plates are grounded. The potential that exists across the windings is in range of 40 to 50 kV. Due to this potential, very low density ash in the flue gas gets separated and deposited on the windings. This deposit on windings is either hammered or scrapped, which causes the deposit as falls into hoppers. The ash is then mixed with water to from ash slurry for disposal.

Continuous Circulating Pump

Each circulating pump consists of single stage centrifugal pump on a wet stator induction motor mounted within a common pressure vessel which consists of three main parts: pump casing, motor housing and motor covers

VALVES

A valve is a mechanical device that controls the flow of fluid (gases, liquids, fluidized solids, or slurries) and pressure within a system or process. A valve controls system or process fluid flow and pressure by performing any of the following functions:

- Stopping and starting fluid flow
- Varying (throttling) the amount of fluid flow
- Controlling the direction of fluid flow
- Regulating downstream system or process pressure
- Relieving component or piping over pressure

There are many valve designs and types that satisfy one or more of the functions identified above. A multitude of valve types and designs safely accommodate a wide variety of industrial applications.

Proper working of valves ensures better availability of unit, safety of the plant, equipment, processes and men.

BASIC PARTS OF VALVES

Valve body

The body(shell), the first pressure boundary of a valve, resists fluid pressure loads from connecting piping. It receives inlet and outlet piping through threaded, bolted, or welded joints. It serves as the principle element of a valve assembly because it is the framework that holds everything together.

The material selected for the valve body depends upon the chemical properties of the fluid and also on the temperature and pressure in the system.

Normally carbon steel materials are used for valves of operating temperature up to 424^{o}C and for valves operating at higher temperatures up to 550^{0}C, low alloy steel with chromium and molybdenum are used. Other materials being used for casting of valve body are cast iron, stainless steel, Bronze etc. Normally cast iron material is used for low pressure line valves operating up to a temperature of 150^{0}C.

Valve Bonnet

The cover for the opening in the valve body is the *bonnet*. In some designs, the body

itself is split into two sections that bolt together. Like valve bodies, bonnets vary in design. Some bonnets function simply as valve covers, while others support valve internals and accessories such as the stem, disc and actuator.

The bonnet is the second principal pressure boundary of a valve. It is cast or forged of the same material as the body and is connected to the body by a threaded, bolted, or welded joint.

Valve Trim

The internal elements of a valve controlling the flow and in physical contact with the line fluid are referred to as a valve's *trim*. The trim typically includes a *disc, seat, stem,* and *sleeves* needed to guide the stem. Because of the trim, basic motions and flow control are possible.

A valve's performance is determined by the disc and seat interface and the relation of the disc position to the seat.

Valve Actuator

The *actuator* operates the stem and disc assembly. An actuator may be a manually operated hand wheel, manual lever, motor operator, solenoid operator, pneumatic operator, or hydraulic ram. In some designs, the actuator is supported by the bonnet. In other designs, a yoke mounted to the bonnet supports the actuator

Valve Packing

Most valves use some form of packing to prevent leakage from the space between the stem and the bonnet. *Packing* is commonly a fibrous material (such as flax) or another compound (such as teflon) that forms a seal between the internal parts of a valve and the outside where the stem extends through the body.

Valve packing must be properly compressed to prevent fluid loss and damage to the valve's stem. If a valve's packing is too loose, the valve will leak, which is a safety hazard. If the packing is too tight, it will impair the movement and possibly damage the stem.

VALVES TYPES

Each type of valve has been designed to meet specific needs. Some valves are capable of throttling flow, other valve types can only stop flow, others work well in corrosive systems, and others handle high pressure fluids. All valves have the same basic components and function to control flow in some fashion, the method of controlling the flow can vary dramatically. In general, there are four methods of controlling flow through a valve.

- Move a disc, or plug into or against an orifice (for example, globe or needle type valve).
- Slide a flat, cylindrical, or spherical surface across an orifice (for example, gate and plug valves).
- Rotate a disc or ellipse about a shaft extending across the diameter of an orifice (for example, a butterfly or ball valve).
- Move a flexible material into the flow passage (for example, diaphragm and pinch valves).

Valves have different functions to perform and can be classified according to their functions as:

Isolating Valves

An isolating valve is one which is normally fully open or fully closed. It must stop flow of fluid completely when required. Examples of isolating valves are Gate Valve, Plug Valve, and Ball Valve.

Regulating valves

A regulating valve controls the rate of flow of fluid, according to requirement. It may be operated in any position from fully open to fully close. Examples of some of the regulating valves are Globe Valves, Angle Valves etc.

Non-return Valves

It permits flow of fluid in one direction only and automatically shuts off if a reversal of fluid flow occurs. The direction of the flow of fluid through the valve is indicated by an arrow on the valve body. Examples of Non-return valves are Swing check non-return valve, lift check non-return valve.

Safety Valves

This valve is designed to open when a predetermined and set pressure has been reached in the system this type of valve is used for safety of the plant. Example of safety valves are Sprint loaded safety valve, Torsion bar type safety valve.

Control Valves

The control valve is a fine control element most commonly used in industrial control systems. It is the function of that fine control element and of the Power unit that operation is to follow the commands given to it by the control circuit.

Self Acting Valve

A self acting valve functions without any external agency. It may be used as a regulating or a regulating and isolating valve. Examples of self acting valves are Ball float valve, steam traps etc.

Valve Function And Types Of Valves To Be Used

Sl. No.	Function	Type of valve to be used
1.	On/Off Service	Gate Valve, Slide Valve, Plug Valve, Ball Valve.
2.	Throttling Service	Globe Valve, Needle Valve, Butterfly Valve, Diaphragm Valve, Pinch Valve.
3.	Prevention of Back Flow	Check Valve, Foot Valve.
4.	Pressure Control	Safety Valve, Back Pressure Regulating Valve, Piston Valve.
5.	Other Controls	Flow Regulating Valve, Solenoid Valve.
6.	Special Purpose	Piston Valve, Bottom Flush Valve, Jacketted Valve, Divrting Valve Etc.

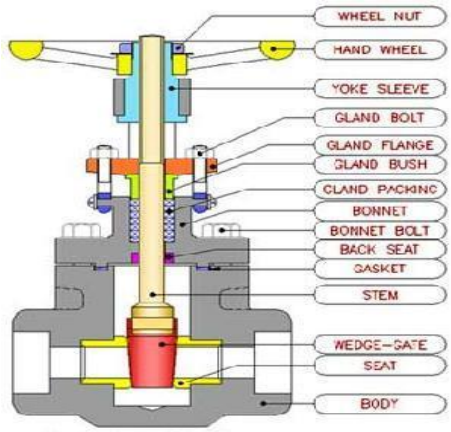
MAJOR TYPES OF VALVES USED AT RSTPS

GATE VALVE

A gate valve is a linear motion valve used to start or stop fluid flow; however, it does not regulate or throttle flow. The name gate is derived from the appearance of the disc in the flow stream.

The disc of a gate valve is completely removed from the flow stream when the valve is fully open. This characteristic offers virtually no resistance to flow when the valve is open. Hence, there is little pressure drop across an open gate valve.

When the valve is fully closed, a disc-to-seal ring contact surface exists for 360^0, and good sealing is provided. With the proper mating of a disc to the seal ring, very little or no leakage occurs across the disc when the gate valve is closed.



Forged Steel Gate Valve

A gate valve can be used for a wide variety of fluids and provides a tight seal when closed. The major disadvantages to the use of a gate valve are:

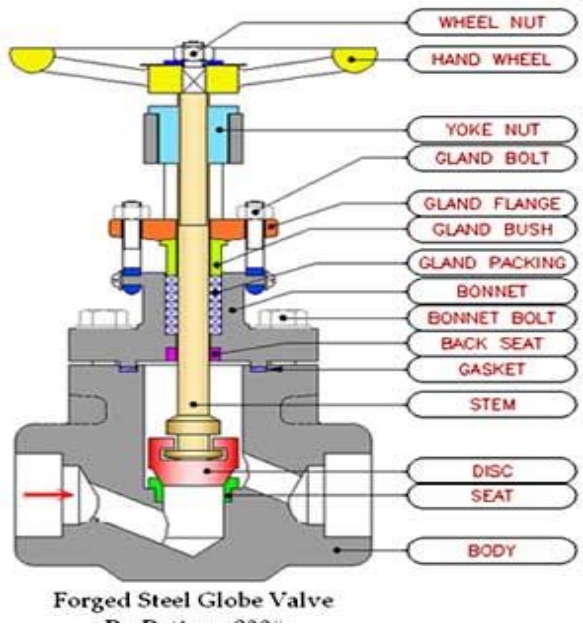
- It is not suitable for throttling applications.
- It is prone to vibration in the partially open state.
- It is more subject to seat and disc wear than a globe valve.
- Repairs, such as lapping and grinding, are generally more difficult to accomplish.

GLOBE VALVES

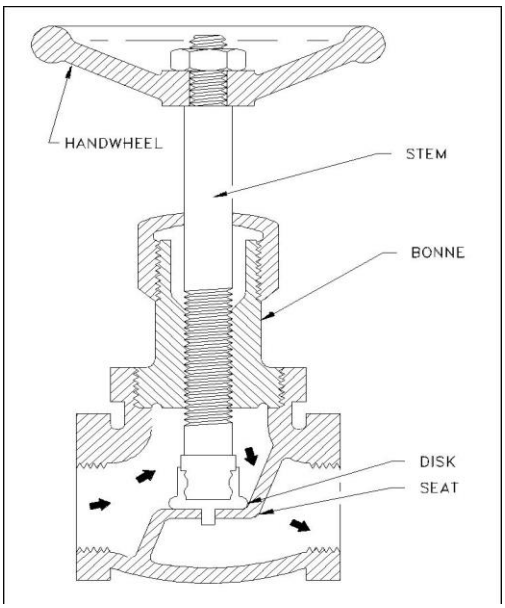
A globe valve is a linear motion valve used to stop, start, and regulate fluid flow. the globe valve disc can be totally removed from the flow path or it can completely close the flow path. The essential principle of globe valve operation is the perpendicular movement of the disc away from the seat. This causes the annular space between the disc and seat ring to gradually close as the valve is closed. This characteristic gives the globe valve good throttling ability, which permits its use in regulating flow. Therefore, the globe valve may be used for both stopping and starting fluid flow and for regulating flow.

When compared to a gate valve, a globe valve generally yields much less seat leakage. This is because the disc-to-seat ring contact is more at right angles, which permits the force of closing to tightly seat the disc.

Globe valves can be arranged so that the disc closes against or in the same direction of fluid flow. When the disc closes against the direction of flow, the kinetic energy of the fluid impedes closing but aids opening of the valve. When the disc closes in the same direction of flow, the kinetic energy of the fluid aids closing but impedes opening. This characteristic is preferable to other designs when quick-acting stop valves are necessary.



Forged Steel Globe Valve



The most evident shortcoming of the simple globe valve is the high head loss from two or more right angle turns of flowing fluid. Obstructions and discontinuities in the flow

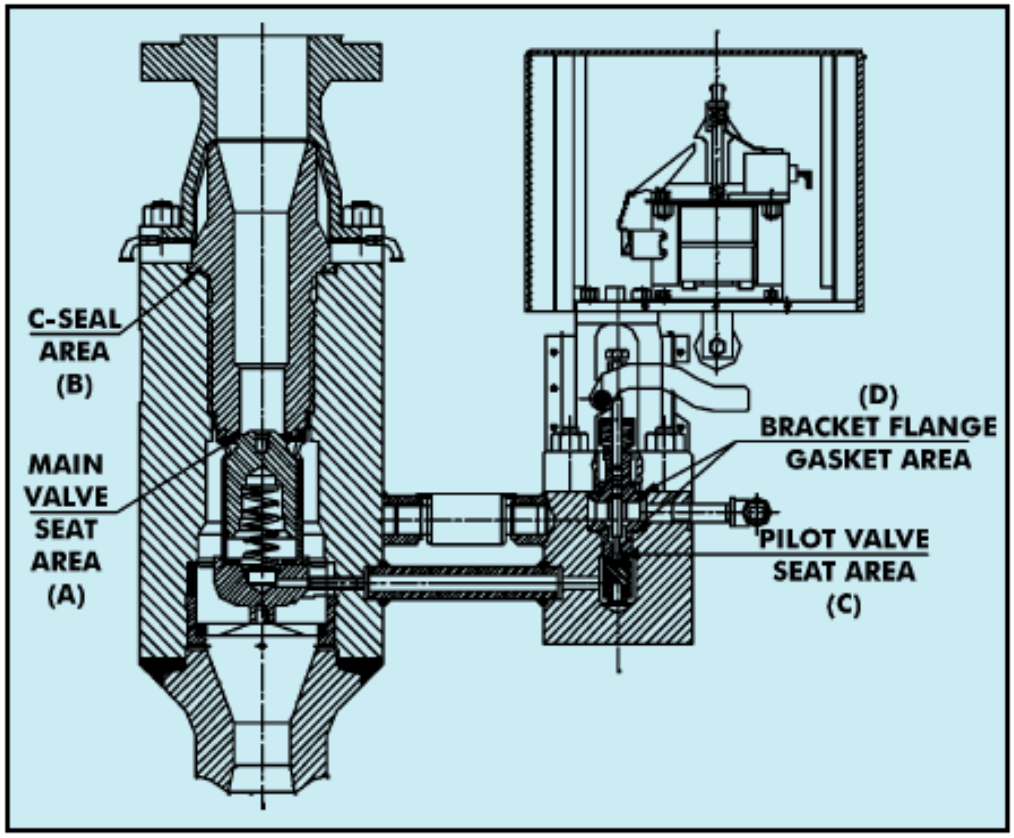
path lead to head loss. In a large high pressure line, the fluid dynamic effects from pulsations, impacts, and pressure drops can damage trim, stem packing, and actuators. In addition, large valve sizes require considerable power to operate and are especially noisy in high pressure applications. Other drawbacks of globe valves are the large openings necessary for disc assembly, heavier weight than other valves of the same flow rating, and the cantilevered mounting of the disc to the stem.

ELECTROMATIC RELIEF VALVE

The electrometric relief valve is an electrically actuated pressure relief device. It may be operated at will by closing a switch or may be set up in conjunction with a pressure sensitive element to relieve pressure automatically and accurately within every closed limit.

The ERV may be used to purge a super heater or a header, thereby decreasing the possibility of damaging safety valve seat or turbine equipment. With the pressure element set to open ERV automatically at pressure slightly below the lowest set spring loaded safety valve, it will effectively prevent the safety valves from lifting except on major over-pressures.

The ERV is ordinarily installed on a manifold, to facilitate servicing. A shut-off valve should be installed directly below the main valve.



MS ERV WITH PILOT VALVE

FUNCTIONING OF A ERV

Functioning of the Electrical System

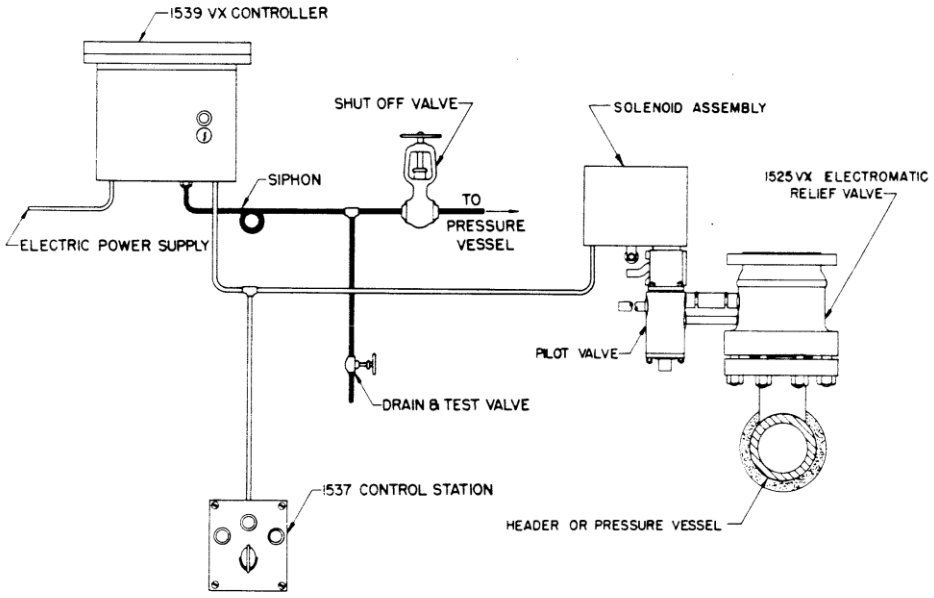
The ERV is actuated by the pressure in any vessel to which it is connected. The construction of the controller is such that it will make and break electrical contact with a difference in pressure. Within controller is the control pressure switch which consists of a high pressure and low pressure switches. The control pressure switch provides relay control below the actuation valve of the high pressure switch, thereby allowing the adjustable blow down range for the electrometric valve. The action of Bourdon Tube type pressure sensing regulation.

When the pressure in the drum reaches the predetermined point at which the valve is set to open and contact is made in the controller. The relay closes, almost instantly solenoid s energized, the valve opens. When the pressure within the vessel drops, the valve closes automatically.

Functioning of Valve

Steam under pressure from the heat transfer unit enters the main valve through the inlet chamber and passes around the disc guide. The steam enters through the clearance space between main valve disc. The main valve is held in the closed position by the steam pressure. A pilot valve disc prevents the escape of the steam. The pilot valve disc is held in closed position by the pilot valve spring and by the steam pressure. It is opened by the operating lever under the action of solenoid plunger head.

When the pilot valve is opened, steam is released through a port at a faster rate than through the clearance space between the main valve disc guides. The resultant unbalance of pressure produces a force which moves the main valve disc from its seat permitting steam to escape to the outlet.



CONSOLIDATED ELECTROMATIC RELIEF VALVE SYSTEM

MOTORISED VALVES

A motorized valve is an electrical device which controls the hot fluid flow in a plant. It is turned on by a motor. They can be found inside the water pipes. Motorized valves direct water from the boiler to the water cylinder and/or radiators.

A motorized valve is powered by a motor which energizes the valve. It also contains a spring which pulls it back when it is de-energized. It contains up to three wires; a grey wire, a white wire and an orange wire. The white wire is energized by the temperature

and time controls. The grey wire is energized by external controls and the orange wire has a dual method of being energized.

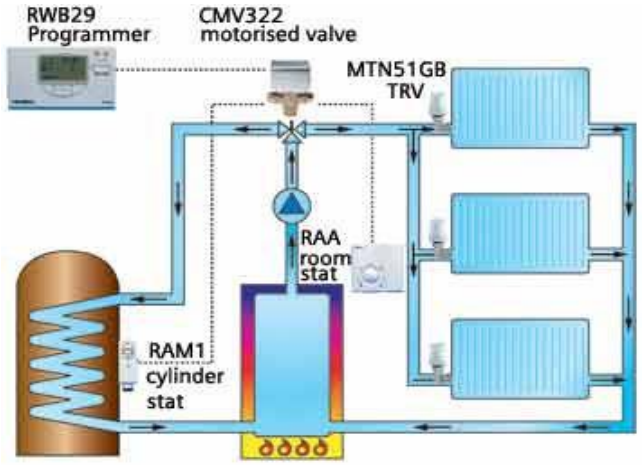
Features:

- Low power consumption
- Choice of compact drives
- Valve remains on last setting if power lost
- Will handle dirty fluids
- Throttle setting produced by wear-resistant control discs.

When energized, drive motors rotate the valve spindle to open or close appropriate valve ports. There are two basic modes of operation: -

a)Power Open/Power Close– Shoe type. Rotate in one direction. Switched by thermostats with changeover output contacts to ensure power is available to close them when heat demands become satisfied. Less popular due to their additional wiring.

b)Spring Open/Spring Close– When powered, the motor drives the swivel paddle or shoe until it is held against either an appropriately positioned mechanical a stop or the opposite outlet port. When de-energised (thermostat satisfied) powerful spring returns the mechanism to its original position.



Each type of valve, depending on its size, construction and the maximum differential pressure at which it should operate, has a finite maximum throughput. Its coefficient of flow (Kv) indicates the volume of water that valve will pass with a pressure drop across it of 1 bar. Shoe valves in general provide a slightly higher throughput than paddle valves.

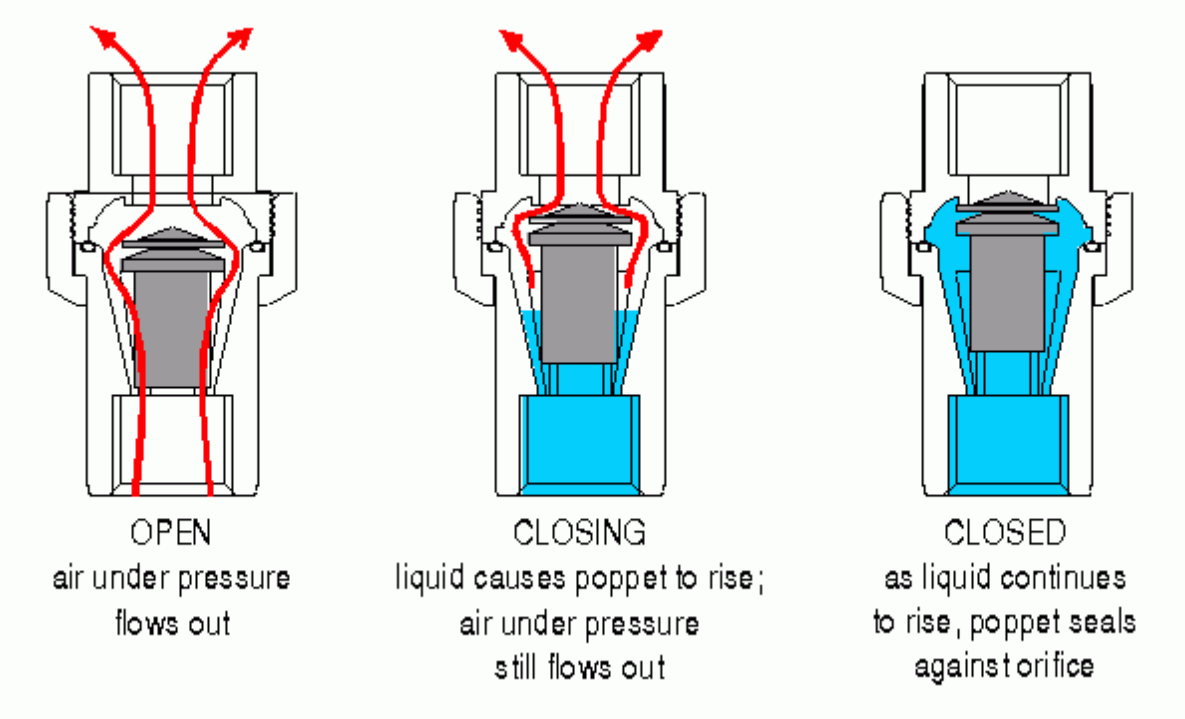
Motorised valves, often installed in the airing cupboard, require a reasonable surrounding air space to allow heat from pipe work and motor to dissipate. Any mounting position is acceptable except with the actuator directly beneath the valve.

PNEUMATIC VALVES

A valve is a mechanism to either control the flow of a gas or a mechanism operated by compressed air to control the flow of some other fluid is a pneumatic valve.Pneumatic valve are an array of components responsible for controlling the pressure, rate, and amount of air as it moves through a pneumatic system. Pneumatic systems, which depend on the force of compressed air to transmit power.

FEATURES:

- Wide range of functions
- Modular construction
- Good quality and design



TYPES

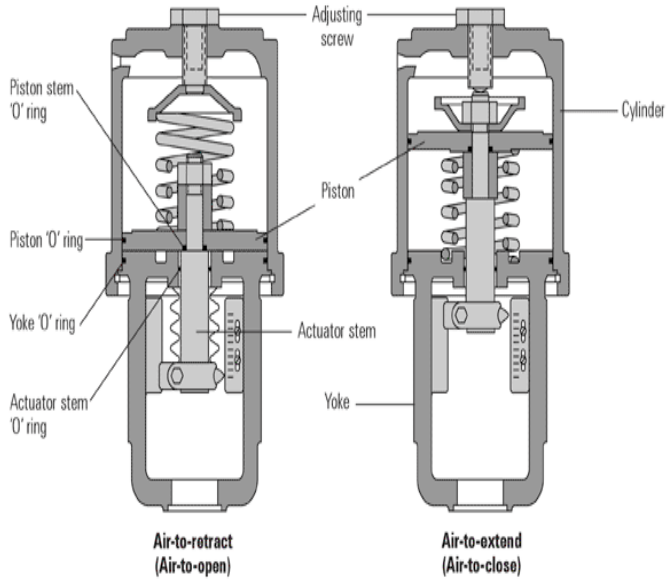
Based on other components within a given application and the type of pneumatic system used, one of several types of pneumatic valves may be found at the heart of the device.Many functional directional pneumatic control valves are classified based on the number of entry and exit ports they possess, the number of flow paths they create, and the mechanism by which ports are opened and closed.

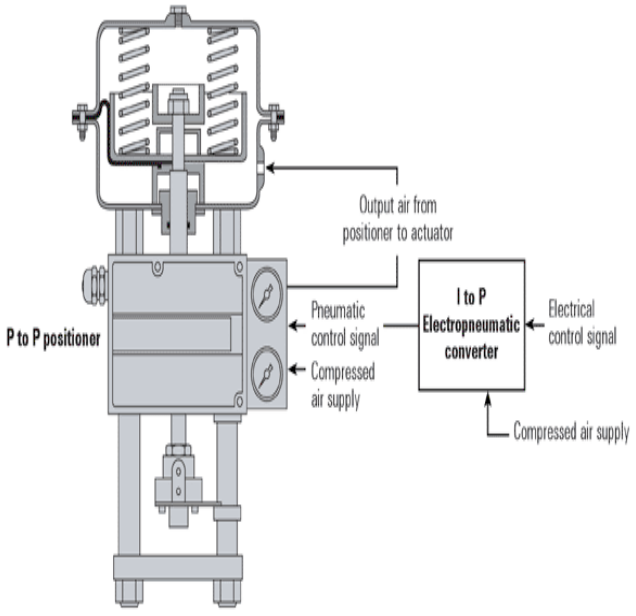
- **Two-Way Directional Valve**: A two-way directional valve passes air in two directions, through two ports which can be open or closed. If the valve ports are closed no air can flow through the valve. If the ports are open, air may move from the first port through the valve and through the second port or in the opposite direction.

- **Three-Way Directional Valve**: A three-way directional valve has three ports, each of which serves a different purpose. The first port is used to connect the valve to an actuator or another device. The second port is connected to an air-flow. The third port is used as an exhaust exit. When the first and second ports are open and the third is closed, air moves through the valve to the device. When the first and third ports are open and the second port is closed, the actuator can vent exhaust. Three-

way valves are often connected to actuators in cylinders, or used in pairs and connected to double-acting cylinders.

- **Spring Offset**: This type of pneumatic valve classification refers to the manner in which air-flow direction is switched. For example, in a two-way directional valve, the valve is either open (air-flow is enabled) or closed (air-flow is prevented). In order for each port to assume an open or close position, an actuator moves a valve spool into position. To release the valve spool and return the pneumatic valve to its previous position, a spring releases the spool. A two-way directional valve that functions in this manner is also called a spring offset valve.





SAFETY VALVES

There are three main types of safetyvalves :

- Spring loaded safety valves
- Torsion Bar safety valves
- Pilot operated safety valves

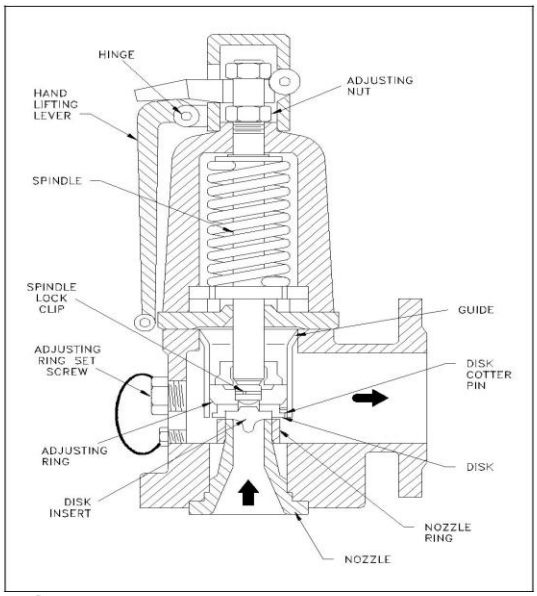
Spring loaded safety valves are commonly used in the all power plants.

Spring Loaded Safety Valve

This valve is designed to give a positive lift when the set pressure is reached and so the valve does not simmer(position of valve is just about opening). If the valve is in this position forlong time, the passage of the steam across the seat has a cutting effect which will cause a scar and thus the valve will pass steam continuously.

The positive lift is achieved by the design of the valve disc. As the valve commences to raise, the area exposed to the steam pressure is greatly increased, it is the full area of the valve face. This causes the valve to lift further so forcing the valve seat upwards inside the valve guide. The steam is now deflected downwards by the lower edge of the valve guide and the reaction on the valve seat, resulting from the deflection, lifts the valve to its fully open position.

As the steam pressure falls the reaction decreases and the and moves down under the influence of its spring. When the valve facing emerges from the guide, the reaction pressure disappears and the valve closes smoothly. The set pressure of the valve can be increased or decreased by the compression screw with which alters the spring force. Blow down (pressure which is the difference of set pressure and the pressure at which the valve closes or reseats) of the valve can be adjusted by moving the upper adjusting ring upwards or downwards



VALVE MAINTENANCE

Safety

While taking up any maintenance job the related safety aspects should always be kept in mind and never be ignored. Following are steps must be observed:

- Obtain a 'permit to work' from competent authority permit must specify the valve to be taken up for maintenance; inform the steps to be taken for isolating the valve from the system.
- Ensure that the valve is isolated from the both sides.
- Drain the pipeline before working and be sure of the nature of the fluid being carried through the pipe. If the line handless liquid of corrosive nature use required personnel protective equipment; if it contains flammable gas arrange for puring by inert gas and keep fire fighting equipment ready nearby.
- Allow the valve to cool down sufficiently.
- Clean the surrounding area, make proper access to the working place. Take care of other hot lines, if any, around the valve.
- Choose right tools. Consult manufactures instruction for special tools, if required.
- Keep valve on proper support.
- Allow only authorized persons in the work area.

MAINTENANCE

Good maintenance includes periodic inspection of valves, proper lubrication of all moving parts, attending small leaks immediately before they develop into big ones necessitating plant shut down for maintenance. Small leaks through glands or flanges may often be stopped by tightening the packing nut of flange bolt repectively.
Maintenance is of two types.

Preventive Maintenance
Breakdown maintenance

PREVENTIVE MAINTENANCE

Preventive maintenance is regularly checking the working parts and taking necessary precautions for its healthy functioning before any failure erupts.
Preventive Maintenance Jobs.

- Wall blowers
- Long retractable soot blowers
- Pump (boosters)
- Air Preheater
- Oil Guns
- Heavy Fuel Oil(HFO) Pumps
- Dozing Pumps

These parts are regularly monitored and are lubricated once a week with special type of oil called SMSP 460 (Servo Machine Servo Prime). Pumps are lubricated with grease and dosing pumps with SMSP.

BREAKDOWN MAINTENANCE

Break down maintenance is performed when the parts are completely damaged or which cannot be rectified by preventive maintenance which leads to the shutdown of total unit. Remedy of breakdown maintenance is the replacement of the damaged part.

The main areas need to be looked into are:

- Joints and Flange
- Maintenance of waterwalls
- Operational difficulties(boiler, drum,deareator tank)
- Tubes(steam,water)

TROUBLESHOOTING OF VALVES

1.	Seat passing	a)overtightening of gland bolts. b) Insufficientlubrication forstem and yoke bush ball bearing etc. c) Damage to body and disc/wedge seats. d)Incorrect operation.	➢ Slightly relieve the gland pressure by loosening the gland nuts. ➢ Lubricate stem, yoke bush and ball bearing according to the lubrication chart. ➢ Machine, gring and lap depending on the extent of damage. ➢ A stop valve or gate valve if used for dropping pressure(throttling) will lead to erosion of seats.

2.	Leakage through body bonnet joint	a) Insufficient bolt tightening. b) Damaged gasket. c) Damage to the sealing surfaces of body and yoke/bonnet. d)Incorrect gasket.	➢ Tighten uniformly and in stages all the nuts. In the case of pressure seal bonnet tighten the castle nut slightly after pressurization. ➢ Replace with new gasket. ➢ Rectify by maintaining parallelism. ➢ Ensure that right type gasket with correct material and dimensions are procured from the recommended suppliers and used.
3.	Leakage through gland packing	a)Insufficient gland pressure. b)Insufficient packing rings. c)Pitting of stem or ridges or grooves in stem surfaces. d)Damaged packing rings. e)Incorrect packing	➢ Tighten the gland bolts. ➢ Fill the stuffing box with sufficient number of packing rings. Too many rings would join the spindle and make the operation difficult. ➢ Replace the stem if the damage is more. ➢ Replace all picking rings. ➢ Ensure that the correct type of gasket, with correct material and dimensions procured from suppliers are only used.
4.	Operational difficulty	a)Insufficient lubrication. b)Over tightening of gland packing. c)Wrong connection of terminals in actuator.	➢ Provide proper lubrication to stem threads, and bearing as per the lubrication chart. ➢ Tighten gland nut only to arrest leakage through gland. ➢ Follow the circuit diagram of the respective actuator. ➢ Replace with new components. ➢ Ensure that the correct type of packing ring with correct material and

		d)Damage to trapezoidal thread in stem/yoke bush. e)Incorrect packing. f)Damage to ball bearing. g)stem bending. h)excessive closing force.	dimensions procured from recommended suppliers are only used. ➢ Replace with new bearing. ➢ Replace with new stem. ➢ Ensure that the valves are not overtightened in the case of motor operated valves. The closing torque should not be set beyond the required setting.
5.	Actuator not operating	a)Wrong connection. b)Motion not transmitted from motor to output shaft damaged gear train. c)Jamming of brake mechanism. d)Limit switches damaged.	➢ Follow appropriate circuit diagram. ➢ Replace the actuator. ➢ Service if possible or replace the actuator. ➢ Replace the limit switches.
6.	Motor trips while opening jammed wedge gate valves.	Excessive opening torque	By-pass opening torque switch for 5% of the travel of stem in the opening direction

ROTATING MACHINES

INTRODUCTION

In order to function boiler successfully many devices are required. Apart from the pressure parts,there are machines which involves rotational mechanism and these are termed as rotating machinery.

Devices which come under rotating machinery are:

- Bunkers
- Feeders
- Sealed air fans
- Wind box
- Coal mills
- Primary air fan(PA fan)
- Induced drought fan(ID fan)
- Forced drought(FD fan)
- Air preheater

Coal Bunkers

These are in process storage silos used for storing crushed coal from coal handling system.

Generally these are made up of welded steel plates. These are located on the top of mills so as to aid in gravity feeding of coal.

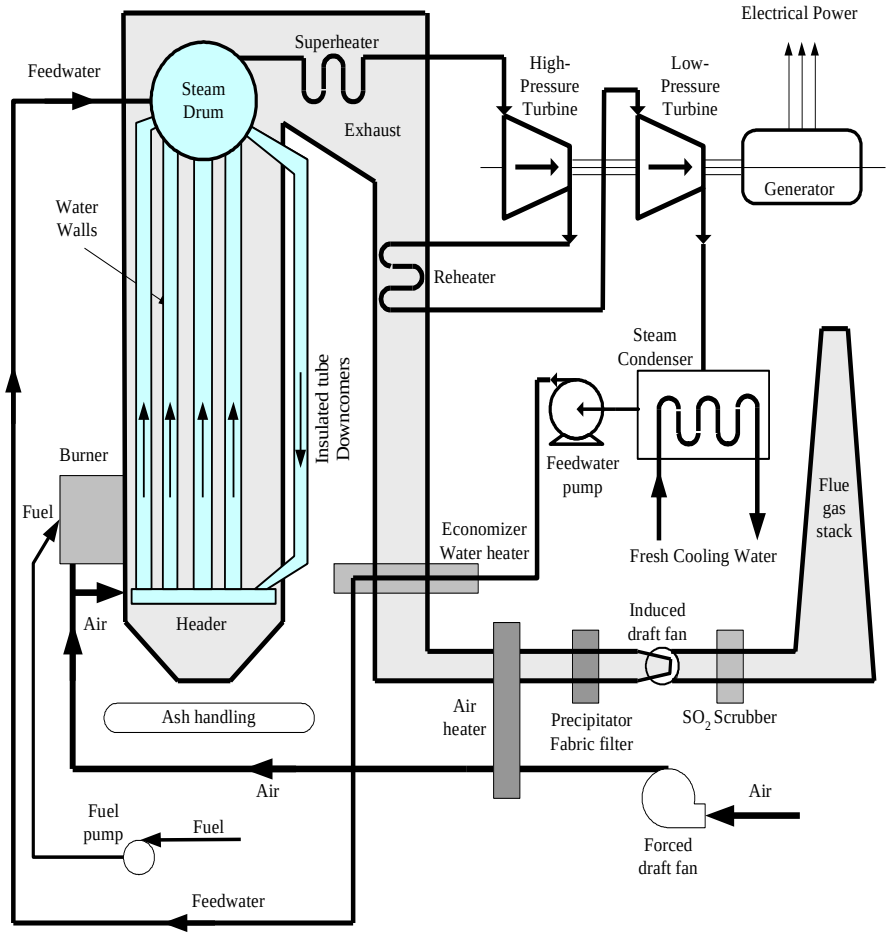
FEEDER:

In most of the power stations the types of feeders used for transporting coal from RC bunker to the mills are

a. Volumetric feeders

1. Chain feeders
2. Belt feeders
3. Table type rotary feeders

Fig 1.06 Flow diagram of a



b. <u>Gravimetric type feeders</u>

In chain type of feeders a continuous chain is moving round the sprockets in which a sprocket is driven by a variable speed DC motor and the other sprocket is a ret un sprocket. On this chain, at different intervals, MS plates are connected which are called as scrapers. This type of chain feeders is called scraper feeders. The coal from the RC bunker falls on a platform, which is below the scraper feeder. When the scraper moves it will scrap the coal and at the end of the table of platform the falls into the pulverizer. The actual fuel bed thickness carried by the scrapers will be more. To restrict this height regulating plate is provided so that height of fuel scraped so that height of fuel scraped by the scraper can be controlled. Refer figure for RC feeder.

Gravimetric coal feeders:

It is used for feeding the coal from the bunker to pulveriser as per requirement. At the time of operation plate injects coal flow and saves conveyer belt from direct in feed impact. Plate can be taken out at the time of pluggage of any other problem and heavy part can be replaced. Front portion of in feed is always slotted in angle so that it could open when coal reaches at well. This in feed opens all by itself during rotation and there is no chance of its getting jammed. Coal is dropped on bolt at an angle to an in feed dresser linker with the coupling.

Technical data of feeder

Capacity of feeder is 18.5 tons per hour

SEAL AIR FAN (SAF)

As to prevent the damage of sleeve bearings of coal mill from pulverized coal, we use seal air fans which blows air to a pressure more than the pressure of coal in a coal mill. Thus, sealing is done by seal air fan. Another fuel used in thermal power is oil. Oil is sent to the furnace through the pump from tank. The burning of fuel and oil requires air, which is called secondary air.

Wind box

These act as distributing media for supplying secondary/excess air to the furnace for combustion. These are generally located on the left and right sides of the furnace while facing the chimney.

What is mean by BOILER DRAUGHT?

The combustion process in the furnance can take place only when it receives steady flow of air and the combustion gases are constantly removed. This is achieved by the boiler draught system. The rate of fuel burning is also depends on the air flowing through the grate. Therefore, a pressure difference between the furnace and the surrounding should exist so that combustion air will flow into the furnace and the product of the combustion(hot gasses) will flow out of the furnace through the chimney. This pressure difference causing the air flow is called draught.

TERMS RELATED TO BOILER DRAUGHT:

DRAUGHT-It is the difference between absolute gas pressure at any point in a gas flow passage and the ambient atmospheric pressure.

Draught is positive if atmospheric pressure is less than gas pressure and negative if atmospheric pressure greater than gas pressure.

Draught differential- It is the pressure difference between two points in the gas flow path.

Draught loss- Pressure loss caused by friction between two points in the gas flow path is known as draught loss.

FUNCTIONS OF DRAUGHT:

Functions of draught are to

- Provide an adequate supply of air for complete combustion of fuel
- Move the hot gases through the system.
- Exhaust the gases to atmosphere through the chimney.

CLASSIFICATION OF DRAUGHTS:

According to the principle or method employed, boiler draughts may be classified as two types.

- Natural draught
- Artificial draught

Natural draught:

It is generally produced by chimney. It is also known as chimney draught. A chimney creates a draught by a simple principle that at high temperature the density of gas is lower. Under this condition it may displaced by a more dense gas.

Natural draught is cheaper and simple to operate. But it has following limitations.

- Draught created depends on chimney height
- Excess height of chimney will make the cost high
- Sufficient draught cannot be produced;only suitable for small boilers
- Weather conditions will affect draught

Artificial draught:

Artificial draught is produced by fans or steam jet. It is also called as mechanical draught.

It is further classified as three types:

- Forced draught
- Induced draught

- Balanced draught

Mechanical draught is produced by fans and blowers. Steam jet can also be used to produce mechanical draught.

The artificial draught as the following advantages:

- Does not depend on climatic conditions
- Draught can be easily controlled
- Higher rate of combustion
- Inferior quality of fuel can be used

But it is costlier and complex to maintain

Forced draught fan is used to create forced draught in the furnace.

Induced draught fan is used to create vaccum in the furnace.

Forced draught fan:

It is located before the furnace i.e., near or at the base of the boiler. It discharge air under pressure into the furnace. There are two FD fans per furnace. The force draught fans rotate at 980 rpm and are of axial reaction type, which supply the necessary secondary air to the wind boxes i.e. the FD fans suck air from the atmosphere, pressurize it and this pressurized air is heated in the secondary air pre-heater (SAPH) and then sent to the furnace. The source of heating in SAPH is the hot steam from low pressure turbine.

Technical data of forced draught fan

Type of induced fan is radial flow centrifugal fan

Number of induced fan used in stage-1 is 2

Volume flow rate is 96.5NM3/sec

Suction pressure 675mmwc

Fan efficiency 78.7%

Starting Torque 245kg M

Direction of rotation is clock wise

Size of motor is 1400vw

Fan Rotated with 740rpm

Type of coupling is claw

Power consumed 1400kw

The inlet gas temperature is about atmospheric temperature.

Induced draught fan:

Induced draught fan or ID fan is located near the base of the chimney i.e.,after the furnace. It induces the vaccum in the furnace causing air to flow into the furnace. There are two ID fans per boiler. The induced draught fans, radial and double suction type extracts ash less than flue gases from the electrostatic precipitator (ESP) through furnace and sends them to the atmosphere through the chimney.

Technical data of induced fan

Type of induced fan is radial flow centrifugal fan

Number of induced fan used in stage-1 is 2

Volume flow rate is 107.5NM3/sec

Suction pressure 375mmwc

Fan efficiency 78.5%

Starting Torque 210kg M

Direction of rotation is counter clock wise

Size of motor is 1200vw

Fan Rotated with 720rpm

Type of coupling is claw

Power consumed 1200kw

The inlet gas temperature is about 145ºC.

The outlet gas temperature is about 154ºC.

The capacity of the fan is 533.8 cubic meters per second.

Balanced draught:

This is the combination of forced and induced draught. In this case furnace pressure will be nearly equal to atmospheric pressure. It used two fans.FD fan is located before the furnace and used to supply the air for combustion. IDfan is located after the furnace removes the gases from the furnace. Balanced draught is adopted in power plants.

STEAM JET DRAUGHT:

In steam jet draught the exhaust steam is used for production drought. The forced drought is produced by placing the steam jet below the furnace grate. The air will be forced into the furnace by the steam jet.

In case of induced drought the steam jet is placed below the chimney. It charges the surrounding air or gas creating vacuum above the furnace which causes the air to flow into the furnace.

PRIMARY AIR FANS (PA FANS)

The main function of primary air fan is to lift the pulverized coal from mills to furnace. Inlet of PA fan is discharge air from FD fan via air preheater these is done because to increase efficiency.

Technical data of primary air fan:

Manufacture MARELLI.

Type of primary air fan is Radial flow centrifugal

Shaft speed 1480rpm

No of fans 6

Design capacity 12.9NM3/sec

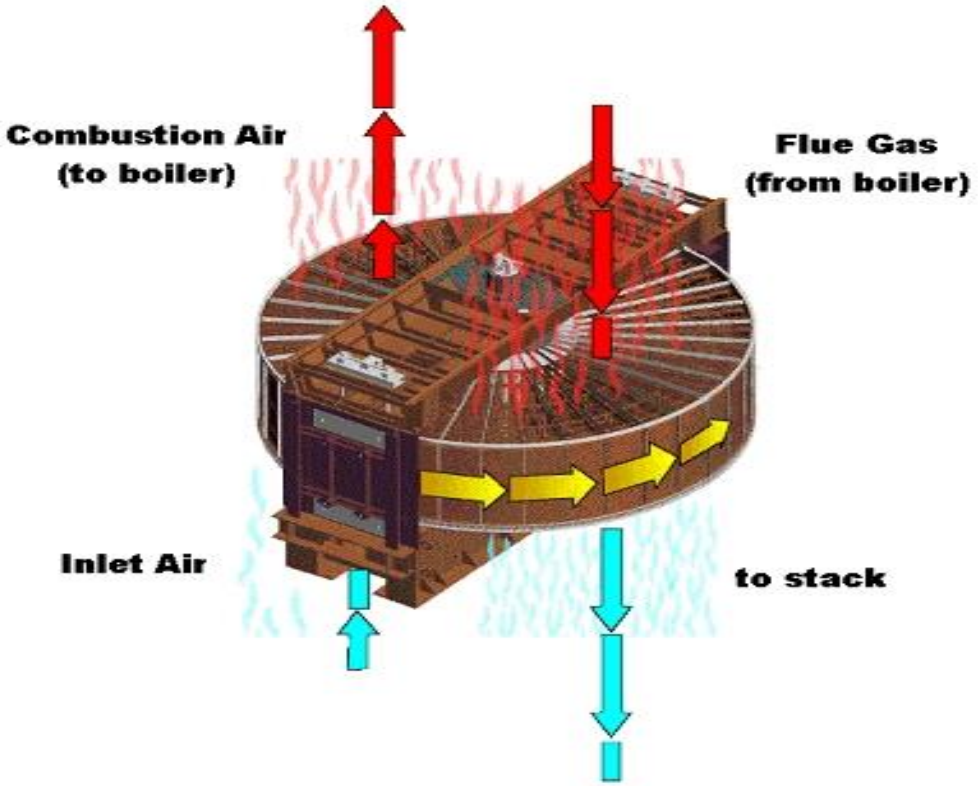
Volume flow rate 10.3NM3/sec

Total pressure 1130mmwc

Temp outlet of PA fan is 46ºC

Fan efficiency 80%

Source of air supply: hot air duct downstream of air heater and FD discharge cold air

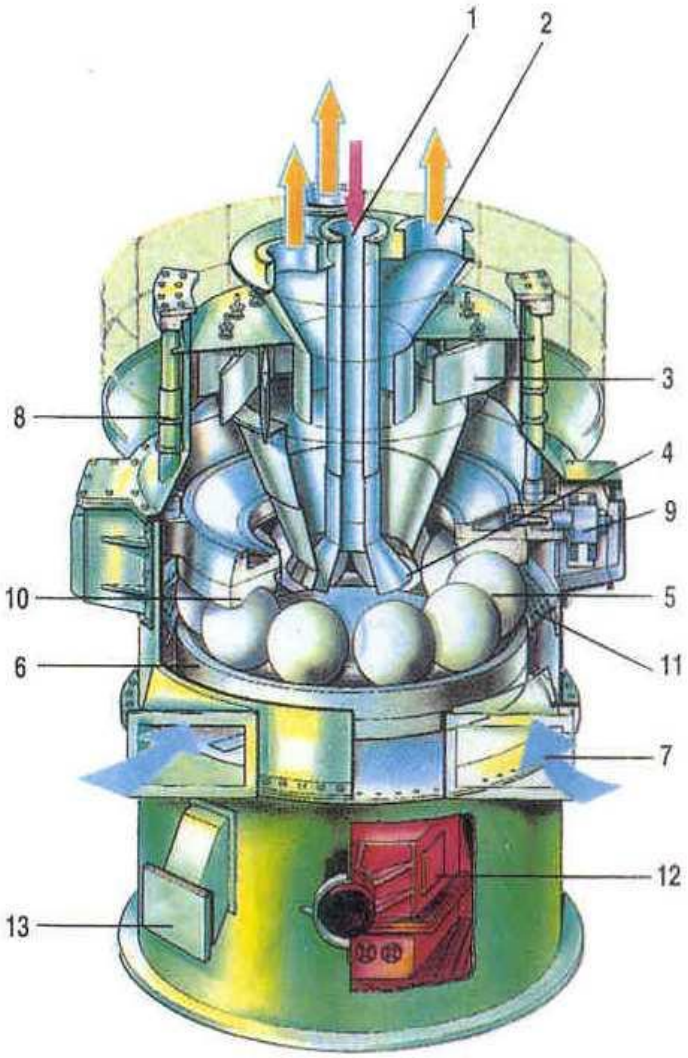


MILLS

This crushed coal gets collected in the coal hopper through which it enters the coal pulverizing mill through the gravity feeder which regulates and maintain a constant flow of coal. In the pulverizing mill, the coal is made to powder form.

Another fuel used in the thermal power plant is oil. Oil is sent to the furnace through the pump, the burning of fuel requires air which is called secondary air.

Coal mills are located adjacent to the furnace at zero meter level. These mills pulverize coal to the desired fineness to be fed to the furnace for combustion.

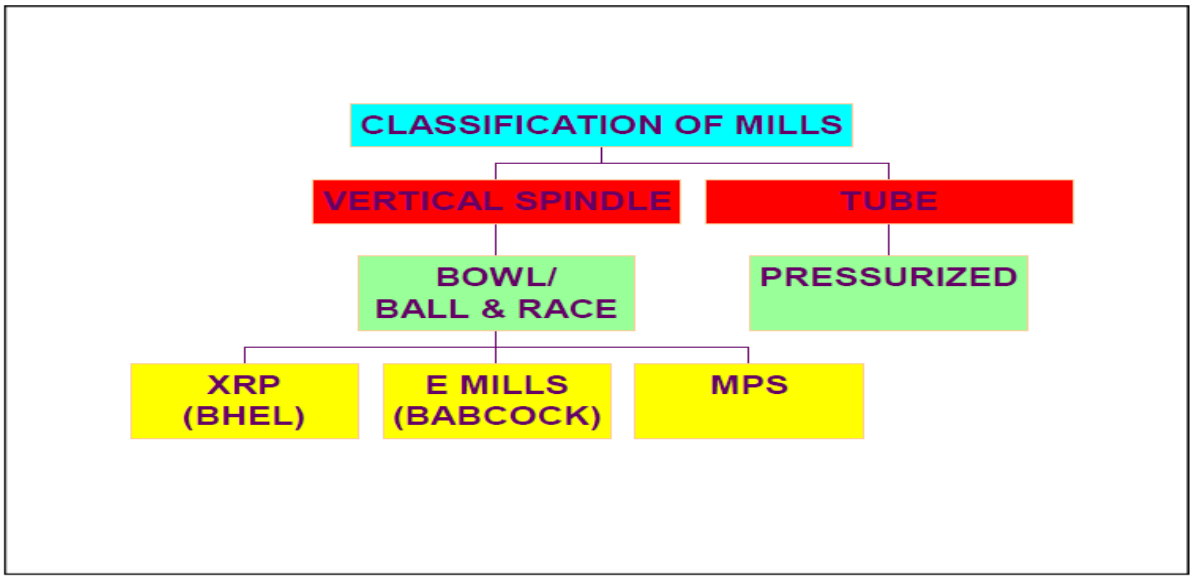


Key Features

1 Raw Material Inlet
2 Product Outlet
3 Adjustable Classifier Blades
4 Oversize Particles Return Chute
5 Hollow Balls
6 Rotating Lower Grinding Ring
7 Primary Air Inlet
8 Loading Cylinders
9 Spider Guides
10 Stationary Upper Grinding Ring
11 Throat Plate
12 Gearbox
13 Reject Box

BALL& RACE MILL EXTERNAL VIEW AT NTPC,RAMAGUNDAM

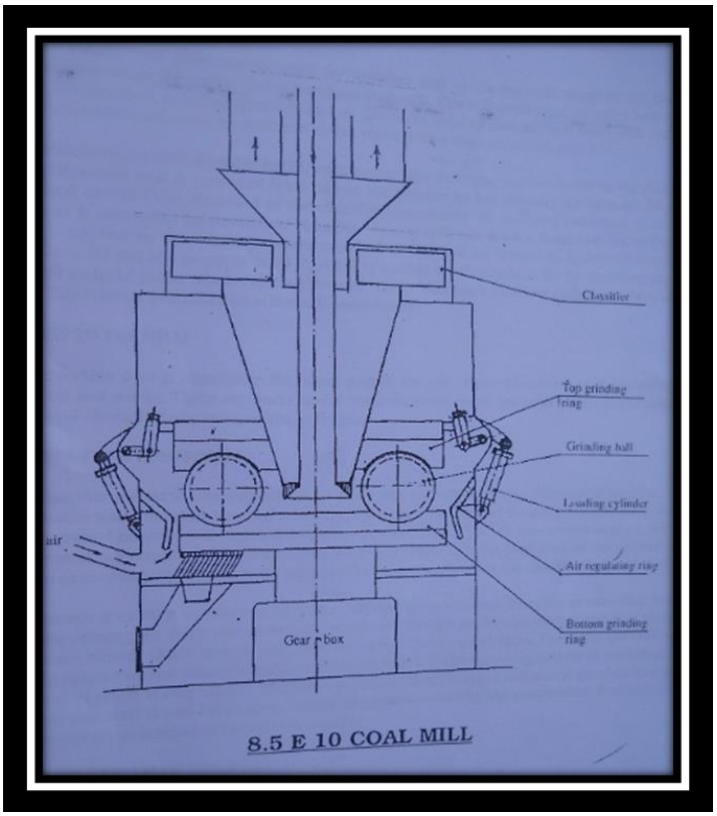
The pulverized coal from the coal mill is sent to the boiler furnace with the help of primary air coming out of from RAPH (Rotating Air Pre-Heater) which is pumped with a PAfan(PrimaryAirFan).



BRIEF DESCIPTION OF MILL:

8.5E10 coal mills are designed for grinding coal to the fineness required for the effective combustion inside the boiler. This is a vertical shaft mill. This mill consists of classifier housing, middle shell, bottom shell, grinding elements i.e., ball and races, loading system, turn table with vertical shaft. The turn table is driven by an electrical motor through two stages reduction gear box.

The measured amount of coal is fed through center pipe from gravimetric feeder to the grinding zone. The pulverized coal is conveyed from mill to the furnace by hot primary air through PF pipes. The required size of PF is classifier zone inside the mill and conveyed to furnace. The fineness is controlled by position of classifier vane at different angles. Required amount of crushing load is applied by the loading system attached to the mill by means of hydro-pneumatic loading cylinders. N2 gas at a pressure of 34 Kg/Cm2 is used in loading system for pressurizing to ring. Un-ground material in the coal is rejected through tramp iron gates attached on both bottom sides to the mill. This reject is evacuated from the mill periodically.



CONTROL SYSTEM OF THE MILL:

The quantity of air supplied to the mill depends on the drop in pressure through the PA measuring device.

The flow rate of the fuel of the mill depends o the drop in pressure through the mill(DP) excluding the classifier. Both these pressure differentials must be submitted to a control which transmits a signal to adjust the supple of fuel, maintaining a pre established ratio between DP of the mill and DP of primary air. With bituminous fuels the air flow adjustment may vary from 70% to 100% of the basic air flow rate, while for coal, it may vary from 50% to 100% of the mill; the relation is linear. The flow rate in the mill project is based on a grinding capacity index of 50 degrees HG and a product fineness of 70% through a 200 B.S. sieve (75micron). Even the characteristics of the PA flow rate measuring instrument are known, we recommend calibration for a control. Refer to the separate instructions for more detailed calibration procedures. From calibration results it is possible to plot a series of curves which will indicate a weight of value of PA differential. During operation coal weights may be determined the differential in the mill established and the governor turned to operate automatically with a correct ratio.

CHECKS DURING OPERATION OF COAL MILL:

1. Loading system pressure is to be maintained at N2-34Kg/Cm2 and Oil-41Kg/Cm2.
2. Lubricating oil temperature is to be observed. (<60 deg C)
3. Lubricating oil pressure is to be observed. (After filter it should be 1 Kg/Cm2)
4. Mill outlet temperature is to be maintained at 70-80 deg C.
5. Coal to PA air ratio is to be maintained (Approx 1:1.8)
6. Mill motor current is to be observed (It should be 17-25 Amp.)
7. Mill DP (400-600 mm WC)
8. Mill to furnace DP (100-150 mm WC)

MAINTENANCE OF COAL MILL

1. Weekly parameter monitoring
2. Monthly PM job
3. Grinding element replacement based on wear measurement of grinding elements (Ball < 527mm, Depth of top ring > 177mm, Depth of bottom ring > 165.5mm) and deteriorated parameters of mill like coal fineness, loading constraints, high rejects etc.

   Grinding elements replacement includes following activities:

a. Spare mill top housing is kept ready before starting the work : This includes repair or replacement of the following components – Classifier cone, skirt flap, turret plate, classifier hopper, tie rods circular piece etc.

b. Dismantling of coal pipes, mill top housing, and old grinding elements, worn out middle shell wear plates, worn out air regulating rings. Hard facing in damaged area of mill body and installation of new bottom ring, slotted air regulating ring, middle shell wear plates, grinding balls, top ring, U clamps and knee assembly.

c. Installation of readily available spare top housing and coal pipes.

d. Pressurizing of loading system and observation for any leakage

e. Internal inspection of gear box

f. Total grinding element replacement activity duration is 72 hours

g. Average life of grinding elements is approx. 6000 running hours.

4. Mill gear box maintenance: It's a David brown make two stage reduction gear box suitable for 8.5E10 mill.

a. These gear boxes are regularly being serviced in the recondition workshop.

b. Spare serviced gear boxes are kept ready for replacement

5. Salient block shaft assemblies are regularly being reconditioned and replaced during mill grinding element replacement to avoid coal leakage in the loading system.

6. Loading cylinders are being regularly reconditioned by chrome plating of ram and assembling with new seals. These cylinders are being replaced during mill grinding element replacement of any leakage in the loading system.

CONCLUSION

A thermal power station works on the basic principle that heat liberated by burning fuel which is then converted into mechanical work by means of suitable working fluid. The mechanical work is converted into electrical energy by means of generator.

The power generation mainly depends upon the boiler which is used for steam generation to supply the qualitative steam to power generating units.Most coal-fired power station boilers use pulverized coal to have better heat transfer capacity upto 90% to convert the water into steam heat is required,in case of 500MW unit, tangential firing is used to heat the water in boiler tubes.

To maintainand run the boiler at rated conditions for maximum power output,its pressure parts are strictly maintained to arrest the undesired pressures obtained. Valves are used to arrest this undesired pressure at various locations to provide effective operating conditions.

The valves in Thermal power stations are required to perform difficult operations in adverse environments of dust and heat. Proper working of valves ensures better availability of unit,safety of plant,equipment,processes and men.

Rotating parts fulfil basic functions like fuel for proper combustion in the boiler with ample amount of air through Forced drought (F.D.) fan,removing flue gases using induced drought fan(ID fan),cleaning,preheating and supplying pulverised coal to boiler.

Effective functioning of these parts ensures healthy working of the power plant to its maximum possible efficiency.

---------- END ----------