Study of the Electrical system of the new Power and Blowing Station II

and

Emergency calculations for power requirements in case of power failure

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under the guidance of

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Contents

Chapter 1

Project Overview

1.1 What is the project about?

- To study of all electrical and mechanical system of PBS-2
- Calculation of the emergency power requirement of different units of PBS-2.
- Identification of the source of power in BSP to ensure emergency supply in case of power failure.

1.2 Objective and Significance of the project

- Detailed exposure of various process involved in power generation system in steel industry.
- Function of boilers , DM water plant ,cooling water pump house , cooling towers , turbine, generator for power requirement in any industry .
- Learning of the various control systems in power plant operations .
- Role of SCADA in electrical control system and communication.
- Calculation of the emergency power requirements of the new Power and Blowing Station II which is being installed in BSP
- Power generation from waste heat of COB-11 is also envisaged in this project and 4 MW along with process steam is being utilized in BSP.
- Total electrical system of BSP are interlinked with PBS-2 for reliable operation of power system in case of power failure

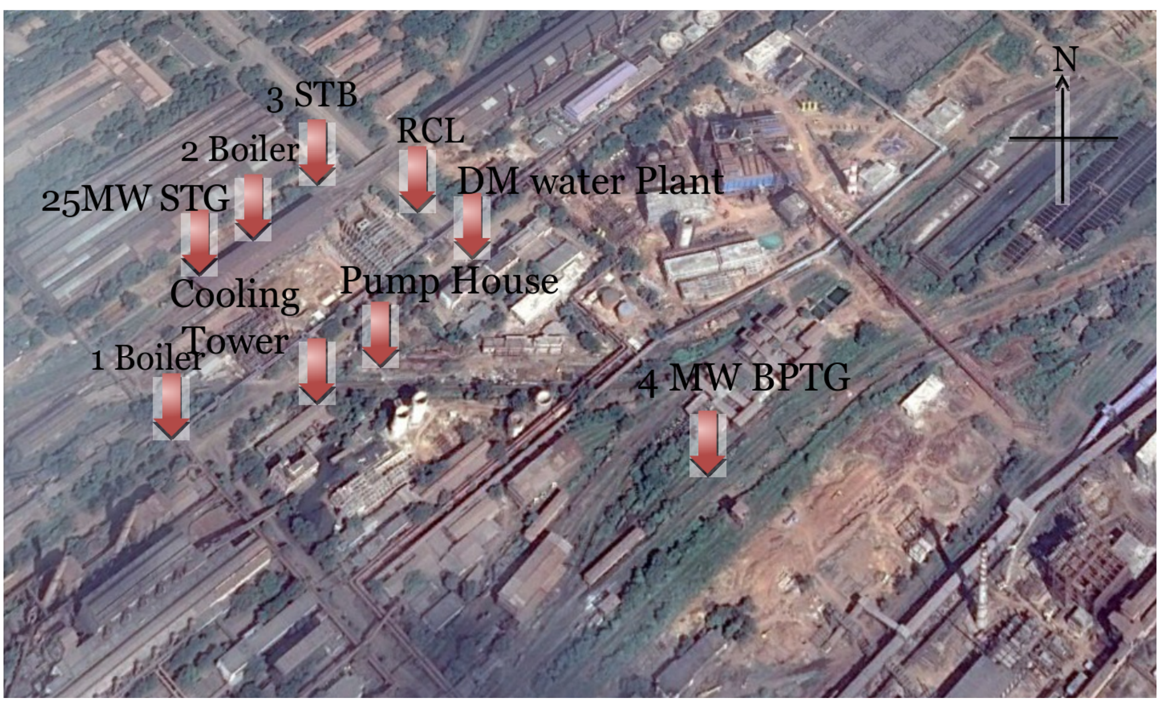
1.3 Learning outcomes and Expected Knowledge gain and Deliverable from the project

- Exposure to all electrical system in power industry like generator reactor HT breaker , LT breaker transformer cable sizing etc.
- Detailed study of SLD for power requirement in any industry
- Project management for execution of any project
- Commissioning methodology of electrical system
- Power calculation of any upcoming unit for reliable operation of plant
- Exposure to power plant operation with detailed knowledge of each equipment
- Introduction to DCS, PLC, SCADA for future references

1.4 Current Status

- The field work has been going on and the detailed study of different units involved in PBS-2 have been made
- The Project is on schedule

1.5 Site Map



1.6 Project Packages

Package	Installation	Contractors	Contract signing date
011-01-A	3 Boilers and its auxiliaries. STB Building along with EOT crane	M/s Fujian Longking Corporation Ltd. and M/s Allied Engineering Services Pvt. Ltd.	24.03.12
011-01-B	25 MW STG, 4 MW BPTG, Cooling Tower, Pump House	M/s Triveni Engineering and Industries Ltd.,Banglore	19.01.12
011-01-C	3X 225 M3 /Hr. DM water Plant	M/s TechnoFab Engineering Ltd., New Delhi	25.02.12
12	3 STB's and its auxiliaries.	Bharat Heavy Electricals Ltd.	11.11.10

Chapter 2

Boiler

Boilers or Steam generators are used to generate steam at desired rate and desired pressure and temperature by burning fuel in its furnace. They can be classified as fire tube or water tube boilers depending on whether the hot gas or water is present in the tubes inside the boiler.

2.1 Types of Boilers

Fire Tube Boilers
Earlier designs include fire tube boilers suitable for small steam requirements. They can be externally fired or internally fired. The externally fired is the one in which furnace is outside the boiler shell. The products of combustion flow through the tubes which are immersed in a shell containing water As the flue gases flow through the tubes, heat is transferred from gas to water and water is converted to steam. In internally fired fire tube boiler, the furnace is present inside the shell containing water. Combustion gases flow through the pipes and let out to the atmosphere. These gases exchange the heat with the water present in the shell. The major shortcoming of fire tube boiler is that the pressure limitations are inherent in its basic design. The steam present in the drum exerts hoop stress on the shell and larger the shell, larger is the stresses induced and to increase the pressure carrying capacity, the thickness has to be increased which increases the manufacturing cost.

Water Tube Boilers
Modern boilers are mostly water tube boilers. These were developed to permit increases in boiler capacity with reasonable metal stresses. Since water tube boilers have water flowing in small tubes, the pressure carrying capacity of the tubes being higher, they are used to generate high pressure steam. The water tube boilers can be further divided as straight tube or bent tube boilers.

2.2 How does a Boiler work

Economizer is the first step in the steam generation process. The feed water from the boiler feed pump enters the economizer where it is heated by the hot flue gases. The hot flue gases leave burner and travel through the furnace to the chimney and exchanges its heat from different heat ex-changers in its way to the exhaust chimneys.

After getting saturated, the feed water is taken to the **Boiler drum**. The purpose of boiler drum is to evaporate the feed water or provide latent heat. The saturated water from the boiler drum comes down via **Downcommers** and is then passed through **water walls (Risers)** which are number of evaporation tubes spaced all around the walls of the furnace and is used to take away the latent heat using the heat exchange from the hot flue gases. The flow of the feed water can be natural circulation by the density difference between the water in the riser and downcommers or when the pressure is higher, the circulation pump is used to provide the flow as the density difference is not enough to cause natural circulation. The mixture of saturated liquid and steam then enters again to boiler drum where the steam and the liquid are separated and the steam goes to the superheaters.

A **Superheater** is a heat exchanger in which heat is transferred in a saturated steam to increase its temperature to the desired value. In modern boilers, more than 40% of the heat absorption takes place in superheaters. Superheaters are commonly classified as either convective, radiant or pendant supreheaters. The **Convective superheaters** are often termed as primary superheaters where the saturated steam from the drum is admitted. After passing through the convective superheater, the steam proceeds to the Radiant superheaters where the heat exchange between the flue gases and the steam is mostly due to radiation. As the heat exchange is due to radiation, the amount of temperature increase is generally more than what is required so the steam is desuperheated in **Desuperheaters**. The desuperheater is a direct contact type and the tapping from the boiler feed water is taken and sprayed over the steam to desuperheat it. The steam is then passed to **Pendant superheater** where the steam is finally heated to the desired temperature. There heat is transferred partly by convection and partly by radiation.

The flue gases are produced in the burners by burning the mixture of gases and preheated air. The gases contain mixture of BF (Blast Furnace gas), CO (Coke oven) gas, LDO (Light diesel oil) gas. The air is preheated using the **Air Preheater**. The air is sucked through the **Forced draught** fan and then passed through the Air Preheater where the heat exchange takes place between the flue gases and the air.

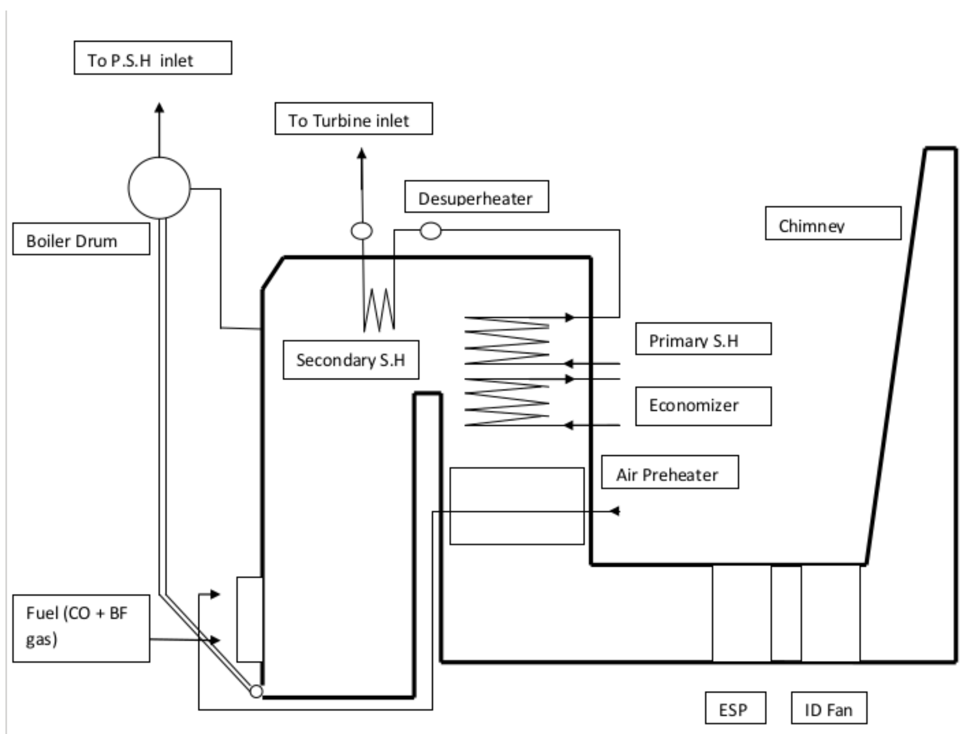
The flue gases after passing through the air perheater then passes through the **Electro-**

static Precipitator where the dust particles are precipitated and the **Induced Draught**. Fan then takes it to the atmosphere via **chimneys**.

2.3 Specifications of Boiler in PBS – 2

Heating area of Economizer	3100 m^2
Heating area of Superheater	967 m^2
Heating area of Water walls	1005 m^2
Heating area of Evaporators	1240 m^2
Total heating area	6312 m^2
Rated capacity	150 T/hr, 383 Mpa, 450°C
Design Fuel :	
BF Gas	3245KJ/Nm^3
BOF Gas	7531 KJ/Nm^3
CO Gas	16246 KJ/Nm^3

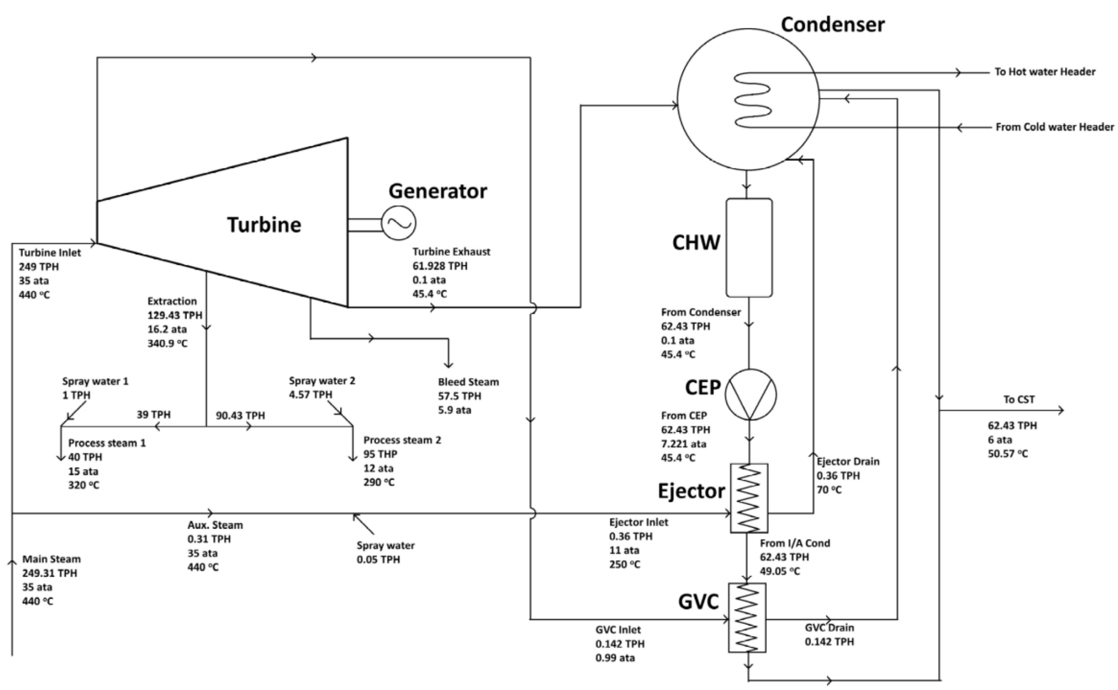
2.4 Flow Diagram of Boiler



Chapter 3

STG 25 MW

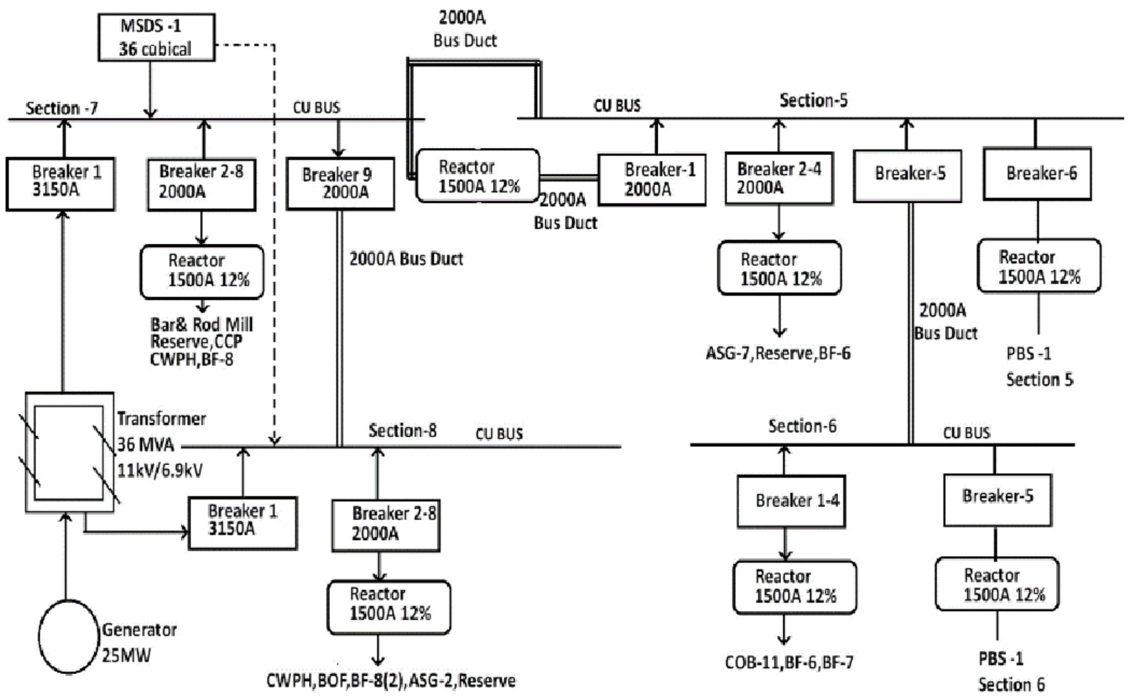
3.1 Process Flow Diagram



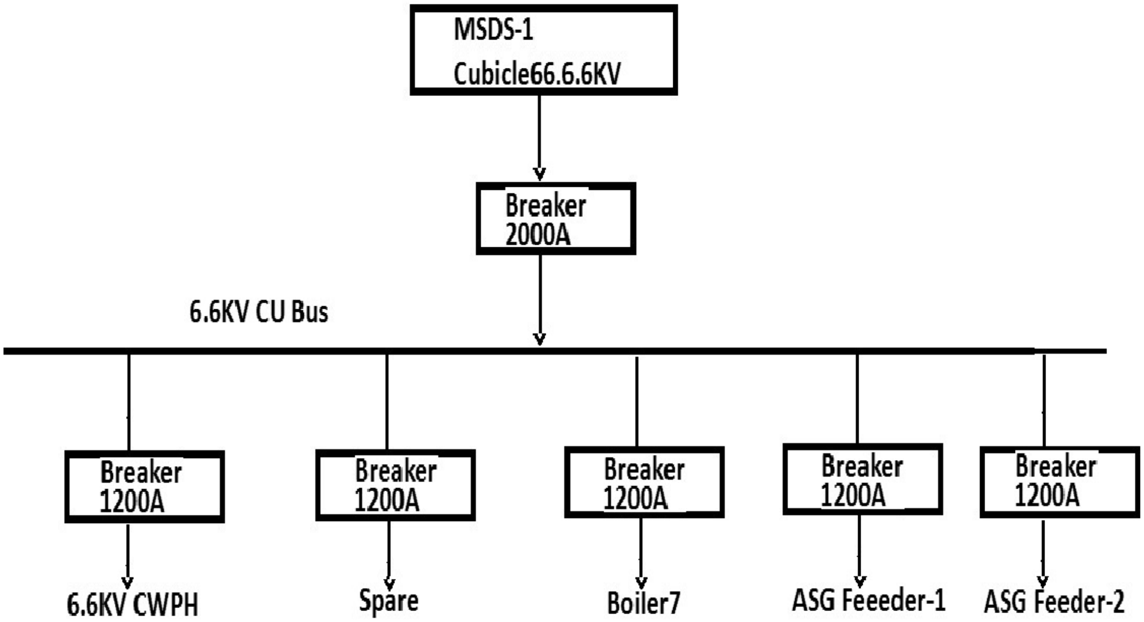
3.2 Electrical Equipment

Equipment	Specification	Location
Transformers	36MVA, 11kV/6.9kV	0 meters B-C
Breakers	1.3150 Amp, 2.2000 Amp	11 meters A-B
Reactor	1500 Amp, 12%	3 meters A-B
DCS		11 meters
LT Panels		11 meters

3.3 STG 25 MW Electrical Component



3.4 STG - Electrical Reserve Supply Switch Board



Chapter 4

Cooling Tower and Pump House

4.1 Overview

Cooling towers are the devices that take heat from the cooling water to cool them for condenser heat removal. The heat is rejected to the atmosphere. The cooling towers can be further divided as Wet type and Dry type.

4.1.1 Wet Cooling towers

Wet cooling tower have showers that sprays hot water over horizontal packing. The outside air enters the tower through louvers on the side of the tower. The water evaporated is directly proportional to cooling. Cold water is collected in a concrete basin and is pumped again to the condensers.

The minimum temperature to which water can be cooled is the adiabatic saturation or wet bulb temperature of the ambient air. At this temperature, the air is 100 cannot absorb more moisture.

A Cooling tower is specified by

$$Approach(A) = (Exit\,Temperature\,of\,C.W.) - (WBT\,of\,ambient\,air)$$

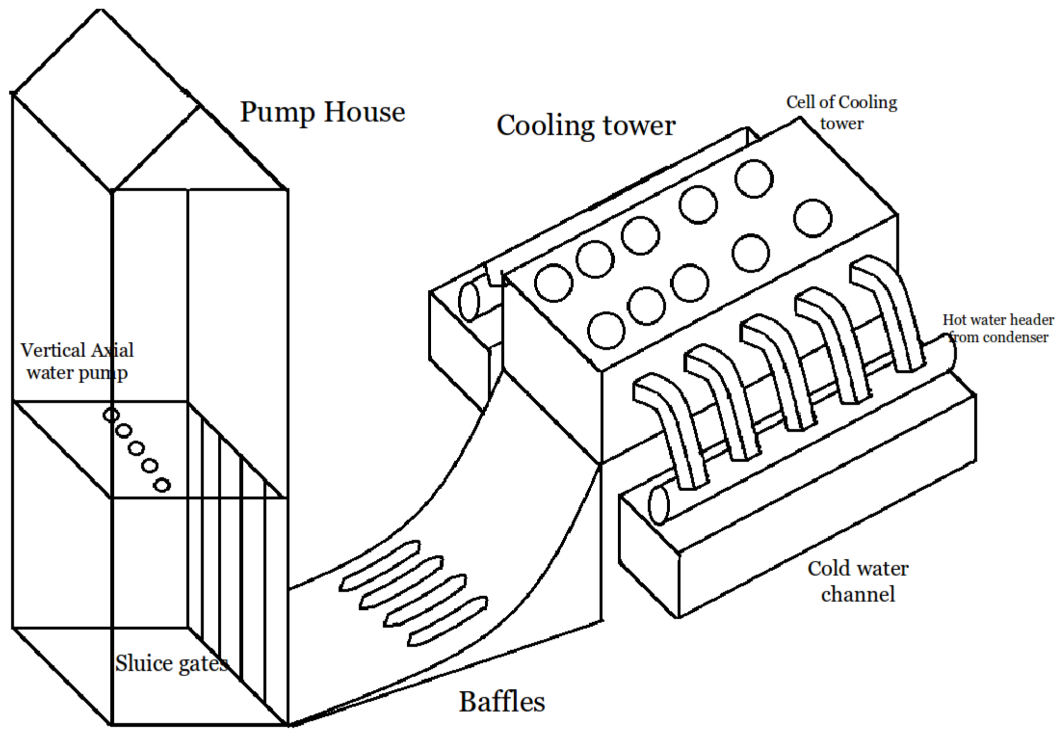
where C.W. stands for Cooling Tower and WBT stands for Wet Bulb temperatue which is the temperature a parcel of air would have if it were cooled to saturation (100% relative humidity) by the evaporation of water into it, with the latent heat being supplied by the parcel.

Also the cooling efficiency is defined as

$$\eta = \frac{Actual\,Cooling}{Maximum\,possible\,Cooling}$$

We have 10 cooling cells with 9 working and 1 standby. Temperature reduces from 42° to 34° at supplied to STG and STB condensor. Its cooling capacity is 19655 m^3/hr. It has 5 vertical axial flow pumps with 3 working and 2 for standby. Water sump in pump house is 8.5 m deep.

4.2 Diagram



Chapter 5

STB

5.1 Process Overview of STB and Auxiliaries

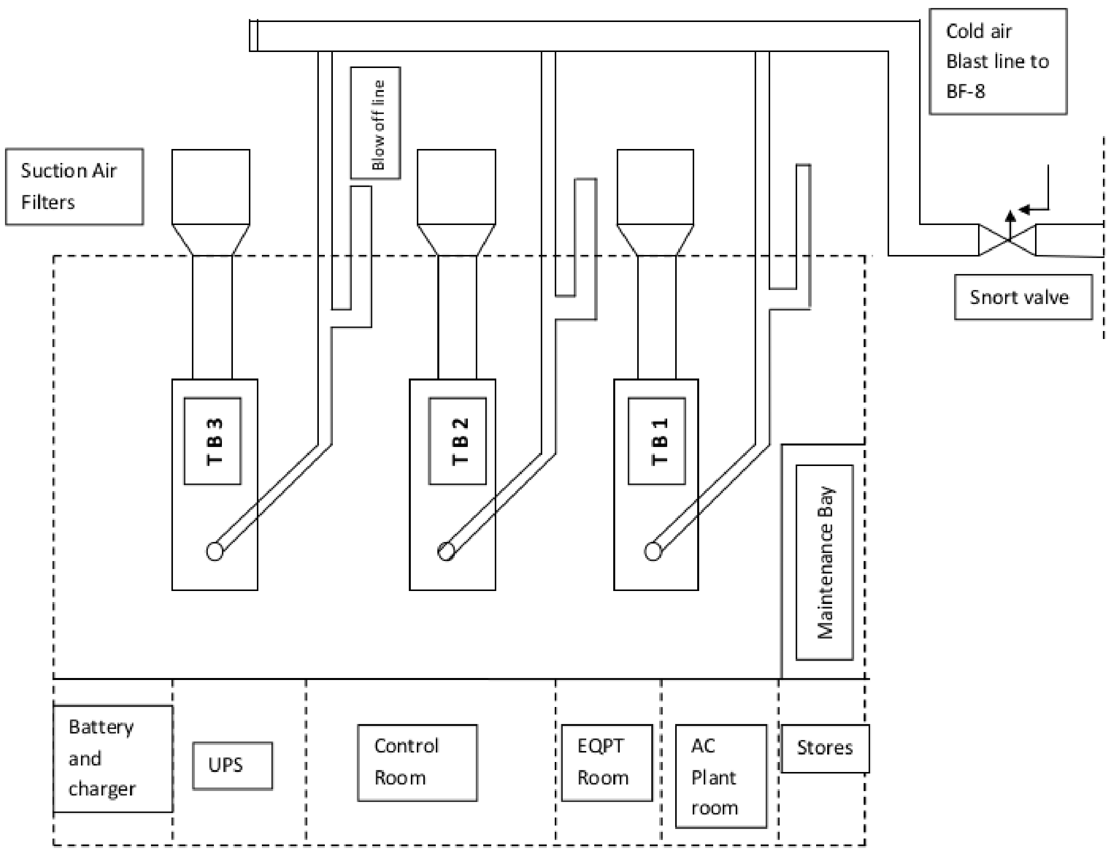
The steam used to drive the blowers is produced in **3 Boilers** at 40 ata, 450 degree Celsius. Waste gases from blast furnace and coke oven mainly BF gas and CO gas are used to fire the burners in boiler to produce steam. The steam so produced is sent to main steam header from where tapings are taken for different stations mainly **Turbo blowers, Turbo generators and Pressure Reducing and De superheating Station**.

Steam enters the **Turbine** at around 36 ata, 440 degree Celsius. The steam in turbine passes through different stages where its enthalpy is converted into rotational energy to drive the turbine shaft which in turn drives the **Blower** attached. The blower thus sucks the air passing through air filtration system and delivers the high pressure air to the blower outlet. The steam from turbine outlet goes through **Condenser** where it is condensed by cooling water to liquid condensate which is collected in hotwell.

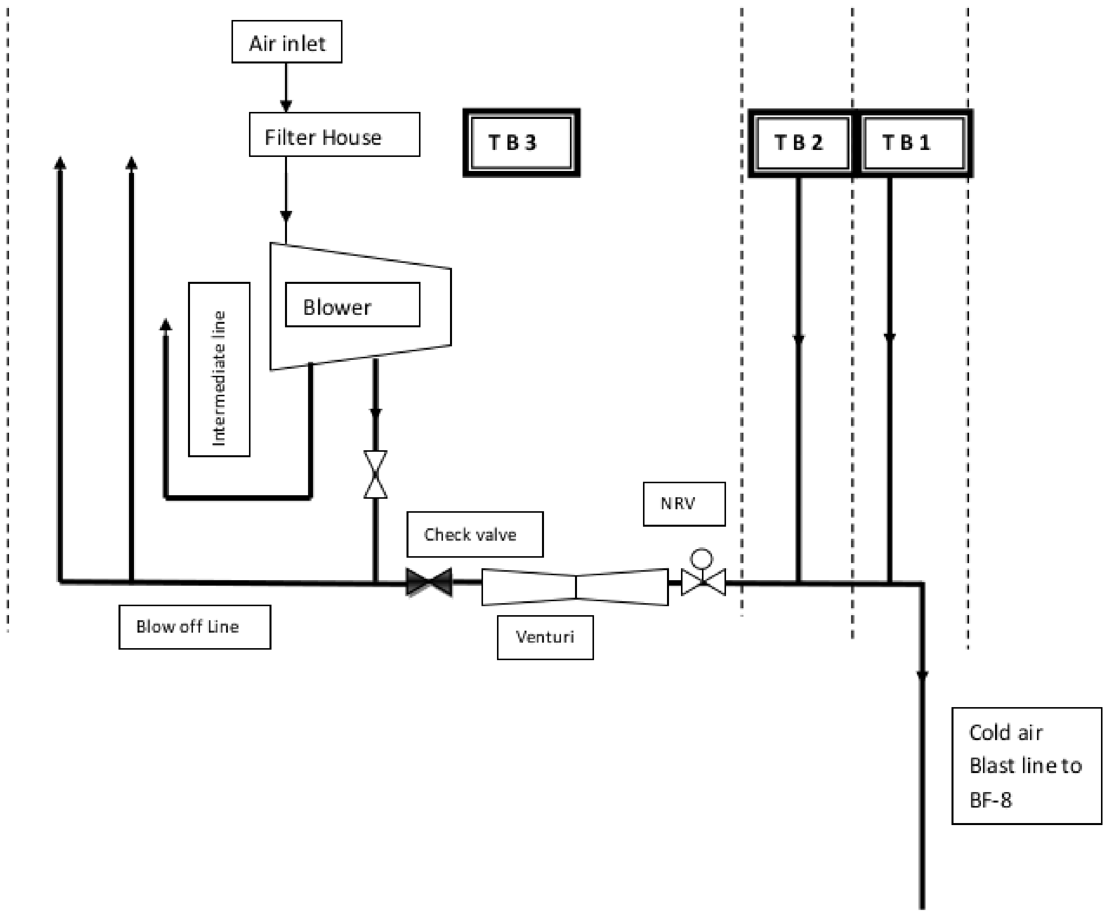
The liquid condensate from the hotwell is then pumped using **Condensate Extraction Pump**. The condensate is then passed through the **Steam Jet Air Ejector** where the condensate is heated and the air in the condenser is simultaneously ejected using the steam from **PRDS**. The condensate is then passed through the **Gland Steam Condenser** where it is heated using the PRDS steam.

The condensate is then stored in the **Condensate Storage Tank**. The condensate is then transferred to the **Dearator** using the **Condensate Transfer Pump**. The condensate is sprayed from the top in the dearator and PRDS steam is used to heat the condensate and remove the impurities. The feed water so formed is collected and then pumped to the Boiler using the **Boiler Feed Pump**. The feedwater in boiler is first converted to saturated liquid by economizer and then it goes to the boiler drum where it is evaporated and then passes through superheater before reaching its final state and transferred to main steam header.

5.2 Layout of STB PBS-2



5.3 Air Distribution system STB PBS-2



Chapter 6

Timeline Ahead

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