A REPORT ON

INDUSTRIAL TRAINING

TITLED

THERMAL POWER GENERATION

ATTENDED AT

National Thermal Power Corporation, VSTPP

Submitted in partial fulfilment for the award of degree of Bachelor of Technology from

KIET GROUP OF INSTITUTIONS, GHAZIABAD

KIET GROUP OF INSTITUTIONS

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NBA Accredited Courses (CSE, ECE, EEE, IT, ME)
"Shaping Young Minds with Skill Oriented & Value Based Education"

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ACKNOWLEDGEMENT

With profound respect and gratitude, I take opportunity to convey my thanks to Mr. B.G PATERIYA Sir for permitting me to complete my training in NTPC Ltd. And to be the part of this esteemed organization.

I extend my heartfelt thanks to Mr. A MARKHEDKAR Sir for providing me the proper guidance during my training period in Vindhyachal Stage I.

I'm extremely grateful to all the operation and guidance that has helped me a lot during the course of training. I have learnt a lot under them and I will always be indebted to them for this value addition in me.

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At last I would like to convey my thanks to all the members of the Electrical Maintenance Dept. I can't really express my feeling of gratitude towards them.

RAVI SHANKER YADAV

SUMMER TRAINEE

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INTRODUCTION

NTPC is the largest thermal power generating company of India. A public sector company wholly owned by Government of India. It was incorporated in the year 1975 to accelerate power development in the country. Within a span of 30 years, NTPC has emerged as a truly national power company, with power generating facilities in all the major regions of the country. NTPC contributes 28.5 % of the country's entire power generation. It lights up every fourth bulb in the country.

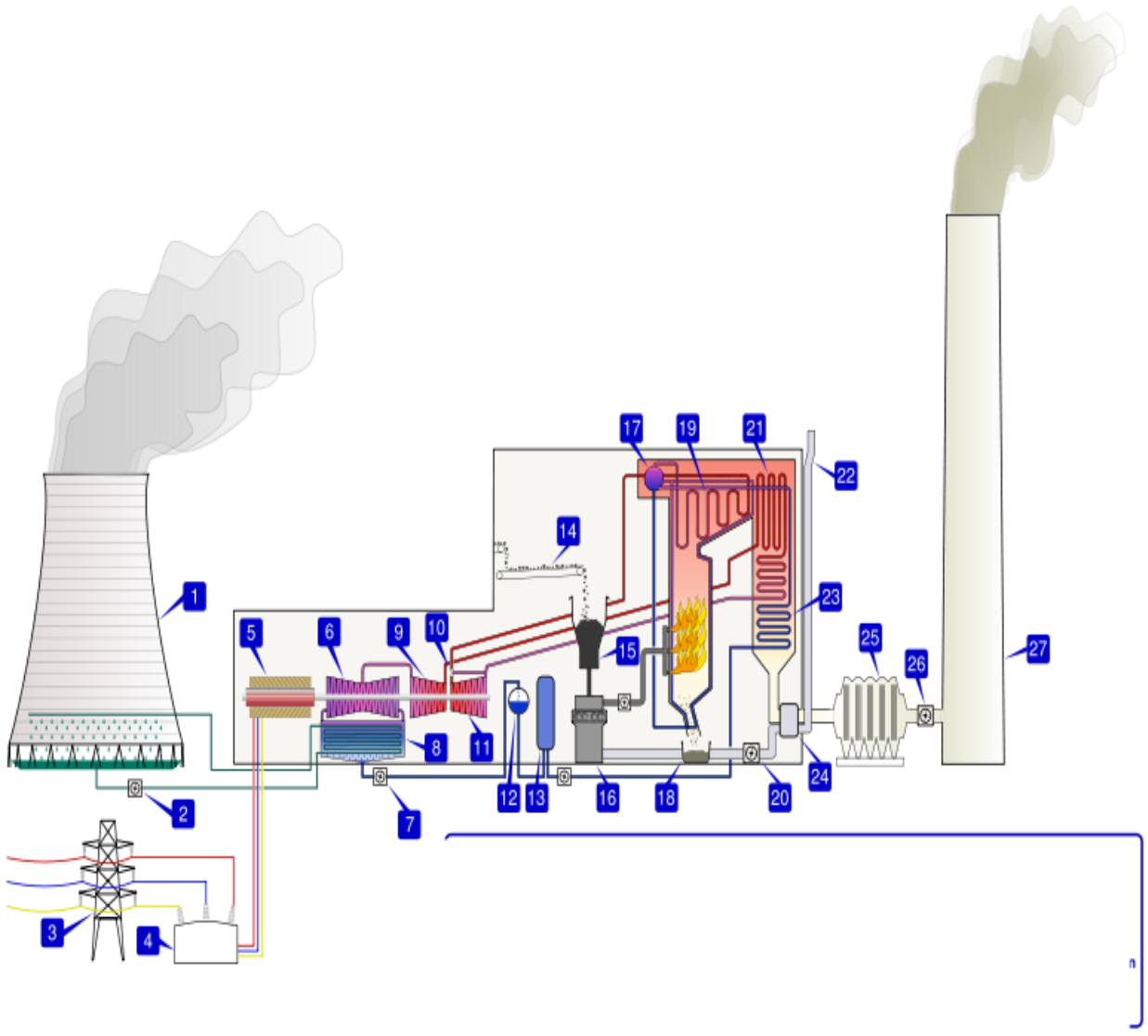
With ambitious growth plans to become a 56,000 MW power company by 2017, NTPC the largest power utility of India has already diversified into hydro sector. 18 NTPC stations have already been accredited with the ISO 14001 certification. In keeping with its well focused environment protection policy, NTPC has set up a "Centre for Power Efficiency and Environmental Protection" (CENPEEP) which functions as a resource centre for development and dissemination of latest technologies in environmental management.

In a remarkable achievement, the recently conducted the Business Today-Hewitt Associate Best Employer Survey 2003 ranked NTPC the 3rd best among major companies in India.

VINDHYACHAL SUPER THERMAL POWER STATION AT A GLANCE

- It is the largest power station in Asia .
- NTPC is the sixth largest thermal power generator in the World and the Second most efficient utility in terms of capacity utilization based on data of 1998.
- It has a total installed capacity of 4760 MW.
- It consists of three stages.
- Stage 1 – 6 × 210 MW
- Stage 2 – 2 × 500 MW
- Stage 3 – 2 × 500 MW
- Stage 4 – 2 × 500 MW
- Stage 5 – 1 × 500MW
- Total land area 6178 acres.
- Water supply Rihand reservoir NTPC Singrauli Discharge Canal (160 cusecs)
- Coal supply from Nigahi and Dudhichua Mines of NCL (10 MMT/annum)
- Fuel oil source from Indian Oil Corporation (IOC) COLD (customer operated lubricant and oil deposit) at Jayant.
- International Assistance from USSR and World Bank under time slice.
- Vindhyachal station belongs to the western region and feeds power to states and union territories of:-

Madhya Pradesh	24.4%
Chhattisgarh	4.7%
Maharashtra	32.3%
Gujarat	20.8%
Goa, Daman & Diu	2.4%
Dadar & nager haveli	0.4%
Unallocated	15%



KEY

1. Cooling tower
2. Cooling water pump
3. Pylon (termination tower)
4. Unit transformer
5. Generator
6. Low pressure turbine
7. Boiler feed pump
8. Condensor
9. Intermediate pressure turbine
10. Steam governor
11. High pressure turbine
12. Deaerator
13. Feed heater
14. Coal conveyor
15. Coal hopper
16. Pulverised fuel mill
17. Boiler drum
18. Ash hopper
19. Superheater
20. Forced draught fan
21. Reheater
22. Air intake
23. Economiser
24. Air preheater
25. Precipitator
26. Induced draught fan
27. Chimney stack

Generation of Coal to Electricity

COAL TO STEAM:

The fig. shows a modern boiler burning pulverized coal at rates up to 200 tones per hour. From the coal store, fuel is carried on a conveyor belt and discharged by means of coal tipper into the bunker. It thus falls, perhaps through a weather, into the coal pulverizing mill, where it is ground to a power as fine as flour. The mill usually consists of a round metal table on which large steel rollers or balls that crushes it.

Air is drawn from the top of the boiler house by the forced draught fan and passed through the air pre heaters, to the hot air duct. From here some of the air passes directly to the burners and the remainder is taken through the primary air fan to the pulverizing mill, where it is mixed with the powdered coal, blowing it along pipes to the burners of the furnace. Here it mixes with the rest of the air and burns the condensate in the economizer and then pass through the air pre heaters , to the electrostatic precipitator . Finally they are drawn by the induced draught fan into the main flue and to the chimney.

The electrostatic precipitator consists of metal plates, which are electrically charged. Dust and grit in the flue gasses are attracted on to these plates, so that they do not pass up the chimney to pollute the atmosphere. Regular mechanical hammer blows cause the accumulation of ash, dust and grit to fall to the bottom of the precipitator where they collect in a hopper for disposal. Additional accumulation is also collected in the hoppers beneath the furnace. The ash is either sold for use in road and building constructions or piped as slurry.

SUPER HEATERS

Super heater heats the high-pressure steam from its saturation temperature to a higher specified temperature.

Reheater

Reheater is used to re-heat the steam from hp turbine to 540 deg.

Economiser

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

Boiler Drum

The steam drum contains steam separating equipment and internal piping for distribution of chemicals to the water, for distribution of feedwater and for blowdown of the water to reduce solids concentration.

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

P.A. Fan:

Ambient air is drawn into the primary air ducting by two 50% duty, motor driven axial reaction fans. Air discharging from each fan is divided into two parts, one passes first through a air pre-heater then through a gate into the P.A bus duct. The second goes to the cold air duct. The mix of both is used to carry the pulverized coal to the boiler.

I.D. Fan

There are three induced draught fans per boiler, two operating and one standby. In 500 MW fans are single-stage, double-inlet centrifugal fans.

F.D. FAN:

Ambient air is drawn into the secondary air system by two 50% duty, motor driven axial reaction forced draft fans. Air discharging from each fan passes first through a air preheated then through a isolating damper into the secondary air bust duct.

Air Heaters

APH is the last heat exchanger in the boiler flue gas circuit. To achieve maximum boiler efficiency maximum possible useful heat must be removed from the gas before it leaves the APH. However certain minimum temperature has to be maintained in the flue gas to prevent cold end corrosion.

An air pre-heater heats the combustion air where it is economically feasible. The pre-heating helps the following:

- Igniting the fuel.
- Improving combustion.
- Drying the pulverized coal in pulverizer.
- Increasing the boiler efficiency.

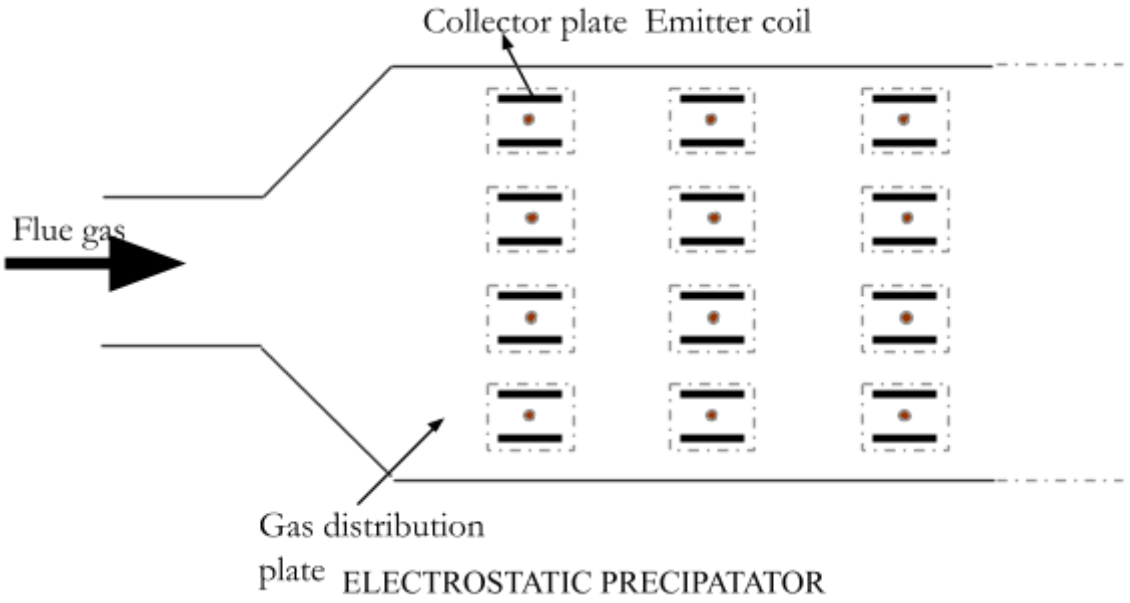
Advantages by use of APH

- Stability of Combustion is improved by use of hot air.
- Intensified and improved combustion.
- Permitting to burn poor quality coal.
- High heat transfer rate in the furnace and hence lesser heat transfer area requirement.
- Less un-burnt fuel particle in flue gas thus combustion and efficiency both are improved.
- Intensified combustion permits faster load variation and fluctuation.

ELECTROSTATIC PRECIPATATOR

It is a device which captures the dust particles from the flue gas thereby reducing the chimney emission. Precipitators function by electrostatically charging the dust particles in the gas stream. The charged particles are then attracted to and deposited on plates or other collection devices. When enough dust has accumulated, the collectors are shaken to dislodge

the dust, causing it to fall with the force of gravity to hoppers below. The dust is then removed by a conveyor system for disposal or recycling.



ELECTROSTATIC PRECIPATATOR

STEAM TO MECHANICAL POWER:

As from the fig. it is clear that a steam pipe conveys steam to the turbine through a stop valve and through control valves that automatically regulate the supply of steam to the turbine. Stop valve and control valve are located in a steam chest and a governer driven from the main turbine shaft , operates the control valve to regulate the amount or steam used.
Steam from the control valve enters the high pressure cylinder of the turbine where it passes through a ring of stationary blade fixed to the cylinder wall. These act as nozzles and direct the steam onto a second ring of moving blades mounted on a disc secured to turbine shaft. This second ring turns shaft as a result of the force of steam. The stationary and moving blades together constitute a `stage` of the turbine and in practice many stages are necessary so that the cylinder contains no. of rings of stationary blades with rings of moving blades arranged between them. The steam passes through each stage in turn until it reaches the end of the high-pressure cylinder and in its passage some of its heat energy is changed into mechanical energy. The steam leaving high-pressure cylinder goes back to the boiler from reheating and return by a further pipe to the I.P. cylinder. Here it passes through another series of stationary and moving blades. Finally the steam enters to L.P. cylinder. As the steam gives up its heat energy to drive the turbine, its temperature and pressure falls and it expands. Because of this expansion the blades are much larger and longer towards the low-pressure ends of the turbine. The turbine shaft usually rotates at 3000 r.p.m.

When as much energy as possible has been extracted from the steam it is exhausted directly to the condenser. The condenser consists of a large vessel containing some 20000 tubes, each about 25mm in diameter. Cold water from the cooling towers is circulated through these tubes and as the steam from the turbine passes around them it is rapidly condensed into water-condensate. Because water has a much smaller comparatively volume then steam, a vacuum is created in the condenser. This allows the steam to be used down to pressure below that of normal atmosphere and more energy can be utilized. From the condenser, the

extraction pump pumps the condensate through low pressure feed heaters. It further passes through feed heaters to the economizer and the boiler for re conversion into steam.

A power station generating 2000MW of electricity requires about 227500m^3 of water per hour for cooling purpose. Where cooling towers are used, about one hundredth part of the cooling water evaporates and a certain amount is returned to its source to carry away any impurities that collect. Most of it however is re circulated.

BOILER FEED PUMP

The boiler feed pump is used to give the required pressure to the feed water before entering into boiler.

H.P. HEATERS

These are regenerative feed water heaters operating at high pressure and located by the side of turbine. The steam is supplied to these heaters form the bleed point of the turbine through motor operated valves.

Condensate Extraction Pumps

The function of these pumps is to pumps out the condensate to the deaerator thru' ejectors, gland steam cooler, and L.P. heaters. These pumps have four stages and since the suction is at a negative pressure, special arrangements have been made for providing sealing.

L.P. Heaters

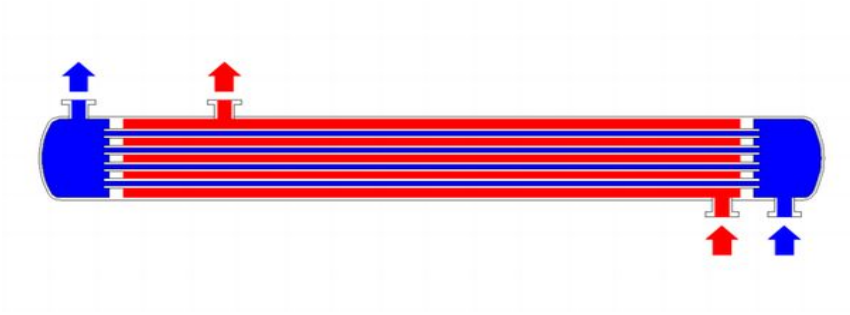
Turbine has been provided with non-controlled extractions which are utilised for heating the condensate, from turbine bleed steam. There are 3 or 4 low pressure heaters in which LP turbine last extractions are used.

Deaerator

Deaerator is a device for air removal from water to make it non-corrosive. Deaerator generally implies not only the deaerator but also the feed water tank below where deaerated water is stored and fed to the suction of boiler feed pumps. The presence of certain gases, principally oxygen, carbon-di-oxide and ammonia, dissolved in water is generally considered harmful because of their corrosive attack on metals, particularly at elevated temperatures. Its function is to remove dissolved gases from the feed water by mechanical means.

Feedwater heater

A Feedwater heater is a component used to pre-heat water delivered to the boiler. Preheating the feedwater reduces the amount of energy needed to make steam and thus reduces plant operation costs. This improves the thermodynamic efficiency of the system.



Feedwater heater

POWER TO ELECTRICITY

The power generated by the turbine is given to generator, which is coupled with shaft of turbine. Generator converts this power into electricity by the rule of Mutual Induction. The electricity produced by the generator is given to the switchyard, which collects, control and finally distribute it through long transformers and cables.

ASH HANDLING SYSTEM

WHAT IS ASH?

Ash is the residue remaining after the coal has been incinerated to constant weight under standard conditions.

- Ash is oxidised form of the mineral matters present in coal.
- Typical ash composition : SiO2, Al2O3, Fe2O3, CaO,MgO etc.
- Coal with more SiO2 & Al2O3, Ash MP > 1400ºC
- Coal with more Fe2O3, CaO & MgO, Ash MP < 1100ºC

WHY ASH HANDLING?

- Ash content of Indian coal used in power station is about 30 to 40 %.
- A typical 2000 MW station produce around 9000T to 12000T of ash per day.
- This huge amount of ash needs to be disposed off continuously.
- Necessary care to be taken for preventing pollution.
- Ash Handling system takes care the above requirement.

WHAT HAPPENS TO THE ASH PRODUCED?

- 20 % Of the ash falls at the bottom of the furnace known as Bottom Ash (BA).
- 80 % of the ash carried away with flue gas known as Fly Ash (FA).
- BA can form slag and clinker depending on the temp of the combustion zone and environment inside reducing environment (Less O2) reduces ash MP.
- BA is disposed off through BA disposal system. The slurry formed shall be transported to slurry sump through pipes.
- FA is collected through ESP and disposed through FA disposal system.

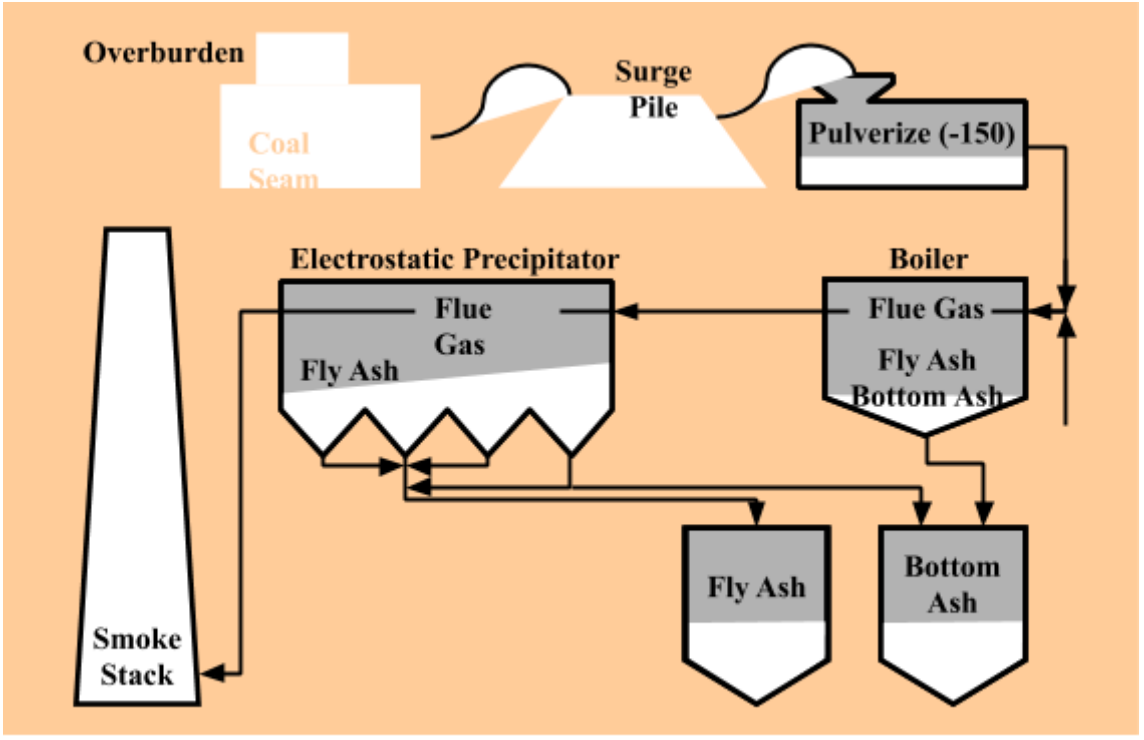
ASH SLURRY PUMP HOUSE

Bottom ash from discharge of jet pumps, economiser and air preheater, slurry from discharge of flushing apparatus and fly ash slurry from wetting head will be led to a common slurry sump of combined ash slurry disposal pump house. From the sump, the slurry shall be continuously pumped to the disposal area by means of slurry pump sets and disposal pipes. Water supply at each of the slurry disposal pump stream suction for flushing the disposal line by running the slurry disposal pumps stream (series) is provided.
The slurry may contain between 15 to 20% ash solids, which are subsequently allowed to sediment under gravity. Approximately 30 to 50% of the water-soluble material will be dissolved in the decanting water.

ASH UTILISATION

Major usages of ash are:

- Fly ash bricks / blocks
- Cellular concrete products
- Light weight aggregates
- Concrete and mortar
- In manufacture of cement
- In manufacture of asbestos products
- Road construction
- Embankment/back fills/land development
- Controlled low strength material (CLSM)
- In agriculture
- Mine filling
- Manufacture of fertilizers



ASH HANDLING PLANT

TRANSFORMERS

“Transformer is a static device which is used to transfer the electrical power from one circuit to other circuit at same frequency and power.

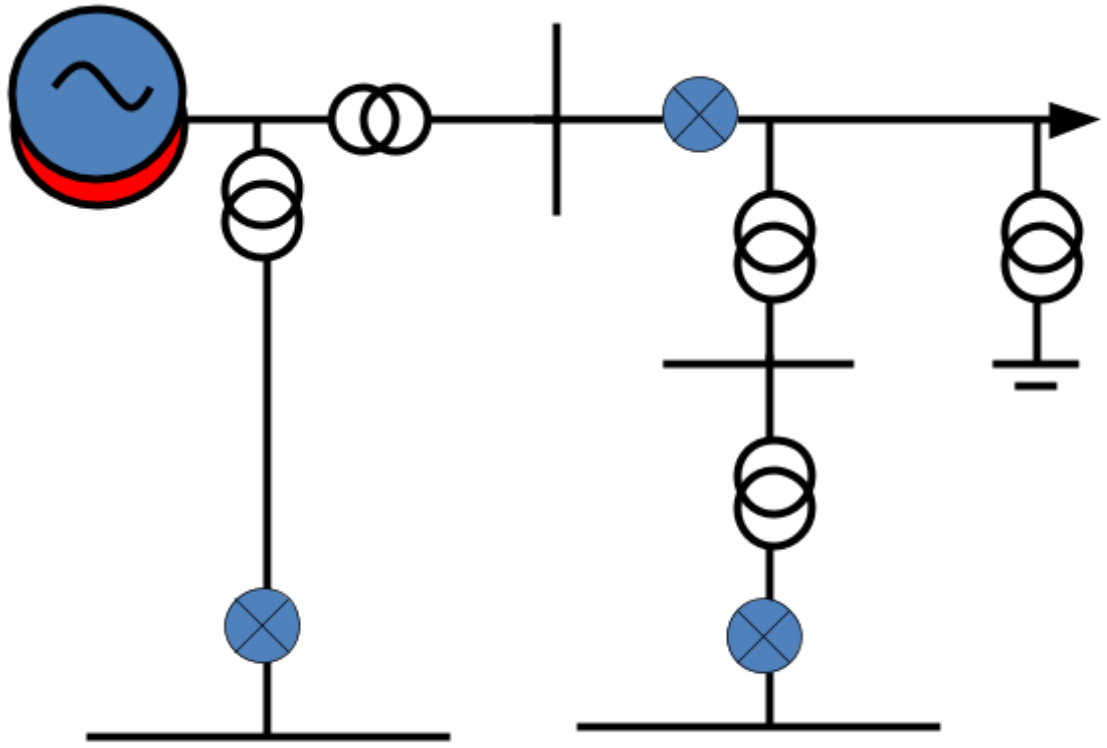
Types

Power transformers : Used in transmission network of higher voltages, deployed for step-up and step down transformer application (420 kV, 132 kV, 66 kV, 33kV)

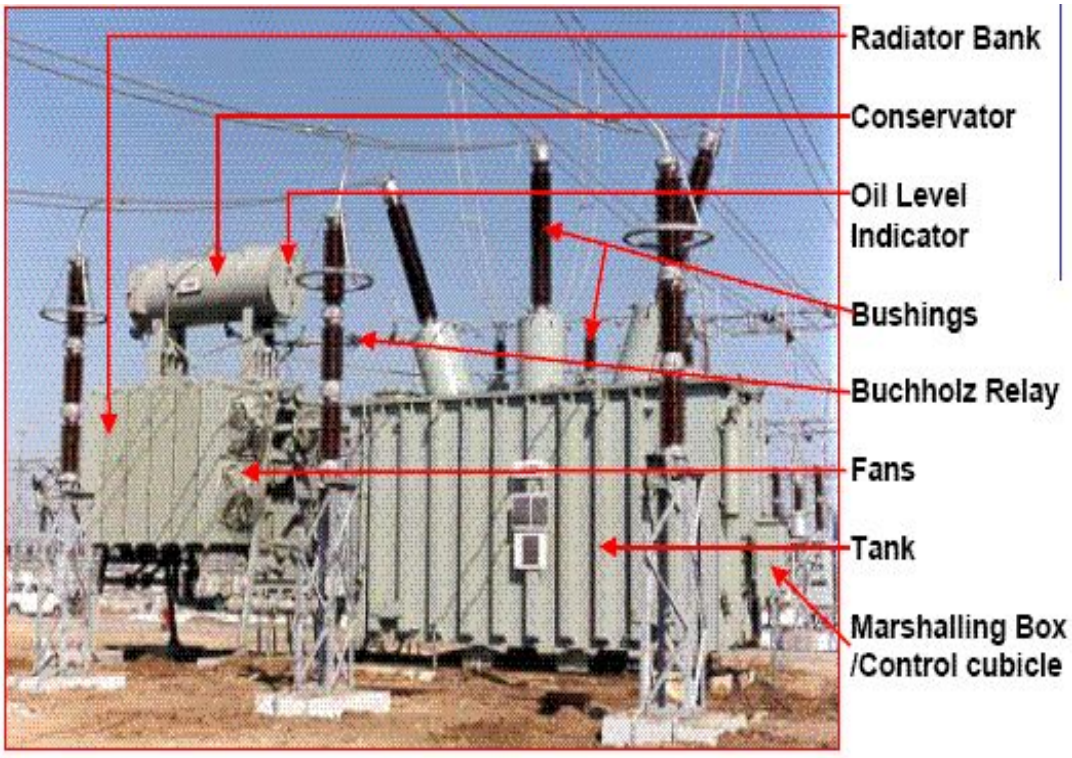
Distribution transformers: Used for lower voltage distribution networks as a means to end user connectivity. (11kV, 6.6 kV, 3.3 kV, 440V, 230V)

Different transformers in a power Plant-

- Generator Transformer (GT)
- Station Transformer (ST)
- Unit Auxiliary Transformer (UAT)
- Inter Connecting Transformer (ICT)



Transformer accessories



Conservator: with the variation of temp there is corresponding variation in the oil volume. To account for this, an expansion vessel called conservator is added to the transformer with a connecting pipe to main tank. In large transformer, an air bag is mounted inside the conservator with the inside bag is open to atmosphere through the breathers & outside surface of the bag in contact with the oil surface.

Breather: to minimize the reduction of insulation strength of transformer conservator is allowed to breathe only through silicate column, which absorbs the moisture in air before it enters the conservator air surface.

Expansion vent (Pressure Relief Device): transformer tank is a pressure vessel as the inside pressure can group steeply whenever there is a fault in the winding and surrounding oil is suddenly vaporized. To prevent bursting of the tank, these tanks are in addition provided with expansion vents.

Bucholz's Relay: this has two Floats, one of them with surge catching baffle and gas collecting space at top. This is mounted in the connecting pipeline between conservator and main tank.

Temperature indicator: there are temperature pockets provided in the tank top cover, which hold the sensing bulls in them. Oil temp measured is that of top oil, where as winding temp is indirect.

COOLING OF TRANSFORMER:

Here the transformers used are oil immersed; heat is dissipated by thermo-syphon sys action. The oil is served as a medium for transferring produced inside the transformer to the outside medium.

As the size of the transformer becomes large, the rate of oil circulating by means of thermo-syphon action becomes insufficient to dissipate all the heat produced and an artificial means of increasing the circulation have to be adopted. Namely forced oil circulation by electric pumps.

Protective Device/Instruments:

WTI
OTI
Buchholz Relay
PRV
Current Transformer for electrical protection

Transformer Insulation

- Minor insulation like inter turn insulation, is achieved using cellulosic paper.
- Major insulation between primary and secondary, phase to phase and inner coil to core. This is achieved by Bakelite, wooden blocks, cellulosic paper cylinders.
- Transformer Oil: derivative or petroleum crude. This has good dielectric strength.

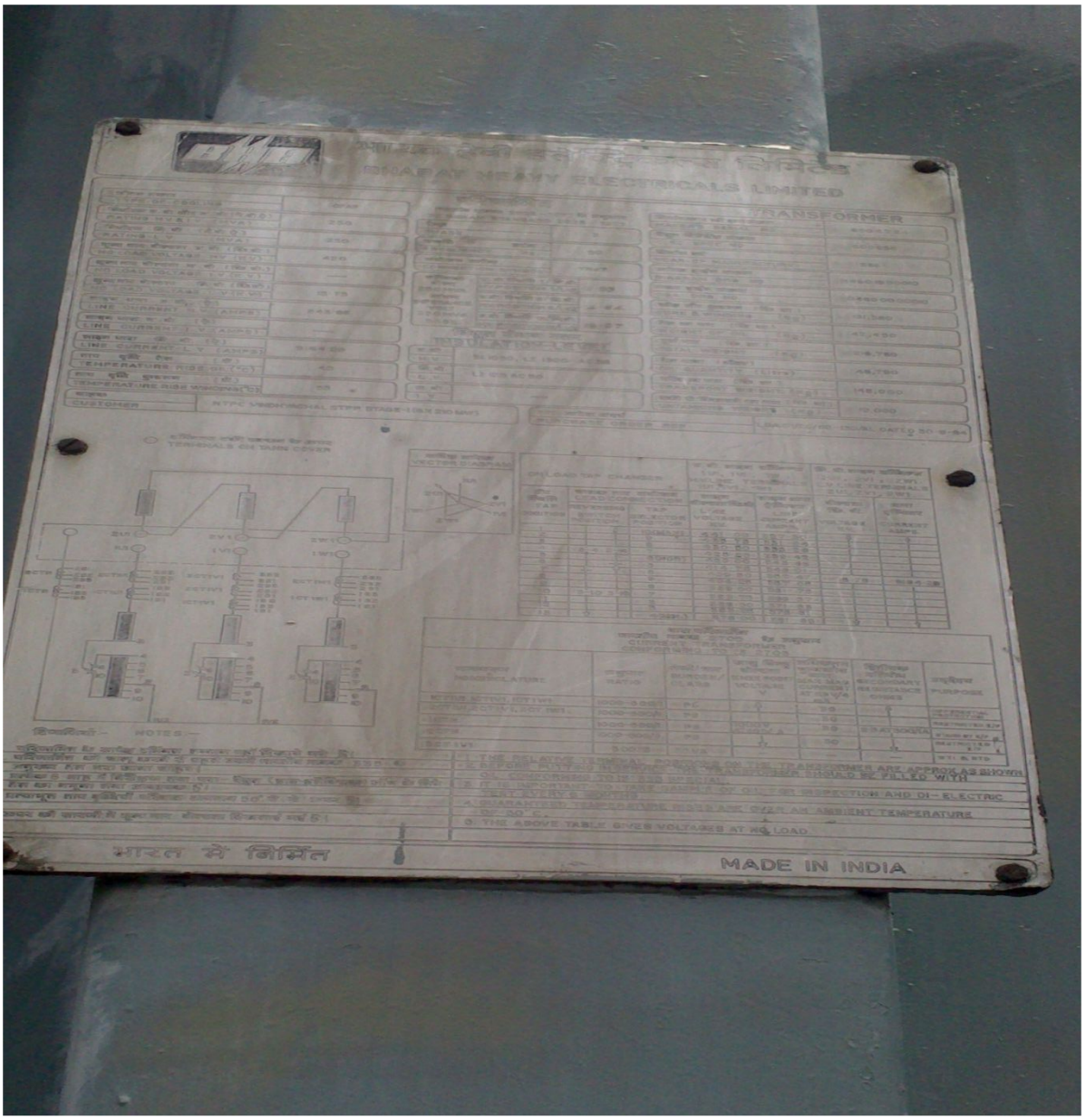
Also a good cooling medium and absorbs heat from the RESISTIVITY VALUES WHEN COMPARED TO PARAFFINIC BASE OILS AND HAVE BETTER OXIDATION STABILITY.

- EQUALLY GOOD PARAMETERS CAN BE ACHIEVED WITH PARAFFINIC BASE OILS ALSO, WHEN PROPERLY REFINED.

Generator transformer stage 1

SPECIFICATION

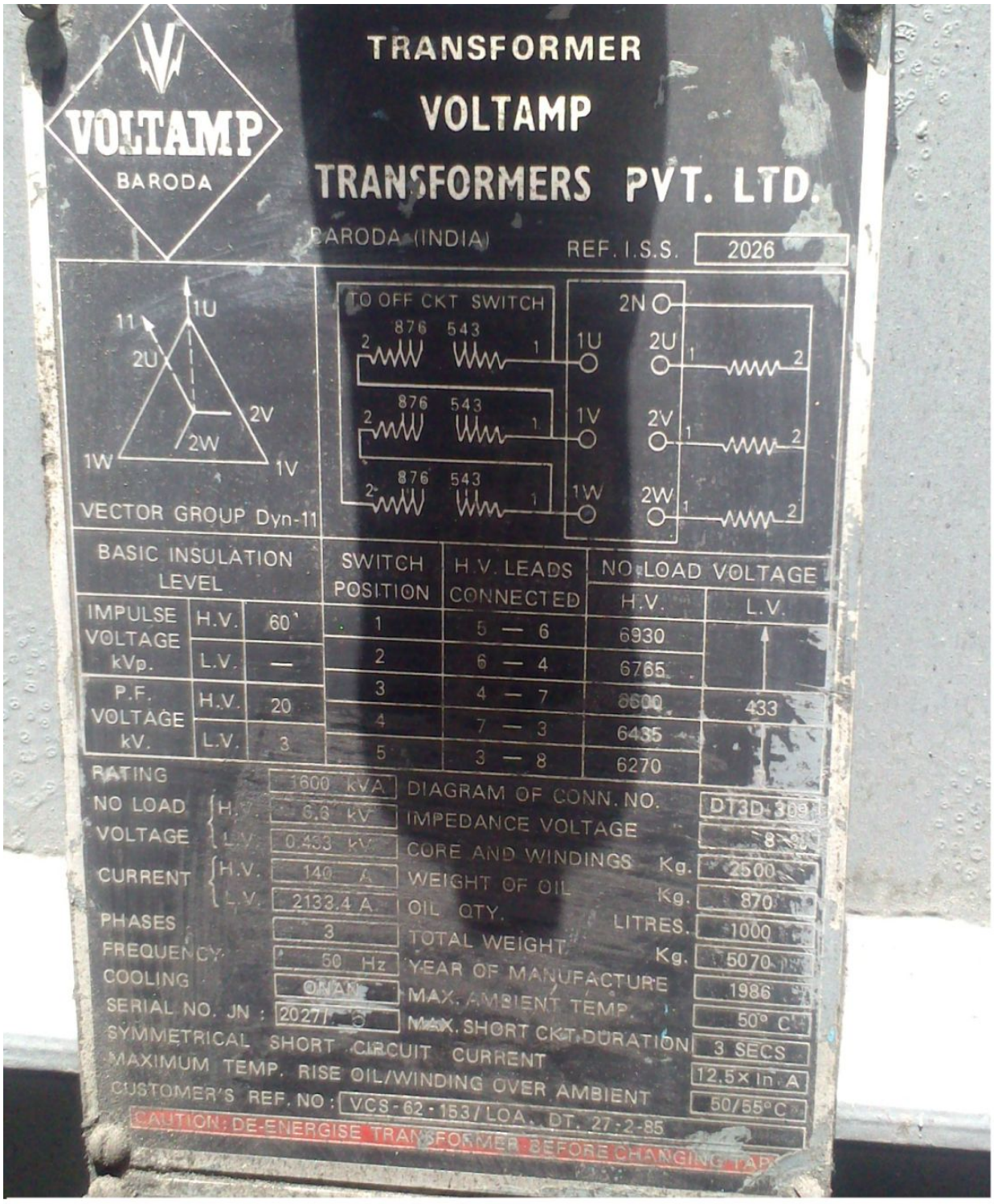
RATED O/P	250MVA
RATED VOLT. (HV)	420KV
RATED VOLT. (LV)	15.75KV
RATED CURRENT (HV)	344A
RATED CURRENT (LV)	9175A


BHARAT HEAVY ELECTRICALS LIMITED
TRANSFORMER
MADE IN INDIA

UAT(unit auxillary transformer)

The generator output is 15.75kv (of stage 1, for other stages it is 21kv) which is stepped up to 400kv by transformer for transmission. However, for running motors and other equipments of power plant, one tapping is taken from the generator output and fed to the unit auxiliary transformer (UAT). UAT steps down the generator o/p voltage to 6.6kv. From UAT two tapping are taken which charge two high tension (HT) bus , i.e. BA and BB of 6.6kv to run HT motors of plant. For HT bus, station transformer charges the HT bus incase UAT or CB fails.
BA and BB bus voltage are further reduced to 440v by step down transformer and form CA and CB bus respectively which are called low tension (LT) buses. LT bus is used for running low tension m/c and equipments of plant such as ceiling fans, lights etc. In case of any failure any failure, LT bus is charged from other unit or from DG (Diesel Generator).

OTI (oil temperature indicator) and
WTI (winding temperature indicator)



Rating of unit auxiliary transformer

GENERATOR

Main Parts of Turbo generator

1. Stator - Stator Frame (Fabrication & Machining)
2. Core Assembly - Stator Core, Core Suspension Arrangement
3. End Shield
4. Stator Winding Assembly - Stator Winding , Winding Assembly, Connecting Bus bar
5. Rotor - Rotor Shaft, Rotor Wedges, Rotor Coils, Wound Rotor, Rotor Assembly
6. Completing Assembly - Bearing Assembly, Shaft Seal Assembly, Oil Catchers, Insert Cover etc
7. Exciter
8. Auxiliary System

EXCITATION SYSTEM are of two types-

Static excitation system (in stage 1)

- Excitation power from generator via excitation transformer. Protective relays for excitation transformer
- Field forcing provided through 415 v aux supply
- Converter divided in to number of parallel (typically 4) paths. Each one having separate pulse output stage and air flow monitoring.
- Two channels : Auto & manual, provision for change over from Auto to Manual
  Limiters: Stator current limiter, Rotor current limiter, Load angle limiter etc.
- Alternate supply for testing

Brushless Excitation System(in stage 2, 3, 4, 5)

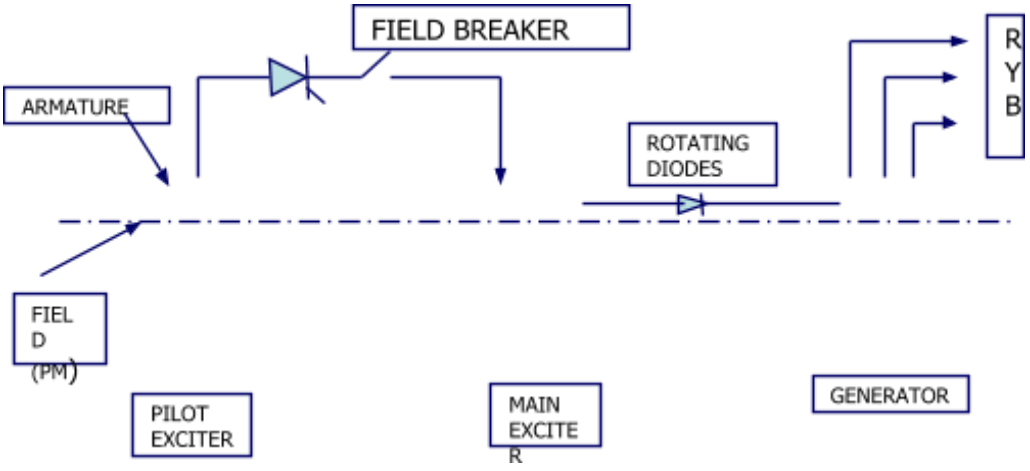
Components:

- Three Phase Main Exciter.
- Three Phase Pilot Exciter.
- Regulation cubicle
- Rectifier Wheels
- Exciter Coolers
- Metering and supervisory equipment.

Features:

- Eliminates Slip Rings, Brush gear and all problems associated with transfer of current via sliding contacts
- Simple, Reliable and increasingly popular system the world over, Ideally suited for large sets
- Minimum operating and maintenance cost

- Self generating excitation unaffected by system fault/disturbances because of shaft mounted pilot exciter



S.NO	Description	Brushless Excitation	Static Excitation
1	Type of system.	Brushless system gets activated with pilot exciter, main exciter and rotating diodes.	Static excitation system uses thyristors & taking supply from output of the generator
2	Dependency on external supply.	No external source requirement since pilot exciter has permanent magnet field.	Field flashing supply required for excitation build up.
3	Response of the excitation system.	Slower than static type since control is indirect (on the field of main exciter) and magnetic components involved.	Very fast response in the order of 40 ms. due to the direct control and solid state devices employed.
4	Requirement of additional bearing and increase of turbo generator shaft length.	One additional bearing and an increase in the shaft length are required.	No additional bearing and increase in shaft length are required.
5	Maintenance.	Less since slip rings and brushes are avoided.	More since slip rings and brushes are required. Also over hang vibrations are very high resulting in faster wear and tear.

GENERATOR COOLING SYSTEM

The 210/ 500 MW generator is provided with an efficient cooling system to avoid excessive heating & consequent wear & tear of its main component during operation.

Rotor cooling system: Rotor is cooled by means of gap pick up cooling, where in the hydrogen gas in the air gap is sucked through the scoops on the rotor wedges & is directed to flow along the ventilating canals milled on the side of the rotor coil, to bottom of the slot where it takes a turn & comes out from the similar canal milled on the other side of the rotor coil to hot zone of the rotor. Due to rotation of the rotor, appositive suction as well as discharge is created due to which a certain quantity of gas flows & cools the rotor.

Hydrogen cooling system: Hydrogen cooling system is used in large capacity generator in view of its high heat carrying capacity & low density, but in view of its forming an explosive mixture with oxygen, proper arrangement for filling.

The hydrogen cooling system mainly comprises of a gas control stand, a drier, a liquid level indicator, hydrogen control panel, gas purity measuring & indicating instrument, valves & necessary instrument necessary for controlling & the inter-connecting piping.

Stator cooling system:

The stator winding is cooled by distillate, which is fed from one end of the machine by Teflon tube and flows through the upper bar & return back through the lower bar of another slot. The cooling water used for cooling stator winding calls for the use of very high quality of cooling water. For this purpose DM water of proper specific resistance is selected. The sys is designed to maintain a constant rate of cooling water flow to stator winding at inlet water temp of 40 digs.

Generator sealing system:

Seal is employed to prevent leakage of hydrogen from the stator at the point of rotor exit. A continuous film between the rotor collar and the Seal Liner (in case of thrust type seal) is maintained by means of oil at pressure, which is about 0.5atm above the casing hydrogen gas pressure. The thrust pad is held against the collar of rotor by means of thrust oil pressure, which is regulated in relation to the hydrogen pressure & positive maintenance of oil film thickness.

The shaft sealing system consists of the following main components:

a) AC oil pump.
b) DC oil pump.
c) Oil injector.
d) Differential pressure regulator.
e) Damper tank.

Bearing:

Self contained ring-oiled bearing are used for horizontal shaft. But for heavy application and high speed, rings oiling is supplemented by recirculation of extremely cooled oil.

Bearing support are designed to afford some degree of alignment of bearing bushing but they are sufficiently rigid so as not affect the critical speed of shaft system

TURBINE

Turbine is the main part of the power plant. The shaft of turbine is directly connected to the rotor of the generator. The shaft rotates at the speed of 3000 rpm. So basically it helps to rotate the rotor of the generator that is why it's called the generator turbine.

Turbine has mainly three parts which can be distinguishing with their pressure level, are:
. High pressure turbine
. Intermediate pressure turbine
. Low pressure turbine

Process:
Highly pressurized (around 170 Kg/ cm^2) super heated (around 520 deg C) steam passes through the high-pressure turbine because of the blade shape (work as a nozzle) it develops pressure on the blades because of this it rotates.

Pressure of the steam drops to 47 Kg/cm^2 and temp drops to 330 deg C in this process. After this it passes through the Re-heater, which is placed in the path of flue gas where its temp rises.

After that this steam passes through the intermediate presses turbine and blades moves because of the shape and energy of the steam. Here the pressure and temp both drops again.

Now this steam passes through the low-pressure turbine and works to move the blades. Here the pressure drops & temp drops again.

SWITCHYARD

Switchgear is one which makes or breaks an electric circuit. The equipments which normally fall in this category are:-

- **Isolators**
- **Switching Isolators**
- **Circuit Breakers**
- **Load Break Switches**
- **Earth Switches**

Isolators can break an electric circuit when the circuit is to be switched on no-load only. These are normally used in various circuits for the purpose of isolating a certain portion when required for maintenance etc.

Switching isolators are capable of
1. Interrupting transformer magnetized currents
2. Interrupting line charging current and
3. Load transfer switching

Its main application is in connection with transformer feeders as the unit makes it possible to switch out one transformer while the other is still on load.

Circuit Breakers can break or make the circuit on load and even on faults. The equipment is most important and is heavy duty equipment mainly utilized for protection of the various circuits and operation at load. Normally circuit breakers are installed accompanied by isolators.

Load break switches are those interrupting devices which can make or break circuits at 8 times the rated current. These are normally installed on the same circuit or on the circuits which are backed up by circuit breakers.

Earth switches are devices which are normally used to earth a particular system to avoid accident, which may happen due to induction on account of live adjoin circuits. These do not handle any appreciable current at all.

CIRCUIT BREAKER (CB)

A circuit breaker breaks the circuit when a fault occurs. Now at high voltages, while breaking the circuit there is an arc produced between the two pieces of contact, which produces heat

and even melts the contacts. So in a circuit breaker we use oil, SF_6 etc. to control or minimize this arc only. If the medium is SF_6, then it behaves as an inert gas and it is pretty hard to ionize the gas so that it can form arcs while breaking the circuit.
There are different ways of classifying circuit breaker. These are:

- On basis of arc quenching medium used
  i. **Oil circuit breaker**
  ii. **Air blast circuit breaker**
  iii. **Sulphur Hexa-fluoride (SF_6) circuit breaker**
  iv. **Vacuum circuit breaker**
  v. **Plasma-** A new type of breaker whose use has begun recently.

- Operating mechanism
  i. **Spring operated circuit breaker**
  ii. **Solenoid operated circuit breaker**
  iii. **Pressure operated circuit breaker**

NOTE: The quality of a circuit breaker depends on the tripping time and the durability of the contact pieces on regular usage. The faster the system is broken off the main circuit the better the circuit breaker is.

SWITCHYARD

It is a switching station which has the following credits :
(i) Main link between Generating plant and Transmission system, which has a large influence on the security of the supply.
(ii) Step-up and/or Step-down the voltage levels depending upon the Network Node.
(iii) Switching ON/OFF Reactive Power Control devices, which has effect on Quality of power.

SWITCHYARD EQUIPMENTS

Transformers :
Transformer transforms the voltage levels from higher to lower level or vice versa, keeping the power constant.

Circuit breakers :
Circuit breakers makes or automatically breaks the electrical circuits under loaded condition.

Isolators :
Opens or closes the electrical circuits under No-load conditions.

Instrument transformers :

Instrument transformers are used for stepping-down the electrical parameter (Voltage or Current) to a lower and safe value for Metering and Protection logics.

Earth switch :

Earth switch is used to connect the charged body to ground to discharge the trapped charge to have a safe maintenance zone.

Lightning arrestors :

Safe guards the equipment by discharging the high currents due to lightning.

Overhead earth wire :

It protects the O/H transmission line from Lightning strokes.

Bus bar :

Bus bar are conductors to which a number of circuits are connected.

Wave Traps/Line traps :

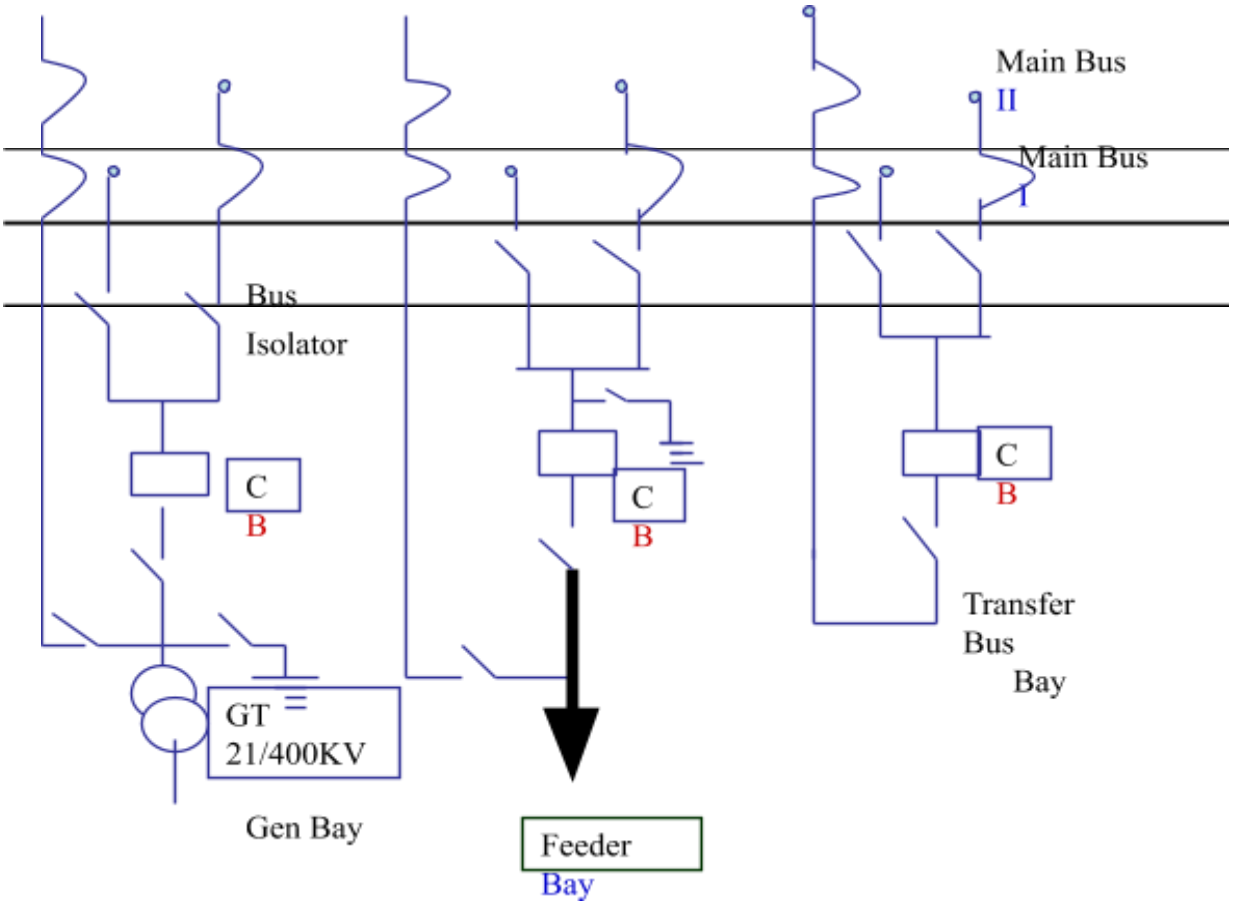
Used in PLCC circuits for Communication and telemetering.

Reactive Power control devices :

Controls the reactive power imbalance in the grid by switching ON/OFF the Shunt Reactors, Shunt Capacitors etc.,

Current Limiting Reactors :

It limits the Short circuit currents in case of faulty conditions.



SINGLE LINE DIAGRAM

CONCLUSION

The training season was very educational and informative. Being a BHARAT NAVRATNA, NTPC has good harmonic relationship and coordination between the staff members. As the vocational training seem laborious job to get in touch with activities. It was nobility of people to provide the information and required theoretical background at their continuous job hour. Most of the equipments were technically strong for huge production. Doing training at NTPC, I hope it would be useful in my future not only in academic but also in professional career. Electricity is just much more than another commodity. It is the life blood of economy and our quality of life. Failure to meet the expectations of society for universally available low cost power is simply not an option. As the world moves to a digital age, our dependency on power quality will grow accordingly. The infrastructure of our power delivery system and the strategies and policies of our insurers must keep pace with escalating demand.

SUGGESTIONS

Some methods to improve the efficiency are

1- Operate the power plant near to design main steam pressure and temperature.

2- Use of VFDs.

3- Replace 6.6 KV HT motors with energy efficient motors.

4- Proper maintenance of LP and HP heaters, economisers, air preheater and superheaters.

5- Maintaining proper vacuum in the condenser.

6- Using LED lights for lighting purpose.

7- Optimising the number of coal Mills running.

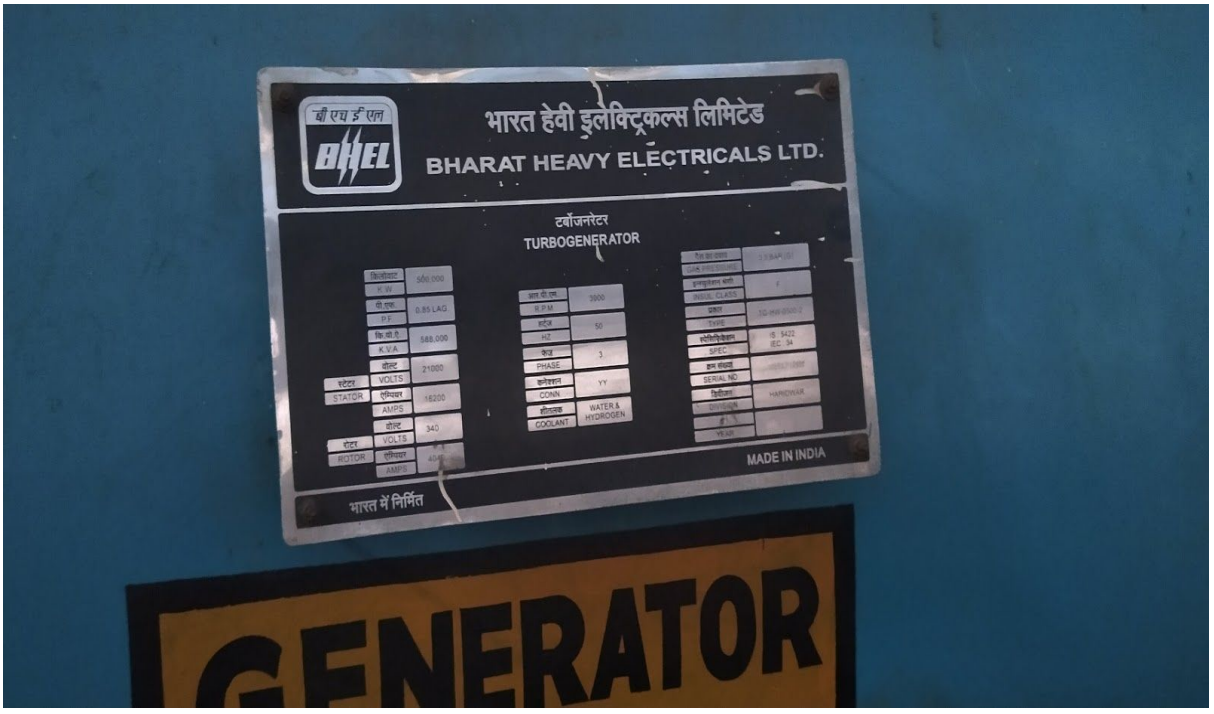
8- Optimising the running of conveyor belts for transporting coal from coal handling plant to main power house site.

9- Optimising the total airflow.

10-Optimising the running of air conditioning systems.

PHOTO GALLERY

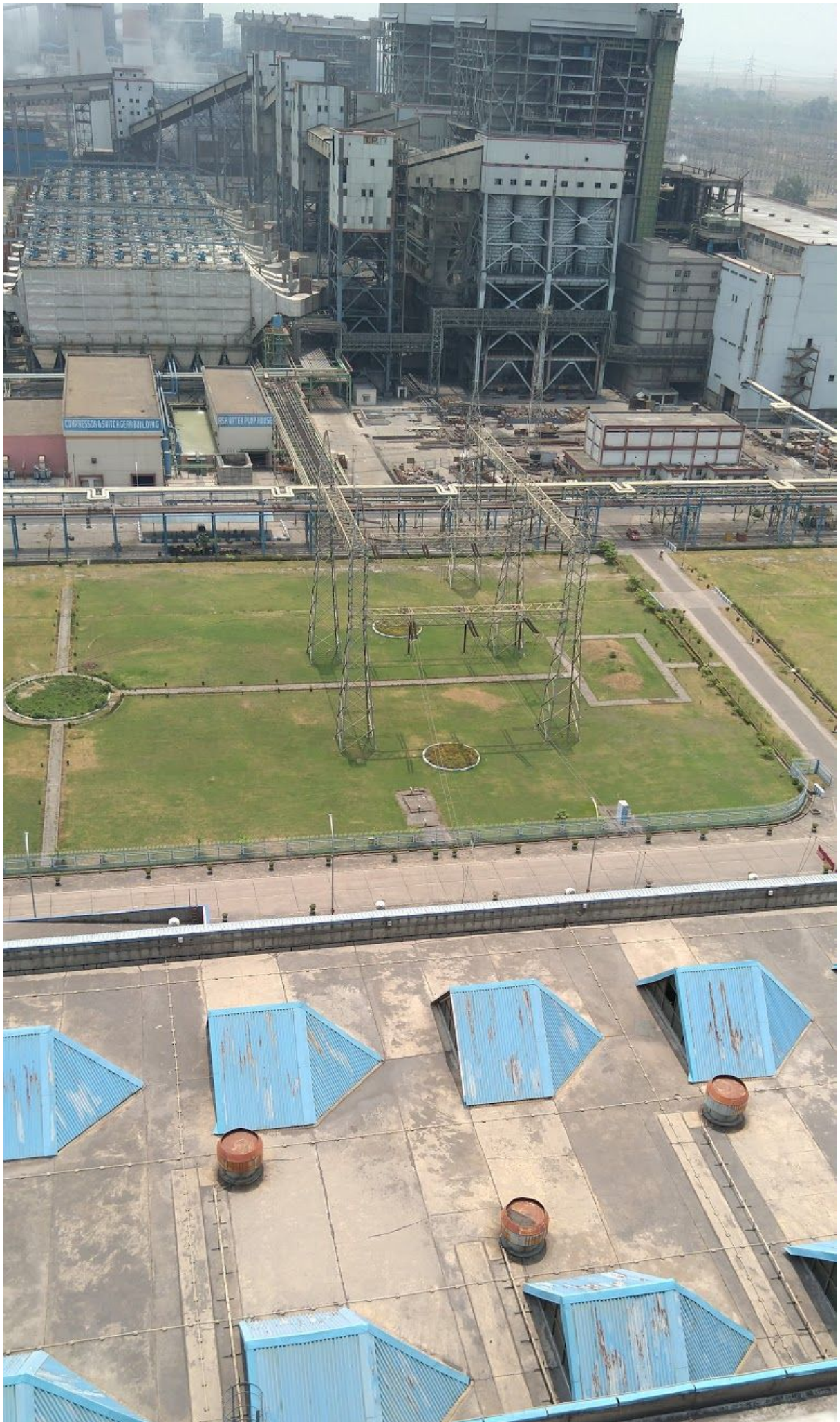
GENERATOR



SWITCH YARD

STAGE-3


ASH DISPOSAL PUMP HOUSE


COMPRESSOR & SWITCHGEAR BUILDING
DSA WATER PUMP HOUSE