Sarvajanik Education Society
SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Electrical Engineering Department

REPORT
ON
INDUSTRAIL VISIT
AT
THERMAL POWER PLANT, UKAI

DATE: 17, April,2025

ELECTRICAL ENGINEERING DEPATMENT
SCET

Industril Visit Detail

Visit to: Ukai Thermal Power Plant
Location: Ukai, Gujarat
Date of Visit: 17 April-2025
Department: Electrical Engineering Department
Institution: Sarvajanik College of Engineering and Technology
Coordinator: Dr. Nilesh V. Shah

Faculty Members Joined for Visit:
1) Dr. Nilesh V. Shah, Associate Professor
2) Prof. Naman Bahtt, Assistant Professor
3) Mr. Munjal Trivedi, Lab Assistant

Number of Students: 54
B.Tech. IV Year [3 students]
B.Tech. III year [16 students]
B.Tech. II year [13 students]
B.Tech. I year [22 students]

Report Prepared By: Students of Electrical Engineering Department

Compiled by: Dr. Nilesh V. Shah, Associate Professor, EED

06:00 am

The journey started from SCET,surat. The 54 students along with 3 faculties were ready for an exciting visit. Sharp at 06:30 am ,one bus of Ukai Dam arrived. It was about to getting afternoon but the students created a very energetic and disciplined environment. The bus were well maintained and comfortable. Within an two hour we were on power plant visit road and our speed geared up. We were yet to cover around 96 kms to reach our destination. After travelling this fun filled journey we were on the entrance to the plant.

Ms. Vaibhavi, Mistry of Ukai Thermal Plant was appointed for the Visit of SCET BTech students at Ukai Thermal Power Plant. She is an alumani of SCET. Sche completed her M. E. From Department of Electrical Engineering in academic year 2017-2018. She has provided detailed practical exposure and demonstrated various components of thermal power plant e.g. Furnace, Boiler, coal and ash handling plant, turbine, alternator, control room, switch yard. Students had wonderful real world learning experience and they had interacted with Engineers for their queries.

The detail description of the Thermal Power Plant is mentioned in the following section.

The Industrial visit had given practical exposure for the content of following subjects:

(i) Power system-1--- BTech Sem-4

(ii) Power System-II ---BTech Sem-5

(iii) Interconnected Power System--- BTech Sem-6

Details of Visit at UNIT-6 THERMAL POWER STATION

Introduction

- Thermal energy is the major source of power generation in India. More than 60% of electric power is produced by steam plants in India. India has large deposit of coal (about 170 billion tonnes), 5th largest in world. Indian coals are classified as A-G grade coals.
- In Steam power plants, the heat of combustion of fossil fuels is utilized by the boilers to raise steam at high pressure and temperature. The steam so produced is used in driving the steam turbines or sometimes steam engines couples to generators and thus in generating electrical energy.
- Steam turbines or steam engines used in steam power plants not only act as prime movers but also as drives for auxiliary equipment, such as pumps, stokers fans etc.
- Steam power plants may be installed either to generate electrical energy only or generate electrical energy along with generation of steam for industrial purposes such as in paper mills, textile mills, sugar mills and refineries, chemical works, plastic manufacture, food manufacture etc.
- The steam for process purposes is extracted from a certain section of turbine and the remaining steam is allowed to expand in the turbine. Alternatively the exhaust steam may be used for process purposes.
- Thermal stations can be private industrial plants and central station.

Advantages And Disadvantages Of A Thermal Power Plant Advantages:

- Less initial cost as compared to other generating stations.
- It requires less land as compared to hydro power plant.
- The fuel (i.e. coal) is cheaper.
- The cost of generation is lesser than that of diesel power plants.

Disadvantages:

- It pollutes the atmosphere due to the production of large amount of smoke. This is one of the causes of global warming.
- The overall efficiency of a thermal power station is low (less than 30%).
- Requires long time for errection and put into action.
- Costlier in operating in comparison with that of Hydro and Nuclear power plants.
- Requirement of water in huge quantity.

Selection of site for thermal power plant

- **Nearness to the load centre:** The power plant should be as near as possible to the load centre to the centre of load .So that the transmission cost and losses are minimum. This factor is most important when Dc supply system is adopted. However in the case of AC supply when transformation of energy from lower voltage to higher voltage and vice versa is possible power plants can be erected at places other than that of load provided other conditions are favorable.

- **Water resources:** For the construction and operating of power plant large volumes of water are required for the following reasons:

(i) To raise the steam in boiler.
(ii) For cooling purpose such as in condensers
(iii) As a carrying medium such as disposal of ash.
(iv) For drinking purposes.

This could be supplied from either rivers or underground water resources. Therefore having enough water supplies in defined vicinity can be a factor in the selection of the site.

- **Availability of Coal:** Huge amount of coal is required for raising the steam. Since the government policy is to use the only low grade coal with 30 to 40 % ash content for power generation purposes, the steam power plants should be located near the coal mines to avoid the transport of coal & ash.
- **Land Requirement:** The land is required not only for setting up the plant but for other purposes also such as staff colony, coal storage, ash disposal etc.

Eg: For 2000MW plant, the land requirement may be of the order of 200-250 acres. As the cost of the land adds up to the final cost of the plant, it should be available at a reasonable price. Land should be available for future extension.

- **Transportation Facilities**: The facilities must be available for transportation of heavy equipment and fuels e.g near railway station.
- **Labour supplies:** Skilled and unskilled laborers should be available at reasonable rates near the site of the plant.
- **Ash Disposal:** Ash is the main waste product of the steam power plant and with low grade coal, it may be 3.5 tones per day , some suitable means for disposal of ash should be though of. It may be purchased by building contractors, or it can be used for brick making near the plant site. If the site is near the coal mine it can be dumped into the disused mines. In case of site located near a river,sea or lake ash can be dumped into it.

- **Distance from populated area:** The continuous burning of coal at the power station Produces smoke, fumes and ash which pollute the surrounding area. Such a pollution due to smoke is dangerous for the people living around the area. Hence, the site of a plant should be at a considerable distance from the populated area.

Major Components of a Thermal Power Plant

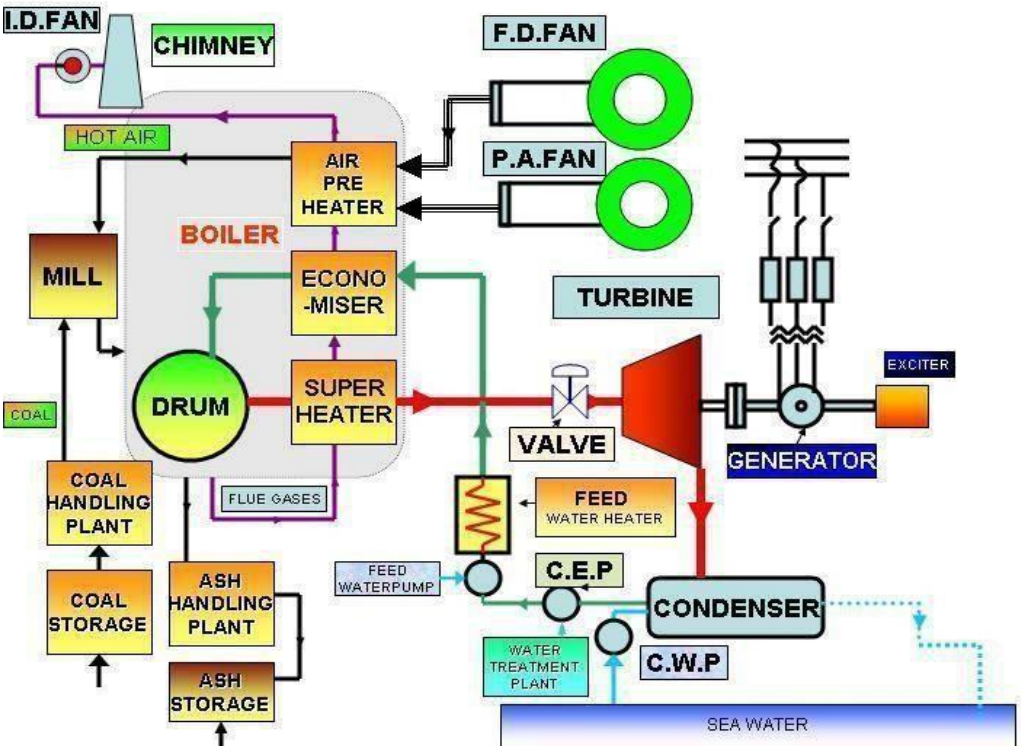

Figure: Schematic diagram of a Thermal power plant.

- **Coal Handling Plant**
- **Pulverizing Plant**
- **Draft or Draught fan**
- **Boiler**
- **Ash Handling Plant**
- **Turbine and Generator**
- **Condenser**
- **Cooling Tower And Ponds**
- **Feed Water Heater**
- **Economiser**
- **Super heater and Reheater**
- **Air pre heater**
- **Alternator with Exciter**
- **Protection and control equipment**
- **Instrumentation**

BOILER

- A boiler (or steam generator) is a closed vessel in which water, under pressure , is converted into steam. The heat is transferred to the boiler by all three modes of heat transfer i.e. conduction ,convection and radiation.
  - Major types of boilers are: (i) fire tube boiler and (ii) water tube boiler
  - Generally water tube boilers are used for electric power stations.

Fire Tube Boiler

- The boiler is named so because the products of combustion pass through the tubes which are surrounded by water.
- Depending on whether the tube is vertical or horizontal the fire tube boiler is divided into two types

1. Vertical tube boiler
2. Horizontal tube boiler

- A fire tube boiler is simple ,compact and rugged in construction. Its initial cost is low.
- Water being more and circulation being poor they cannot meet quickly to changes in steam demand.
- As water and steam ,both are in the same shell, higher pressure of steam are not possible , the maximum pressure which can be had is 17.5 kg/cm^2 with a capacity of 15,000kg of steam per hour.
- For the same output the outer shell of a fire tube boiler is much larger than that of a water tube boiler.
- In the event of a sudden and major tube failure. Steam explosions may be caused in the furnace due to rush of high pressure water into the hot combustion chamber which may generate large quantities of steam in the furnace.
- Fire tube boilers use is therefore limited to low cost small size and low pressure plants.

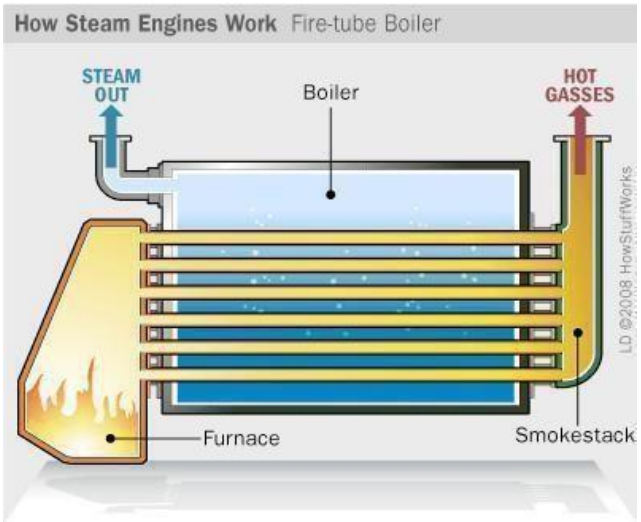

Figure : Fire Tube Boiler Water Tube Boilers

- In this boiler, the water flows inside the tubes and hot gases flow outside the tube .
- Water tube boiler are classified as

1. Vertical tube boiler
2. Horizontal tube boiler
3. Inclined tube boiler

- The circulation of water in the boiler is may be natural or forced.
- For Central steam power plants large capacity of water tube boilers are used.
- The tubes are always external to the drum they can be built in smaller size and therefore withstand high pressure.
- The boiler drum contains both steam and water, the former being trapped from the top of the drum where the highest concentration of dry steam exists.

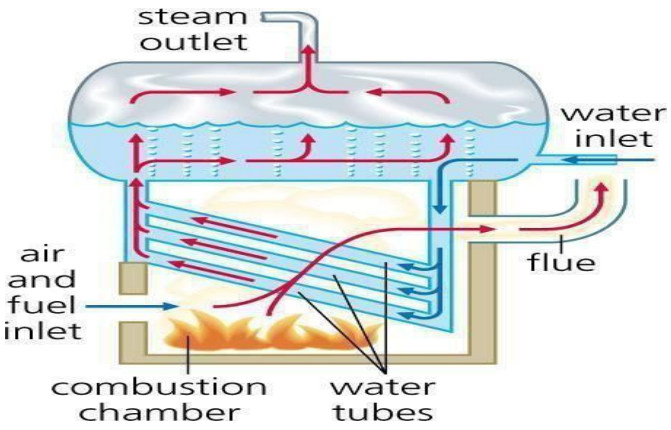

Figure :Water tube boiler

SUPERHEATER AND REHEATERS

- The function of the super heater is to remove the last trash of moisture from the saturated steam leaving the boiler tubes and also increases its temperature above the saturation temperature.
- For this purpose the heat of the combustion gases from the furnace is utilized.
- Super heated steam is that steam which contains more heat than the saturated steam at the same pressure. The additional heat provide more energy to the turbine hence power out put is more.
- Superheated steam causes lesser erosion of the turbine blades and can be transmitted for longer distance with little heat loss
- A superheater may be convention type, radiant type or combination. However ,convention superheaters are more commonly used.

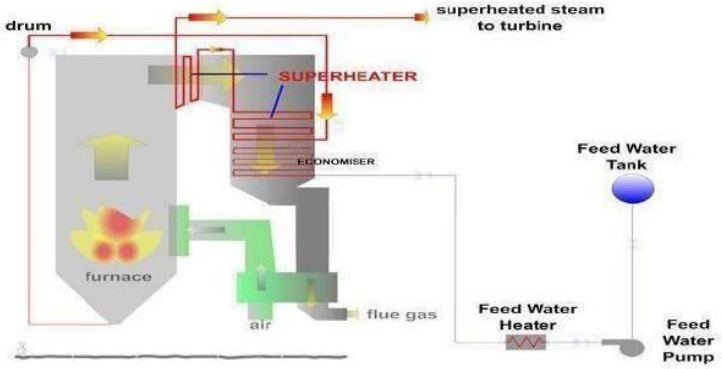

Figure : Functions of superheater

Figure: Superheater

REHEATER

- In addition to super heater modern boiler has reheater also. The function of the reaheater is to superheat the partly expanded steam from the turbine, this ensure that the steam remain dry through the last stage of the turbine.
- A reheater may be convention type, radiant type or combination.

Feed Water Heaters: These heaters are used to heat the feed water by means of blend steam before it is supplied to the boiler. Necessity of heating feed waterbefore feeding it back to the boiler arises due to the following reasons.

- Feed Water heating improve overall efficiency.
- The dissolved oxygen which would otherwise cause boiler corrosion are removed in the feed water heater.
- Thermal stresses due to cold water entering the boiler drum are avoided.
- Quantity of steam produced by the boiler is increased.
- Some other impurities carried by steam and condensate, due to corrosion in boiler and condenser, are precipitated outside the boiler.

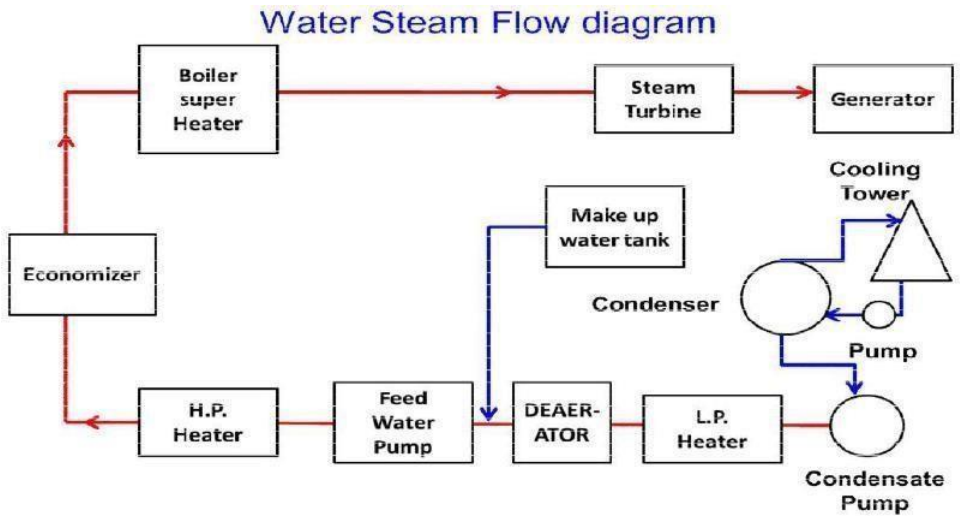

Figure: Water steam flow diagram

ECONOMIZER

- Boilers are provided with economizer and air pre-heaters to recover heat from the flue gases. An increase of about 20% in boiler efficiency is achieved by providing both economizer and air pre-heaters.
- Economizer alone gives only 10-12% efficiency increase, causes saving in fuel consumption 5-15 %. The feed water from the high pressure heaters enters the economizer and picks up heat from the flue gases after the low temperature super heater.

- Economizer can be classified as an inline or staggered arrangement based on the type of tube arrangement.
- For pressure of 70 Kg/cm^2 or more economizer becomes a necessity.
- The tubes are arranged in parallel continuous loops.
- Feed water flows through the tubes and the flue gases outside the tubes across them. The feed water should be sufficiently pure not to cause forming of scales and cause internal corrosion and under boiler pressure.
- The temperature of the feed water entering the economizer should be high enough so that moister from the flue gases does not condense on the economizer tubes.

AIR PREHEATERS

- After the flue gases leave economizer, some further heat can be extracted from them and is used to heat the incoming air for combustion.
- Air preheaters may be of following types:

  - Plate type
  - Tubular type
  - Regenerative type

- Cooling of flue gases by 20^{0}increase the efficiency of the plant by 1%.
- The use of air preheaters is more economical with pulverized fuel boilers because the temperature of flue gases going out is sufficiently large and high air temperatures (250 to 350^0 C) is always desirable for better combustion.
- Air preheaters should have high thermal efficiency, reliability of operation, less maintance charges, should occupy small space, should be reasonable in initial cost and should be accessible.
- In order to avoid corrosion of the air preheaters, the flue gases should not be cooled below the dew point.

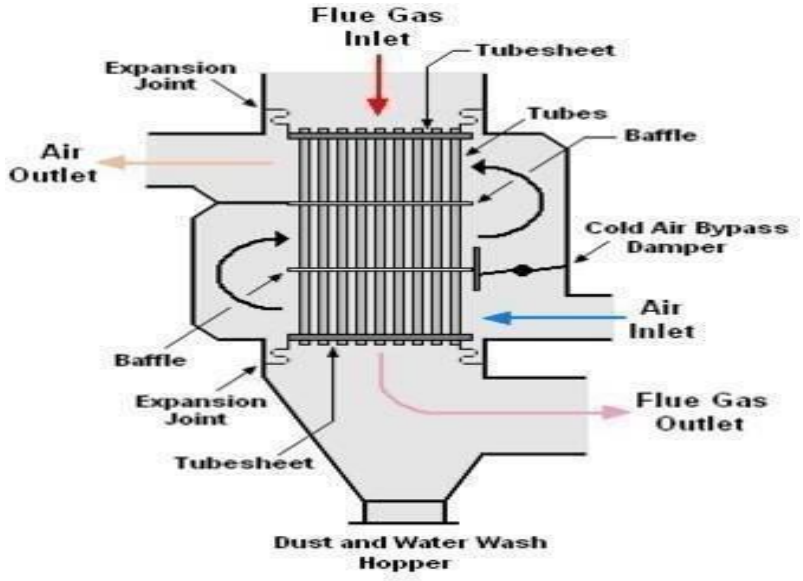

Figure : Air Preheater

STEAM TURBINES

- Steam entering from a small opening attains a very high velocity.
- The velocity attained during expansion depends on the initial and final content of the steam.
- The difference in initial and final heat content represent the heat energy to be converted to kinetic energy.

There are two types of steam turbines:

1) Impluse turbine and
2) Reaction Turbine

Figure: Steam Turbine

Impuse Turbine:

- In this turbine there are alternate rows of moving and fixed blades. The moving blades are mounted on the shaft and fixed blades are fixed to the casing of the turbine.
- A set of fixed nozzle is provided and steam is passed through these nozzles. The P.E in steam due to pressure and internal energy is converted to K.E. The steam comes out of the nozzles with very high velocity and impinges on the rotor blades.
- The direction of steam flow changes without changing its pressure.
- Thus due to the change in momentum the turbine rotor starts rotating.

Reaction Turbine:

- Reaction turbine have no nozzles. These two have alternate rows of moving and fixed blades. The moving blades are mounted on shaft, while fixed blades are fixed in casing of turbine.
- When high pressure steam passes through fixed blades, then steam pressure drops down and velocity of steam increases.
- As steam passes over moving blades, the steam expands and imparts energy,resulting in reduction in

pressure and velocity of steam.

Note:Turbines used in thermal power stations are Impuse, Reaction or combined. Generally multistage turbines are used. H.P steam after doing work in the H.P stage passes over l.P stage . more workis extracted thereby, with consequent increase in thermal efficiency.

Compounding of steam turbines:

Single stage turbines are of low efficiency.

In compounding, a number of rotors are connected or keyed to the same shaft Two types of compounding are used: velocity compounding and pressure compounding **Governing of steam turbines:**

Governing signifies the process of controlling the volume of steam to meet the load fluctuation.

CONDENSERS

The function of the condenser is to condense the steam exiting the turbine. The condenser helps maintain low pressure at the exhaust.

Two types of condensers are used.

Table : Jet and Surface Condensers

Jet condenser (contact type)	Surface condenser (non-contact type)
Exhaust steam mixes with cooling water.	Steam and water do not mix.
Temperature of the condensate and cooling water is same while leaving the condenser.	Condensate temperature higher than the cooling water temperature at outlet.
Condensate cannot be recovered.	Condensate recovered is fed back to the boiler.
Heat exchanged by direct conduction	Heat transfer through convection.
Low initial cost	High initial cost.
High power required for pumping water.	Condensate is not wasted so pumping power is less.

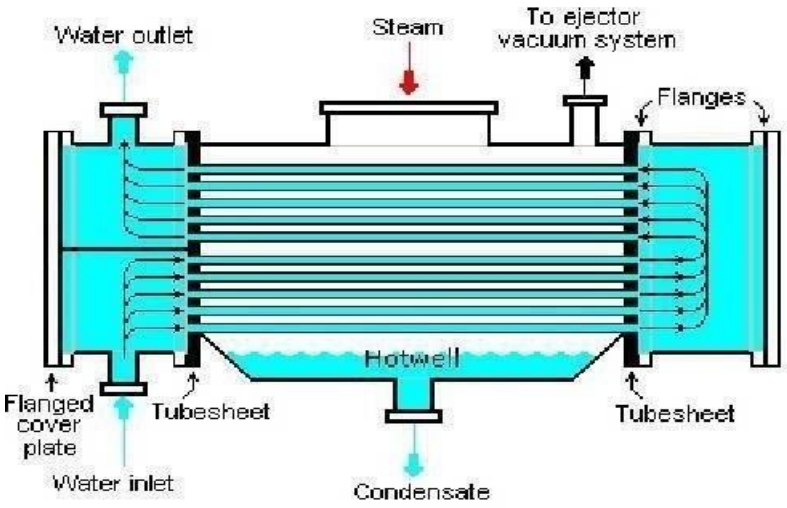

Figure: Condenser

Figure: Surface Condenser

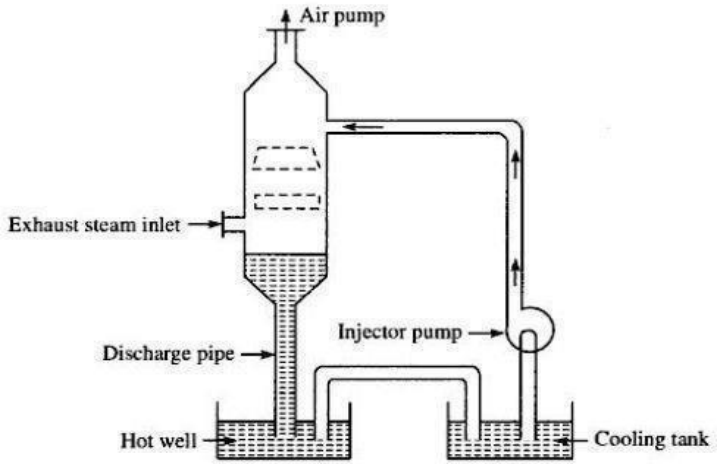

Figure : Jet Condenser

DEAERATORS

- A deaerator is a device that is widely used for the removal of oxygen and other dissolved gases from the feedwater to steam-generating boilers.
- In particular, dissolved oxygen in boiler feedwaters will cause serious corrosion damage in steam systems by attaching to the walls of metal piping and other metallic equipment and forming oxides (rust).

- There are two basic types of deaerators,

1. the tray-type an
2. the spray-type

- The tray-type (also called the cascade-type) includes a vertical domed deaeration section mounted on top of a horizontal cylindrical vessel which serves as the deaerated boiler feedwater storage tank.
- The spray-type consists only of a horizontal (or vertical) cylindrical vessel which serves as both the deaeration section and the boiler feedwater storage tank.

COOLING TOWERS AND SPRAY PONDS

- Condensers need huge quantity of water to condense the steam.
- Water is led into the plants by means of circulating water pumps and after passing through the condenser is discharged back into the river.
- If such a source is not available closed cooling water circuit is used where the warm water coming out of the condenser is cooled and reused.
- In such cases ponds and cooling towers are used where the water loses heat to the atmosphere.

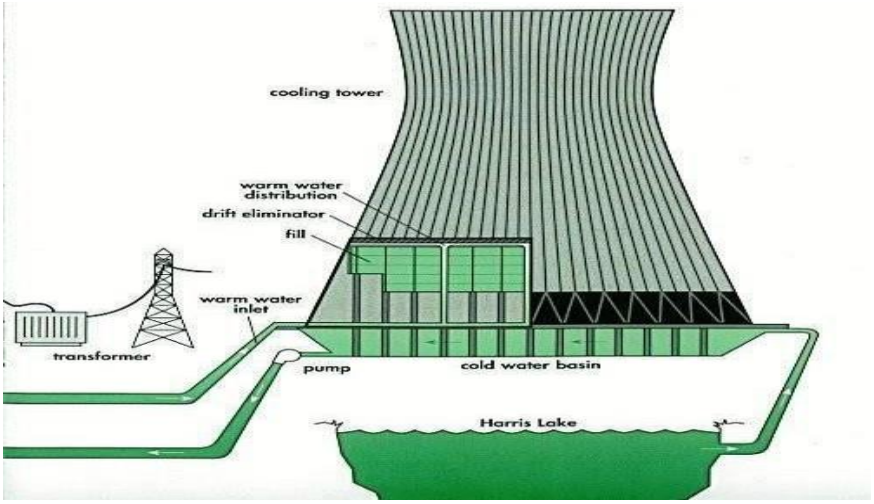

Figure : Cooling Tower

Figure : Cooling Towers

ELECTROSTATIC PRECIPITATORS

- An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge.
- the basic idea of an ESP:
  - *Charging*
  - *collecting.*
  - *removing*

- Every particle either has or can be given a charge—positive or negative.

- we impart a negative charge to all the particles in a gas stream in ESP.

- Then a grounded plate having a positive charge is set up.

- The negatively charged particle would migrate to the grounded collection plate and be captured.

- The particles would quickly collect on the plate, creating a dust layer. The dust layer would accumulate until we removed it.

- The structural design and operation of the discharge electrodes (rigid-frame, wires or plate) and collection electrodes.

  - tubular type ESP
  - plate type ESP

- The method of charging

  - single-stage ESP

  - two-stage ESP
- The temperature of operation

  - cold-side ESP

  - hot-side ESP

- The method of particle removal from collection surfaces

  - wet ESP

  - Dry ESP

Glimpse of the Event

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List of Students & Faculty of Industrial Visit

SARVAJANIK COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

List of Students Attending Industrial Visit at Ukai Hydro and Thermal Plant

Date: 17-April-2025

Btech Sem-4

SR.NO.	ENROLLMENT NO.	STUDENT NAME	Mobile No.	Sign
1	ET23BTEL003	CHAUHAN JAINAM KANUBHAI	9023959690	
2	ET23BTEL006	GAJJAR SARVAGNA	9978459144	
3	ET23BTEL011	RAKTIM PANRUI	8980377429	
4	ET23BTEL013	SOLANKI HARSHVARDHAN	9328469659	
5	ET23BTEL014	YUG AGARWAL	9879928249	
6	ET24BTEL801	ABHIJITH SANTOSH	8238301035	
7	ET24BTEL802	CHOUDHARY RITIK	7046447874	
8	ET24BTEL803	HINGU YASH	9429735928	
9	ET24BTEL810	NAYAN SURTI	9638531783	
10	ET24BTEL811	SURTI MEET		
11	ET24BTEL812	TAYADE KUNAL		
12	ET24BTEL814	ZAVERI HARSHAL		
13	ET24BTEL901	KANHAI TRIVEDI		
Btech Sem-6				
14	ET21BTEL007	JAYNIKA VIJAY JEEWA	9638306657	
15	ET21BTEL023	PATEL NOAMAN SALIMBHAI	9016661945	
16	ET21BTEL024	PATEL VRAJKUMAR PRAVINBHAI	9033117779	
17	ET21BTEL030	SHUKLA MAHARSHI	9825967403	
18	ET21BTEL031	SIDDHPURIA MAULINI UDAYKUMAR	9974189502	
19	ET22BTEL001	ABHILASH BANERJEE	9558524399	
20	ET22BTEL002	DEVANI DHRUV MANOJBHAI	6358175174	
21	ET22BTEL003	HARSHAL ANISH KABRAWALA	9484448889	
22	ET22BTEL005	JOSHI AADITYA PARESHKUMAR	9870000146	
23	ET22BTEL008	PATEL ABHI CHHAGANBHAI	8849454896	
24	ET22BTEL009	PATEL JAY DHARMESHBHAI	9408721790	
25	ET22BTEL010	PATEL MANAN UTTAMBHAI	8141077818	
26	ET22BTEL011	PATEL MOHIT BRIJESHKUMAR	8160990806	
27	ET22BTEL014	VERMA JIGARKUMAR	9913453274	
28	ET23BTEL801	AMIT KUMAR	6005389418	
29	ET23BTEL805	PATEL SHUBHAM UMEDBHAI	6359736349	
Btech Sem-2				
30	ET24BTEL001	AMBADATH ADITYA SUNIL	9016005421	
31	ET24BTEL002	BHANABHAGVANWALA MOHIT ALPESHKUMAR	9099056532	
32	ET24BTEL003	BHAVYA THARAKAN	8849065660	
33	ET24BTEL004	DHRUTIBEN RAKESHKUMAR PARMAR	9825768928	

ELECTRICAL ENGINEERING DEPARTMENT SCET SURAT

34	ET24BTEL007	DURVA PATEL	9099075533	
35	ET24BTEL008	GANDHI AYUSH HITESHKUMAR	8160131847	
36	ET24BTEL009	GANDHI PRISHA PARAGBHAI	9408334563	
37	ET24BTEL011	JASH AMISHKUMAR PATEL	9825939384	
38	ET24BTEL012	KAPADIA KALYAAN SNEHAL	9033095534	
39	ET24BTEL013	KHANDWALA KAVYA DHARIT	9727039190	
40	ET24BTEL014	KHILAWALA UJVAL VIMALKUMAR	8141680005	
41	ET24BTEL019	PARMAR PRAKASH CHANDUBHAI	7874432985	
42	ET24BTEL020	PATEL DAKSH RAKESHKUMAR	7046030116	
43	ET24BTEL021	PATEL JIYA VASANTBHAI	9601404051	
44	ET24BTEL022	PATEL KRISH JITENDRA	9824227047	
45	ET24BTEL024	PATEL VISHVAKUMARI NAVINBHAI	9725107445	
46	ET24BTEL025	REVATHY NAIR	9104861308	
47	ET24BTEL026	SHAH LUCKY LALITKUMAR	7861070770	
48	ET24BTEL029	VAGHASIYA DEVAM JAGDISHBHAI	9512327421	
49	ET24BTEL032	VEER SHAH	9737927226	
50	ET24BTEL033	YASH AMIT JINWALA	9499774999	
51	ET24BTEL034	YASHASVI PANKAJ AGARWAL	8905566798	
Btech Sem-8				
52	ET21BTEL004	Tej Desai	7984841773	
53	ET21BTEL011	Hitarth Lekhadiya	6354285443	
54	ET21BTEL019	Jaimin Patel	9099716369	
Faculty Member				
55	Associate Professor	Dr. Nilesh V. Shah	9427808978	
56	Assiastant Professor	Prof. Naman Bhatt	9879489915	
57	Lab Assistant	Mr. Munkal Trivedi	9824733779	

ELECTRICAL ENGINEERING DEPARTMENT SCET SURAT