UNIT III

STEAM POWER PLANT

Basic Civil and Mechanical Engineering

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Steam Power Plant

Steam is used to drive steam engines and steam turbines due to the following reasons:

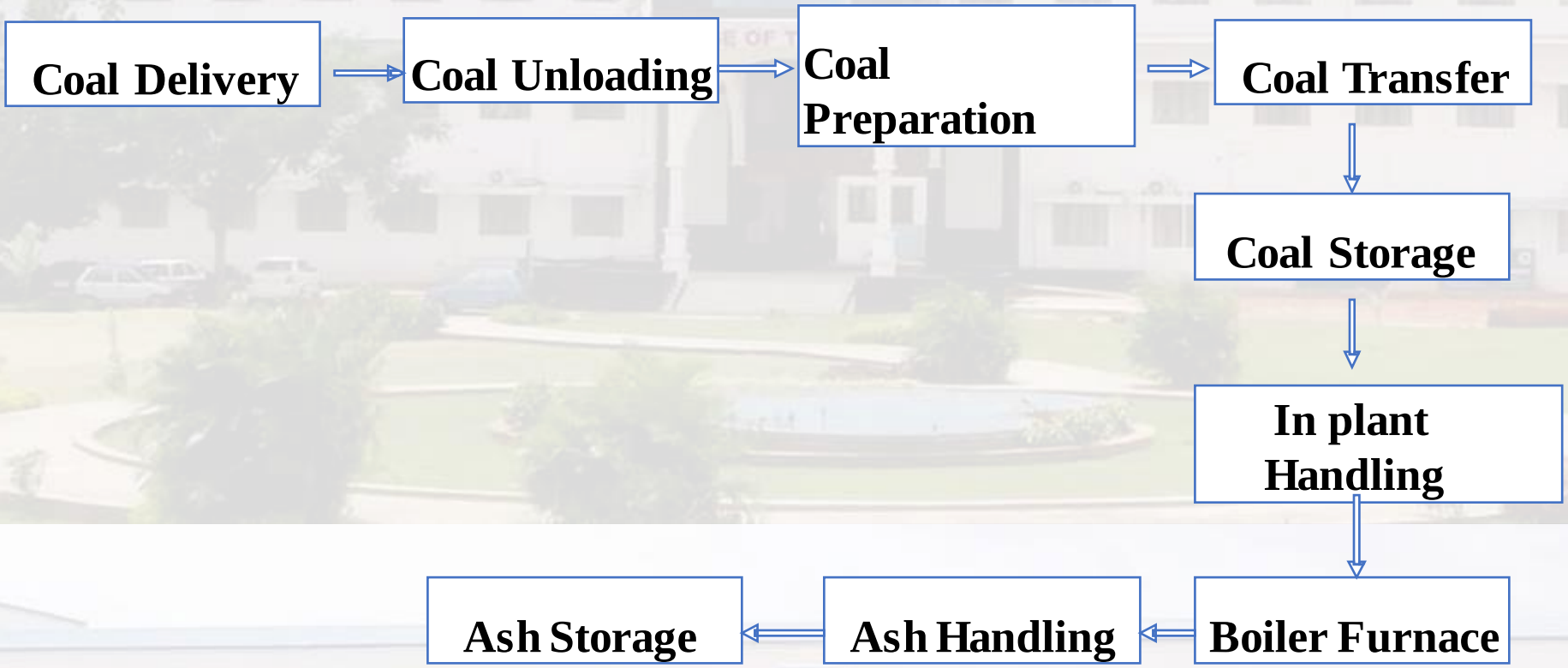
1. Steam can be raised quickly from water
2. It does not react much with materials.
3. It is stable at temperatures required in the plant

Layout of Steam Power Plant

The layout of steam power plant has the following circuits:

1. Fuel (Coal) and ash circuit
2. Air and flue gas circuit
3. Feed water and steam flow circuit
4. Cooling water flow circuit.

Coal and Ash Circuit



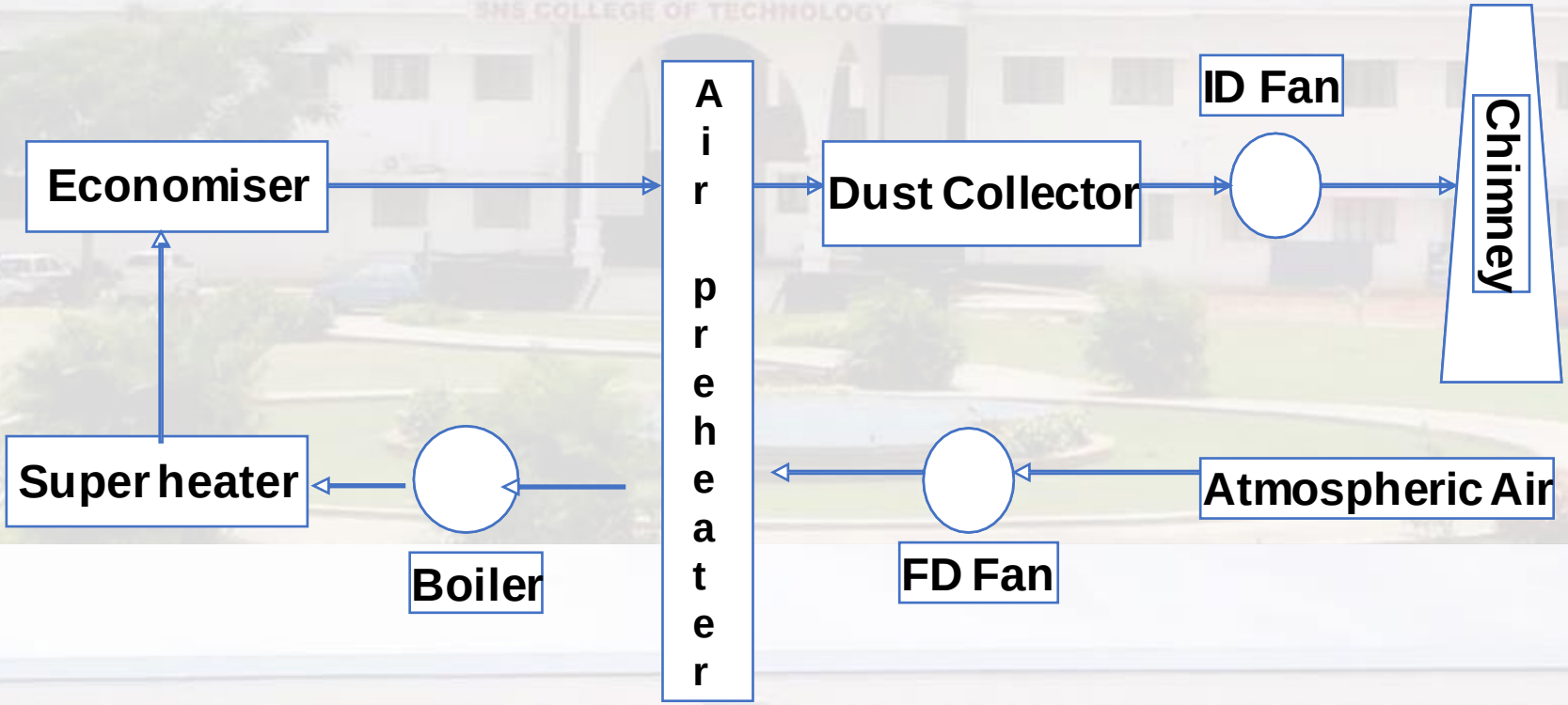
Coal and Ash Circuit

- Coal from mines is delivered by ships, rails or trucks to the power station.
- Coal received at coal yard.
- Coal is sized by crushers, breakers etc.,
- The sized coal is stored in coal storage.

Coal and Ash Circuit

- From stock yard, the coal is transferred to the boiler furnace by means of conveyors, elevators etc.,
- The coal is burnt in the boiler and ash is formed.
- Ash coming out of the furnace will be too hot, dusty and accompanied by poisonous gases.
- The ash is transferred to the ash storage.
- Generally the ash will be quenched to reduce the temperature and the dust content

Air and Flue Gas Circuit



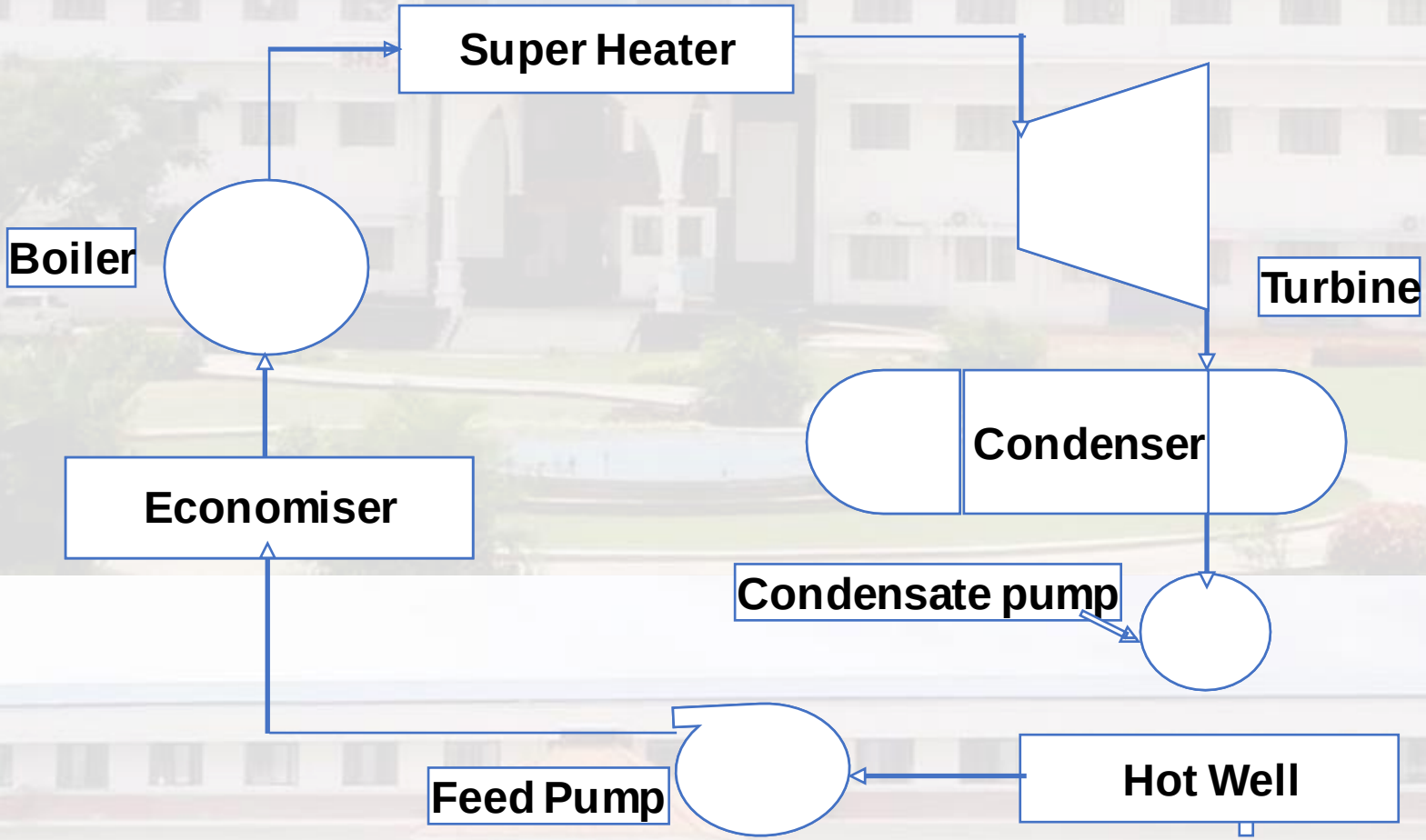
Air and Flue Gas Circuit

- Air is taken from the atmosphere by the action of FD fan.
- It is passed through an air pre heater
- The air is preheated by the flue gases in the pre heater.
- This preheated air is supplied to the furnace to aid the combustion of fuel.

Air and Flue Gas Circuit

- Due to the combustion of fuel the flue gases are formed.
- The flue gases from the furnace pass over the boiler tubes and super heater tubes.
- Then the flue gases pass through economiser to heat the feed water.
- After that it passes through a dust collector.
- It is then exhausted to atmosphere through chimney.

Water and Steam Circuit



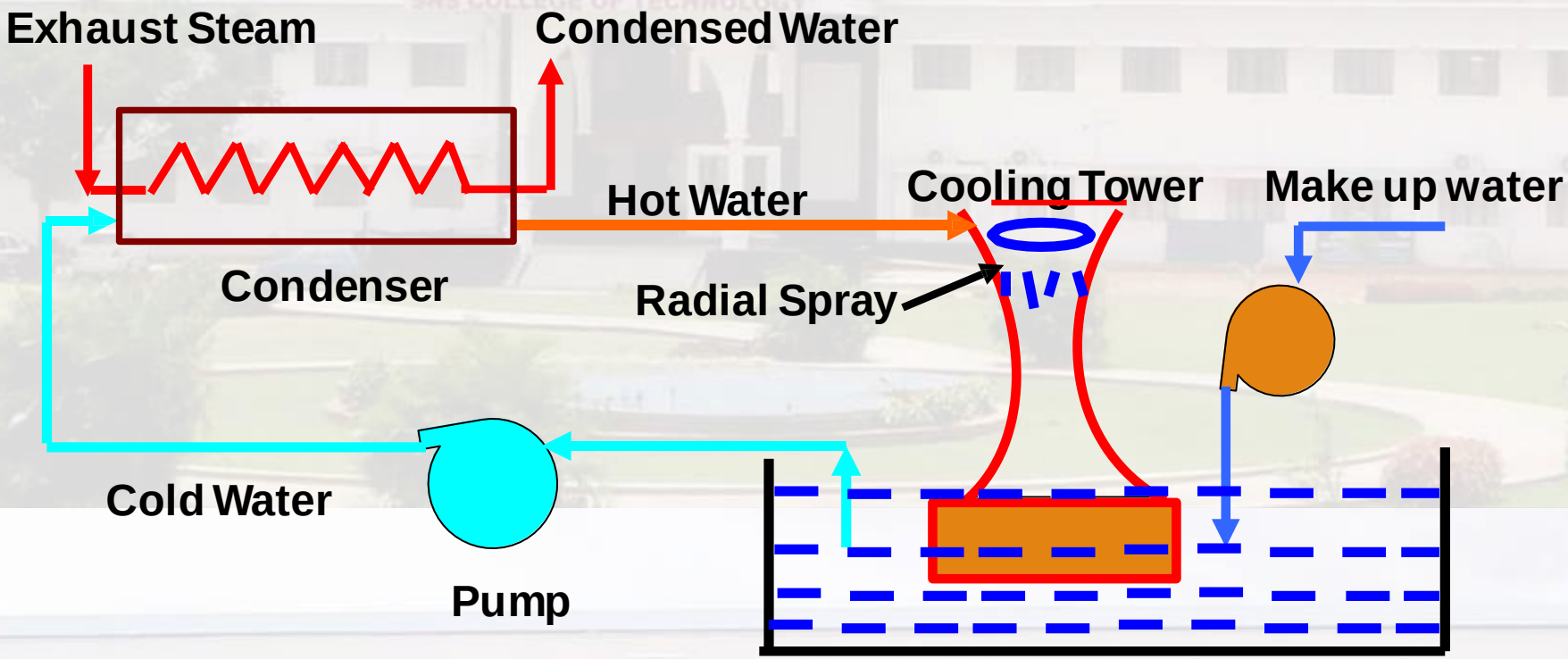
Water and Steam Circuit

- The water is preheated by the flue gases in the economiser.
- This preheated water is then supplied to the boiler drum.
- Heat is transferred to the water by the burning of the coal.
- Due to this, water is converted into the steam

Water and Steam Circuit

- The steam raised in boiler is passed through a super heater.
- It is superheated by the flue gases.
- The turbine drives generator to produce electric power.
- The expanded steam is then passed through the condenser.
- In the condenser, steam is condensed into water the re circulated

Cooling Water Circuit



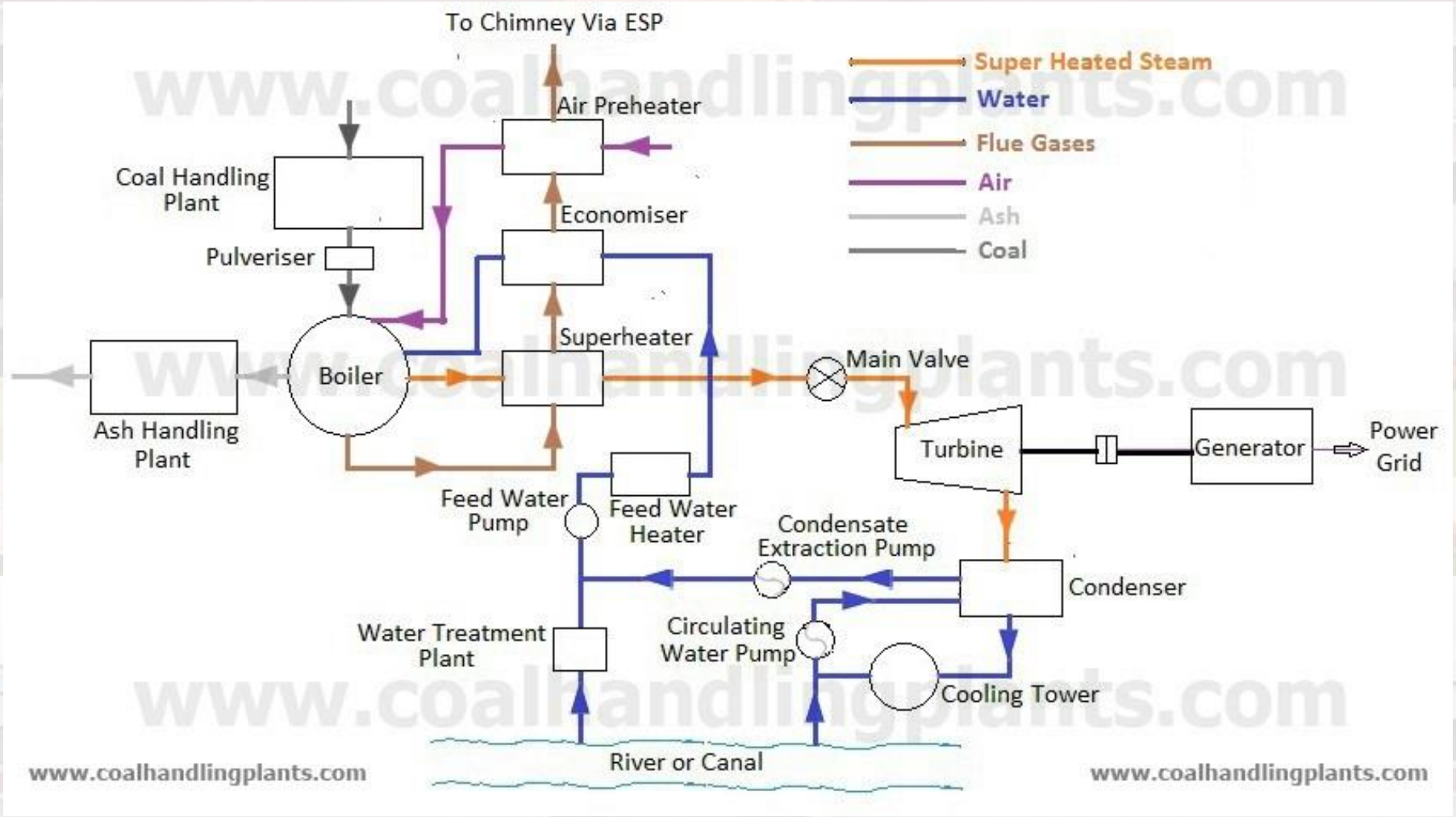
Cooling Water Circuit

- The exhaust steam from the turbine is condensed in the condenser.
- In the condenser, the cold water is circulated to condense the steam into water.
- The steam is condensed by loosing its latent heat to the circulating the cold water.
- Hence the cold water gets heated.
- This hot water is then taken to a cooling tower.
- In cooling tower the water is sprayed in the form of droplets through nozzles.

Cooling Water Circuit

- The atmospheric air enters the cooling tower from the openings provided at the bottom of the tower.
- This cold water is again circulated through the pump, condenser and the cooling
- Some amount of water may be lost during circulation.
- Hence make up water is added to the pond by means of a pump

Steam (Thermal) Power Plant



Steam (Thermal) Power Plant

Layout of Steam (Thermal) Power Plant

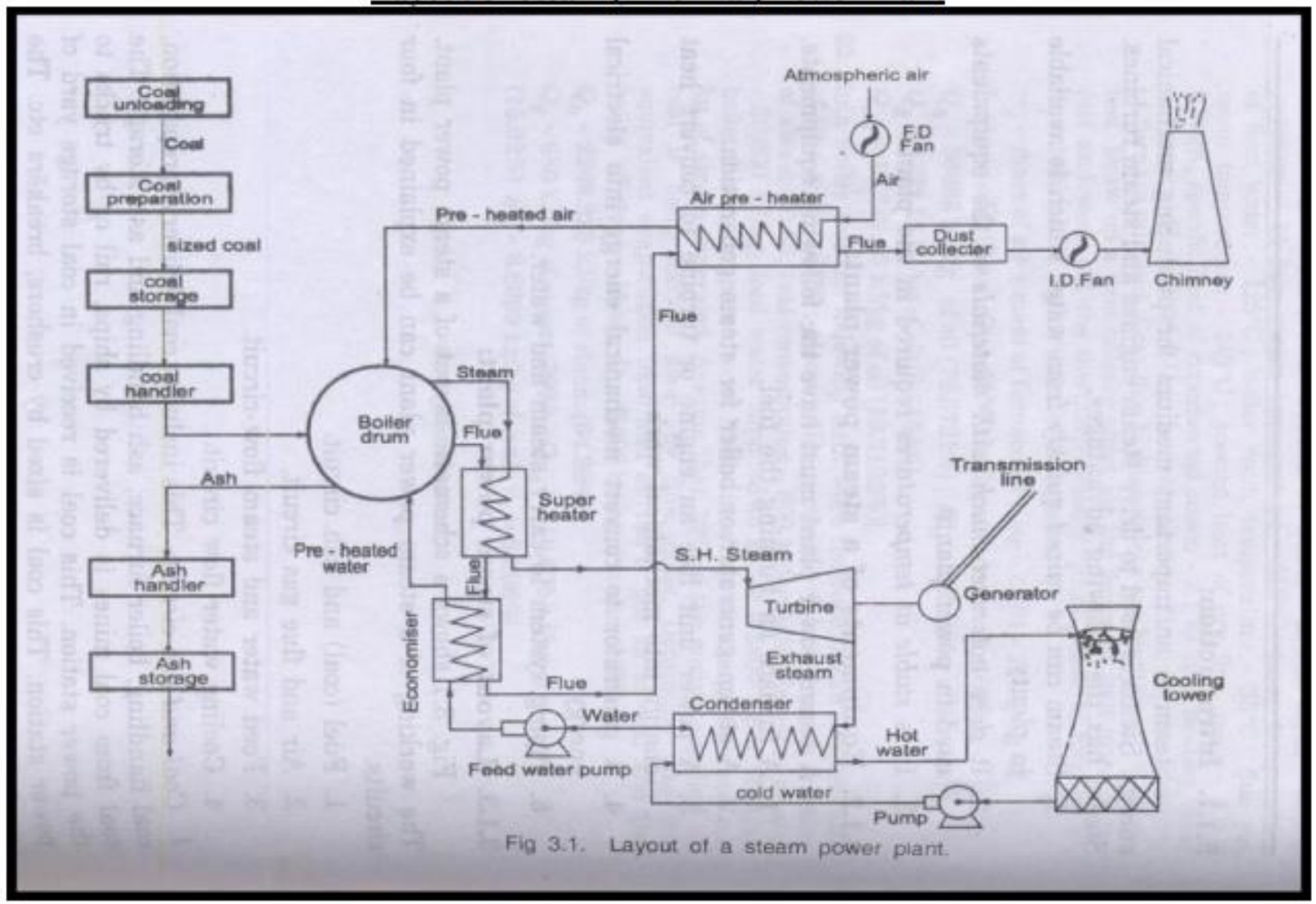
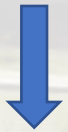


Fig 3.1. Layout of a steam power plant.

Energy Conversion Process

Chemical Energy (Fuel/Coal)

Heat Energy (Boiler)



Mechanical Energy (Turbine)

Electrical Energy (Generator)

Advantages

- Life of plant is more (25-30 years) compared to Diesel plant (2-5 years)
- Repair and maintenance cost is low when compared to diesel plant.
- Initial cost is less compared to nuclear plant.
- Suitable for varying load conditions.
- No radio active harmful wastes are produced
- Unskilled operators can operate the plant.
- The power generation does not depend on the water storage.
- There are no transmission losses, as they are located near load centres.

Disadvantages

- Less efficient than diesel plants.
- Starting up and bringing into service takes more time.
- Cooling water required is more.
- Space required is more.
- Storage required for the fuel is more.
- Ash handling is a big problem
- Not economical in areas which are remote from coal fields.
- Manpower required is more.
- For large units, the capital cost is more.

THANK YOU

ASSESSMENT

https://play.kahoot.it/v2/?quizId=5f54a816-752c-4648-b1aa-a7d61c8ebbc7