1.3 SUPER CRITICAL BOILERS

Boiler is an apparatus to produce steam. Thermal energy released by combustion of fuel is transferred to water, which vaporizes and gets converted into steam at the desired temperature and pressure.

The steam produced is used for:

- Producing mechanical work by expanding it in steam engine or steam turbine.
- Heating the residential and industrial buildings.
- Performing certain processes in the sugar mills, chemical and textile industries.
- Boiler is a closed vessel in which water is converted into steam by the application of heat. Usually boilers are coal or oil fired.

A BOILER SHOULD FULFIL THE FOLLOWING REQUIREMENTS

Safety. The boiler should be safe under operating conditions.

Accessibility. The various parts of the boiler should be accessible for repair and maintenance.

Capacity. The boiler should be capable of supplying steam according to the requirements.

Efficiency. To permit efficient operation, the boiler should be able to absorb a maximum amount of heat produced due to burning of fuel in the furnace.

It should be simple in construction and its maintenance cost should be low. Its initial cost should be low. The boiler should have no joints exposed to flames. The boiler should be capable of quick starting and loading. The performance of a boiler may be measured in terms of its evaporative capacity also called power of a boiler. It is defined as the amount of water evaporated or steam produced is in kg per hour. It may also be expressed in kg per kg of fuel burnt.

The increasing fuel costs with decreasing fuel quantity have constantly persuaded power engineers to search for more economical methods of power generation. The most recent method to produce economical thermal power is by the use of super-critical steam cycle.

Between the working ranges of 125 bar and 510°C to 300 bar and 600°C, large numbers of steam generating units are designed which are basically characterized as sub-critical and super-critical. Usually a sub-critical boiler consists of three distinct sections as preheater (economizer), evaporator and superheater and in case of super-critical boiler, the only preheated and superheaters are required.

The constructural layouts of both types of boilers otherwise practically identical. With the recent experiments gained in design and construction of super-critical boilers, it has become a rule to use super-critical boilers above 300 MW capacity units.

The **advantages** of supercritical boilers over critical types are listed below:

The heat transfer rates are considerably large compared with sub-critical boilers. The steam side heat transfer coefficient for sub-critical is 16500 kJ/m^2-hr°C when the steam pressure and temperature are 180 bar and 538°C whereas the steam side heat transfer, coefficient for super-critical boiler is 220000 kJ/m^2hr-°C when the steam is generated at 240°C.The pressure level is more stable due to less heat capacity of the generator and therefore gives better response. Higher thermal efficiency (40-42%) of power station can be achieved with the use of super critical steam. The problems of erosion and corrosion are minimized in super-critical boilers as two phase mixture does not exist. The turbo generators connected to super critical boilers can generate peal loads by changing the pressure of operation. There is a great ease of operation and their comparative simplicity and flexibility make them adaptable at load fluctuations.