POWER PLANT ENGINEERING

DIESEL POWER PLANT

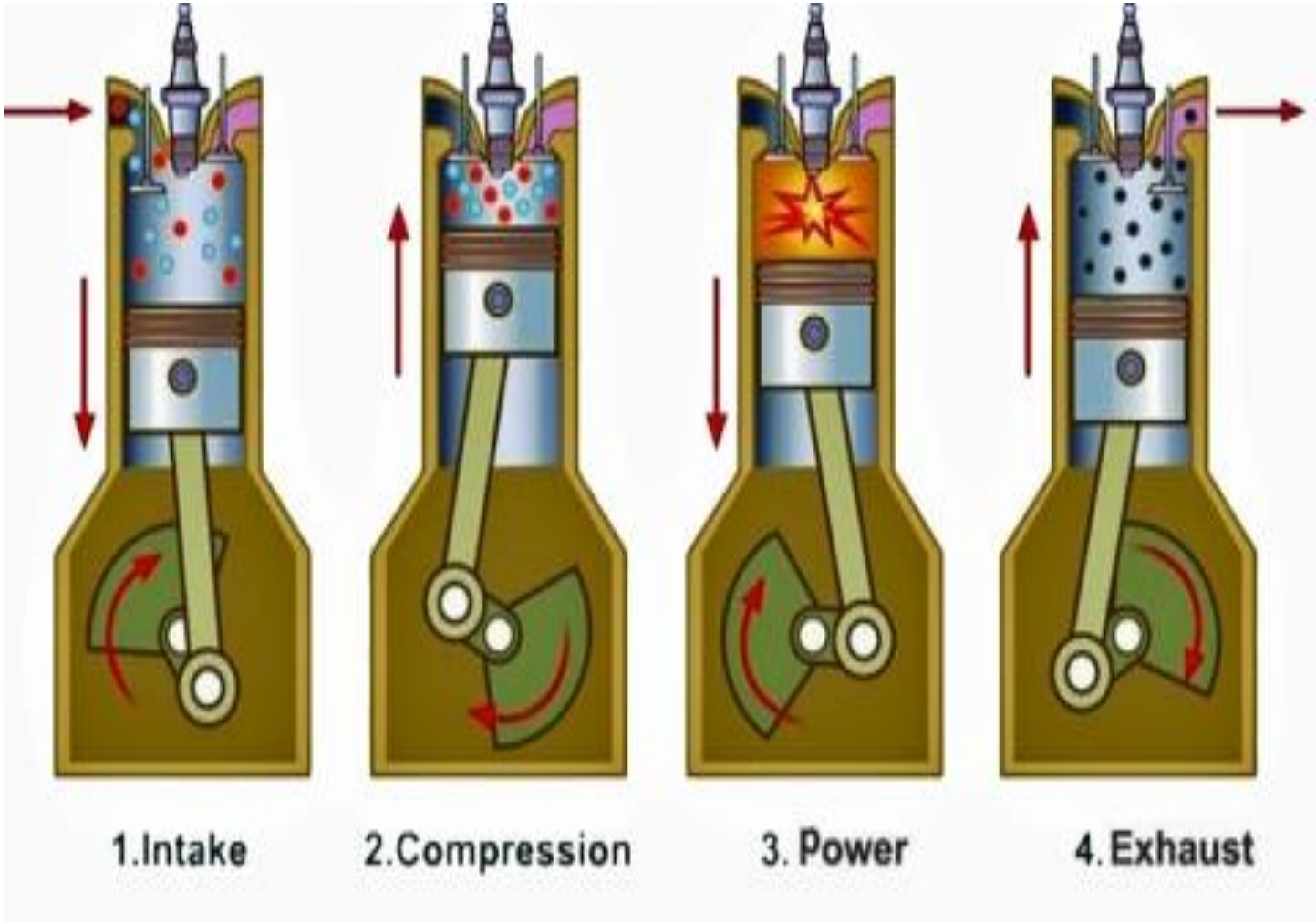
➢INTRODUCTION:

- A generating station in which **diesel engine** is used as the prime mover for the generation of electrical energy is known as **diesel power station**
- Diesel power plants produce power in the range of 2 to 50 MW.
- They are used as standby sets for continuity of supply such as hospitals, telephone exchanges, radio stations, cinema theatres and industries.
- They are suitable for mobile power generation and widely used in railways , submarine & ships.

Applications of diesel power plant

- They are used as central station for small or medium power supplies.
- They can be used as stand-by plants to hydro-electric power plants and steam power plants for emergency services.
- They can be used as peak load plants in combinations with thermal or hydro-plants.
- They are quite suitable for mobile power generation and are widely used in transportation systems such as automobiles, railways, air planes and ships.

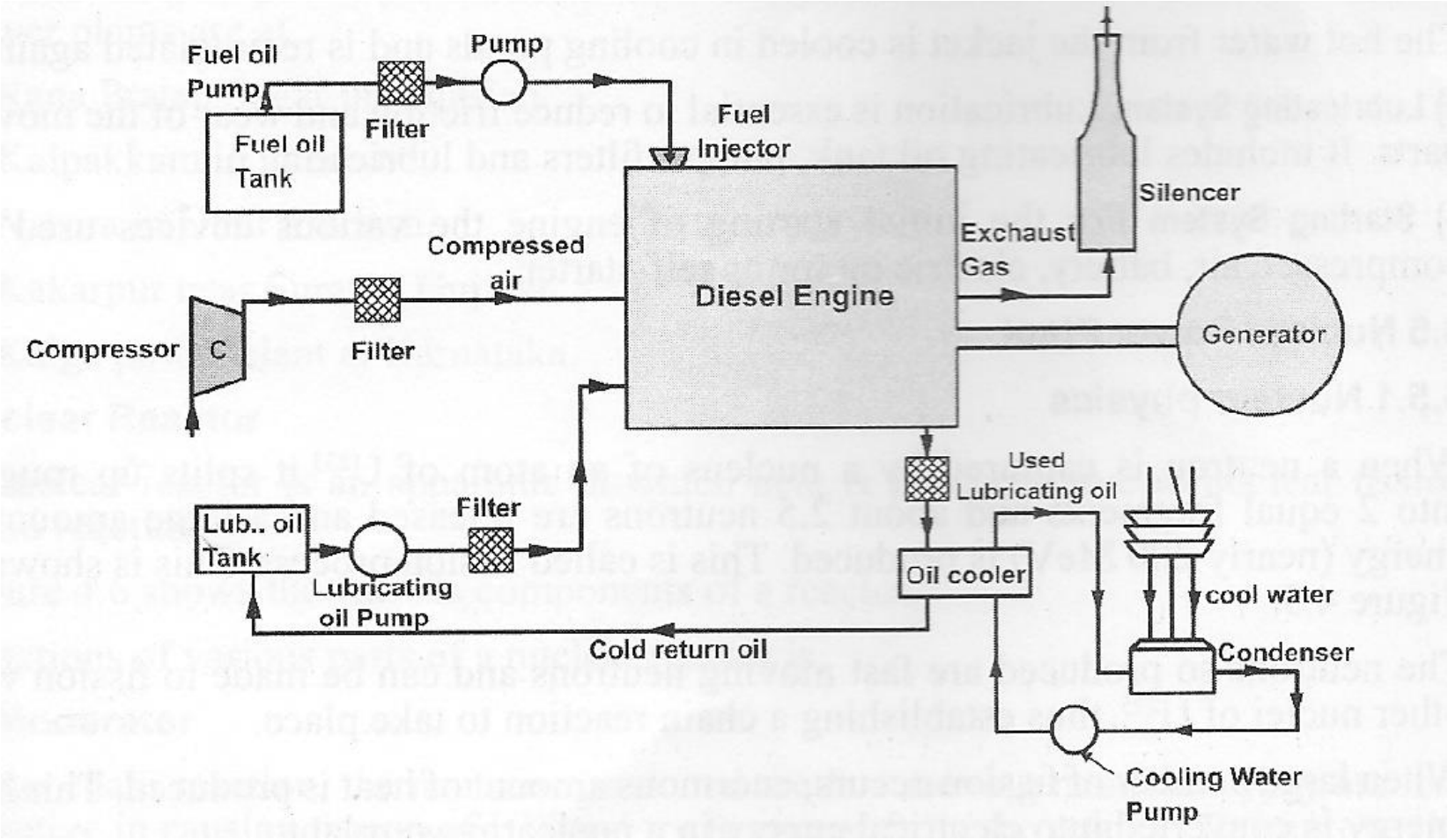
Four stroke engine



Working of 4 stroke engine

DIESEL ENGINE power plant

GENERAL LAYOUT



Essential elements of Diesel Power Plant

- Engine System
- Starting System
- Lubrication System
- Fuel System
- Cooling System
- Exhaust System

Engine system

- **ENGINE:** This is the **main component** of the plant which develops required power. The engine is generally directly coupled to the **generator**
- Generally classified as two stroke engine and four stroke engines.

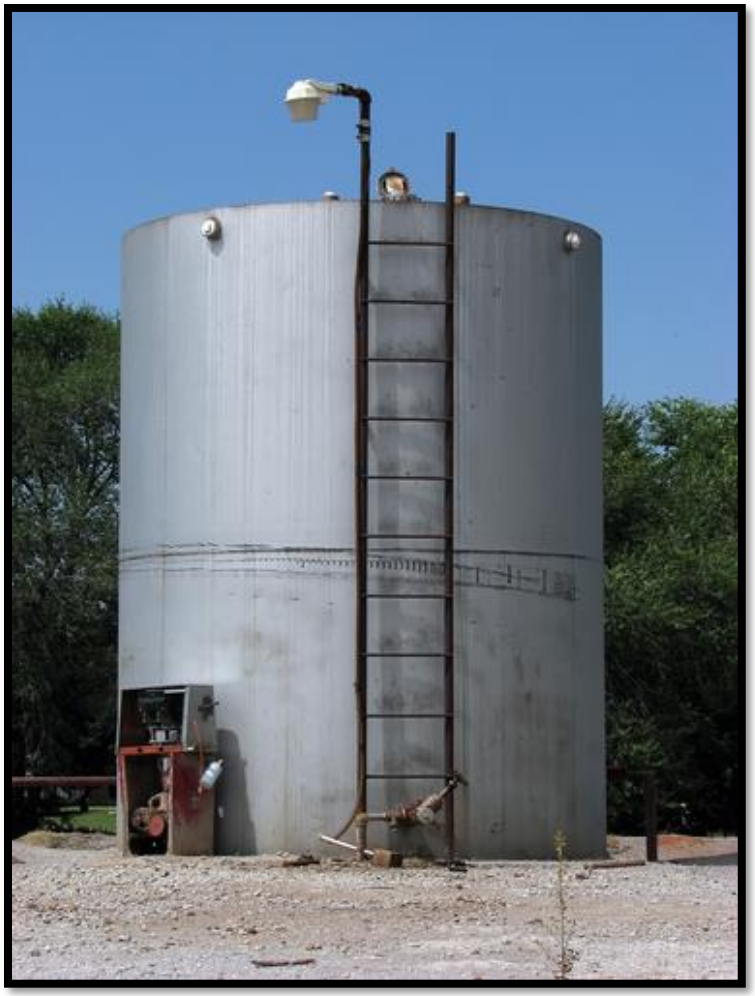
Starting system

- The function of this system is to start the engine from cold by supplying compressed air at about 17 bar supplied from an air tank. Fuel is admitted to the remaining cylinders and ignited in the normal way causing the engine to start.

Lubrication system

- It includes the oil pumps, oil tanks, filters, coolers and connecting pipes.
- The purpose of the lubrication system is to reduce the wear of the engine moving parts
- Part of the cylinder such as piston , shafts , valves must be lubricated.
- Lubrication also helps to cool the engine

oil tank



Fuel system

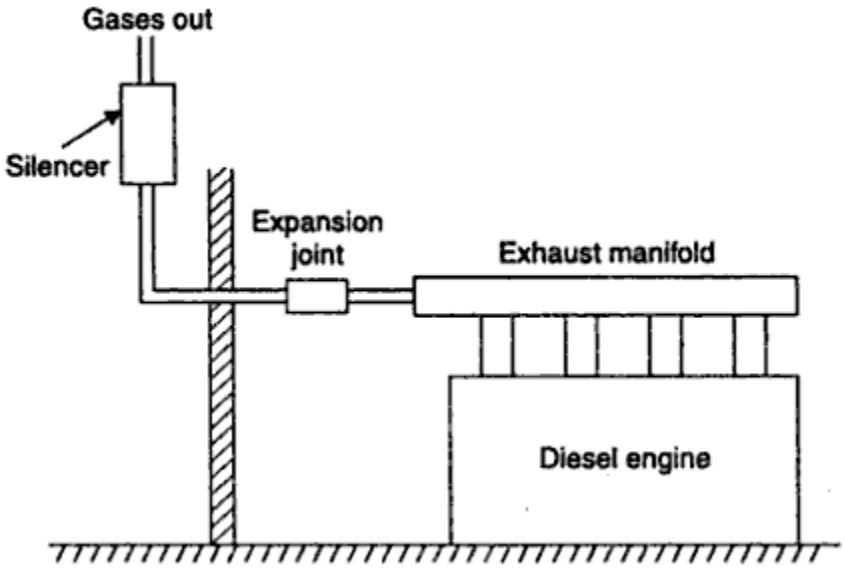
- It includes the storage tank, fuel pump, fuel transfer pump, strainers and heater.
- Pump draws diesel from storage tank to day tank through the filter
- Diesel is filtered before being injected into the engine by the fuel injection pump.

strainers

Cooling system

- The temperature of the hot gases inside the cylinder may be as high as 2750 c . If there is no external cooling, the cylinder walls and piston will tend to assume the average temp. of the gases.
- Cooling is necessary because:
- To avoid deterioration or burning of lubricating oil.
- The strength of the materials used for various engine parts decreases with increase in temperature. Local thermal stress can develop due to uneven expansion of various parts.
- Due to high cylinder head temp. the efficiency and hence power O/P of the engine are reduced.

Exhaust system



Exhaust system

- This includes the silencers and connecting ducts.
- The exhaust gases coming out of the engine is very noisy.
- silencer (muffler) is provide to reduce the noise.

ADVANTAGES AND DISADVANTAGES OF DIESEL POWER PLANT

ADVANTAGES->

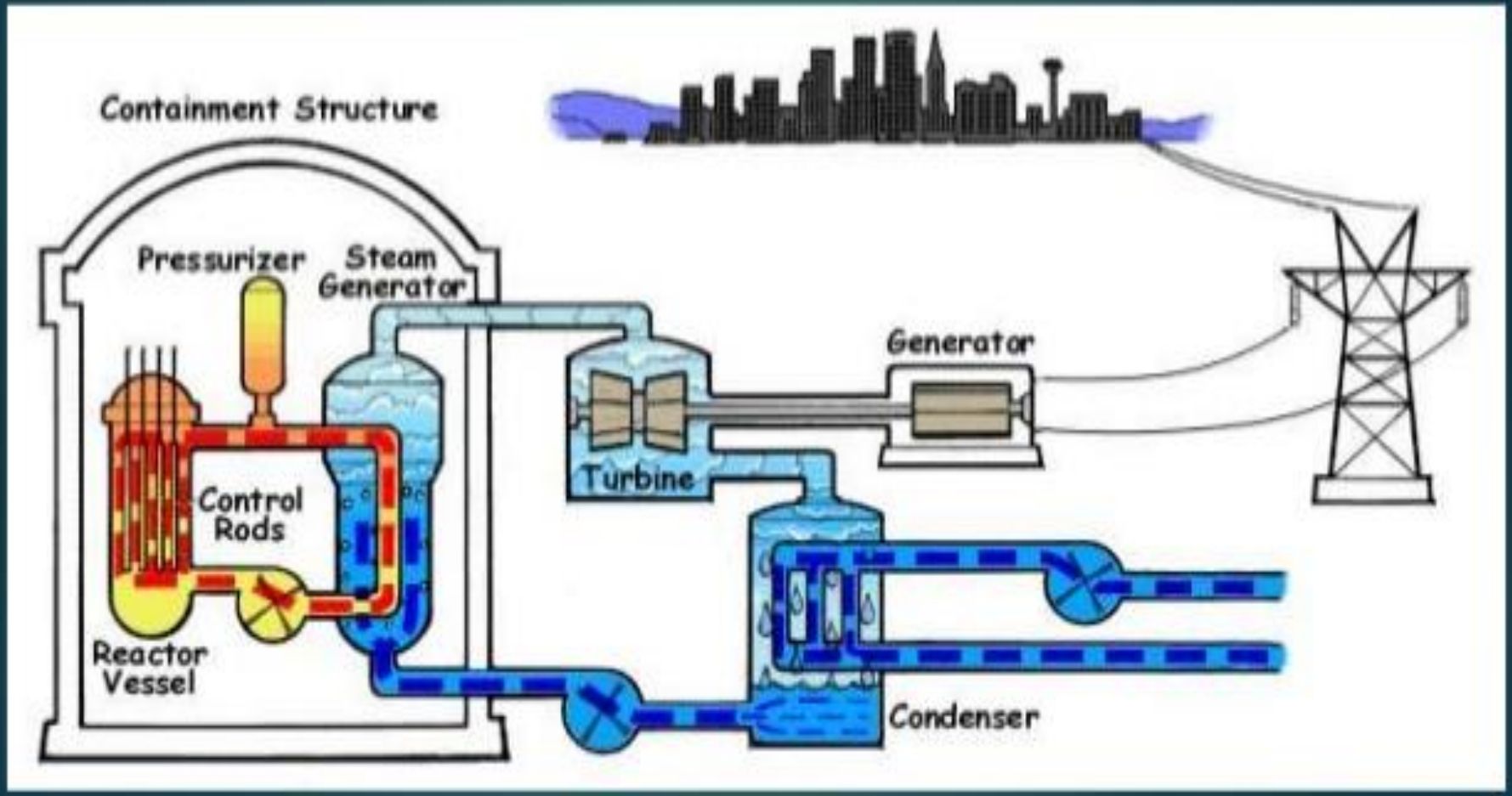
- Simple design & layout of plant
- Occupies less space & is compact
- Can be started quickly and picks up load in a short time
- Requires less water for cooling
- Thermal efficiency better that of Steam Power Plant of same size
- No ash handling problem
- Less operating and supervising work is required

DISADVANTAGES->

- High running charges due to costly price of Diesel
- Generates small amount of power
- Cost of lubrication very high
- Maintenance charges are generally high
- Noise problem
- Capacity is restricted. Cannot be of very big size

NUCLEAR POWER PLANT

Pressurized Water Reactor (PWR)



Pressurized Water Reactor (PWR)

- Uranium (Uranium – 235) as fuel.
- Chain reaction produces high level of heat.
- Heat tubes pass the heat to the primary cooling system water simply by contact.
- Primary cooling system is a closed circuit of pressurized water.
- Primary water enters the reactor vessel at 296 °C and exit at 327 °C.

Pressurized Water Reactor (PWR)

- The water than passes into a steam generator where it transfers it heat to a secondary system.
- To ensure that water in the primary system remains in the liquid state a pressurizer will maintain the constant level of 155 bars.
- Hence the name "*Pressurized Water Reactor*".

Pressurized Water Reactor (PWR)

- Within the steam generator heat stored in the primary system water is transferred to a secondary system.
- The heated water enters the bottom of the steam generator transfers its heat to the secondary system water through the U tubes then returns to the reactor vessel for a new cycle.

Pressurized Water Reactor (PWR)

- Water in the secondary system is heated to boiling temperature turns into steam and then travels to the turbine set.
- After passing through the turbine the steam is recondensed into liquid water and return to the steam generator for another cycle.
- Steam pressure from the secondary system drives the generators to produce electricity.

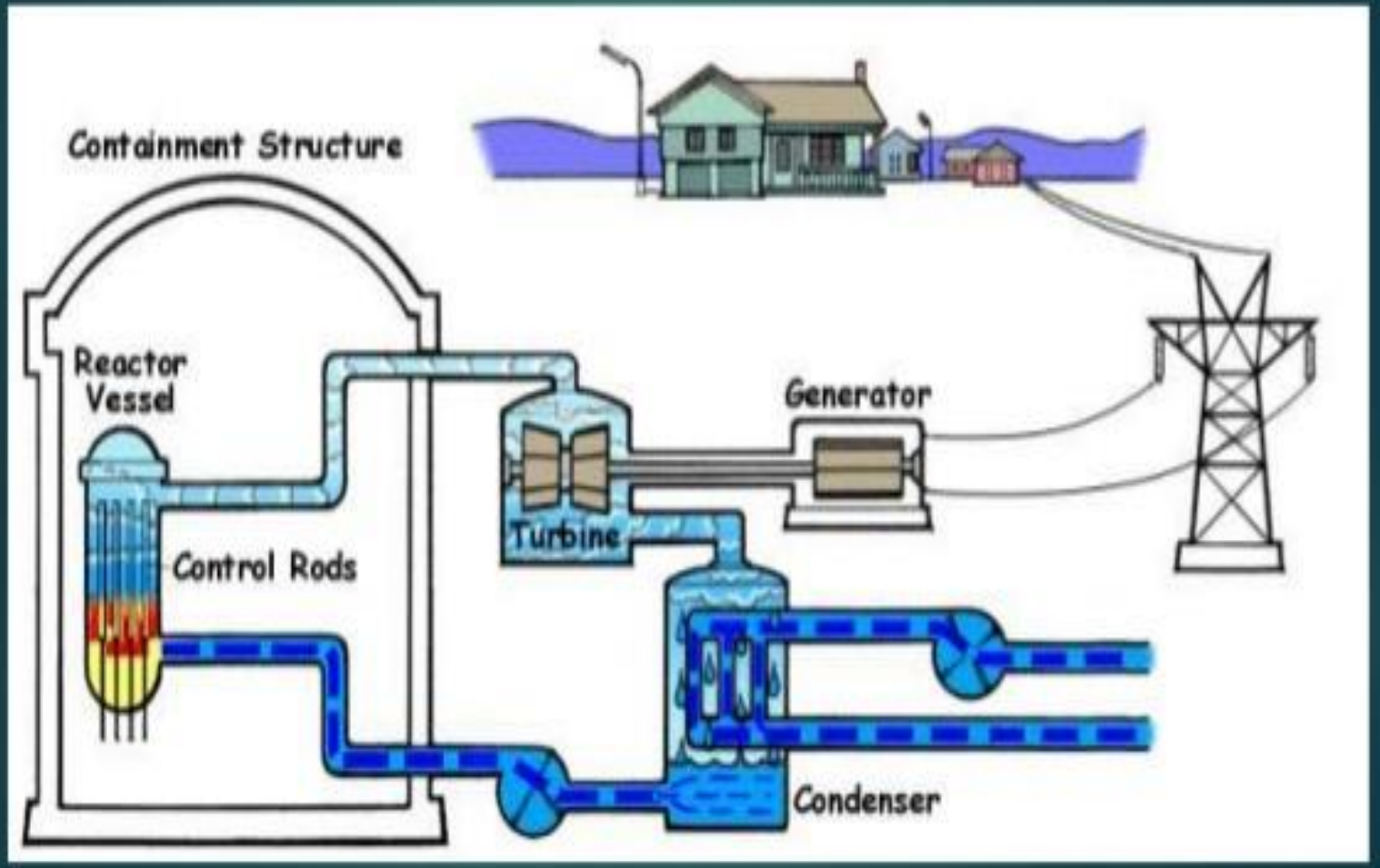
Advantages

- Water used as coolant, moderator and reflector is cheap and available in plenty.
- The reactor is compact and high power density (65 KW/liter).
- Hardly 60 control rods are required in 1000 MW plant.
- Inspecting and maintaining of turbine, feed heaters and condenser during operation.
- Reducing fuel cost and extracting more energy.

Disadvantages

- Requires high pressure vessel and high capital cost.
- Thermodynamic efficiency of plant is as low as 20% due to low pressure.
- Corrosion problems are more severe. Use of stainless steel for vessel is necessary.
- Fuel recharging requires a couple of months time.

Boiling Water Reactor (BWR)



Boiling Water Reactor (BWR)

- The core inside the reactor vessel creates heat.
- A steam-water mixture is produced when very pure water (reactor coolant) moves upward through the core, absorbing heat.
- The steam-water mixture leaves the top of the core and enters the two stages of moisture separation where water droplets are removed before the steam is allowed to enter the steam line.

Boiling Water Reactor (BWR)

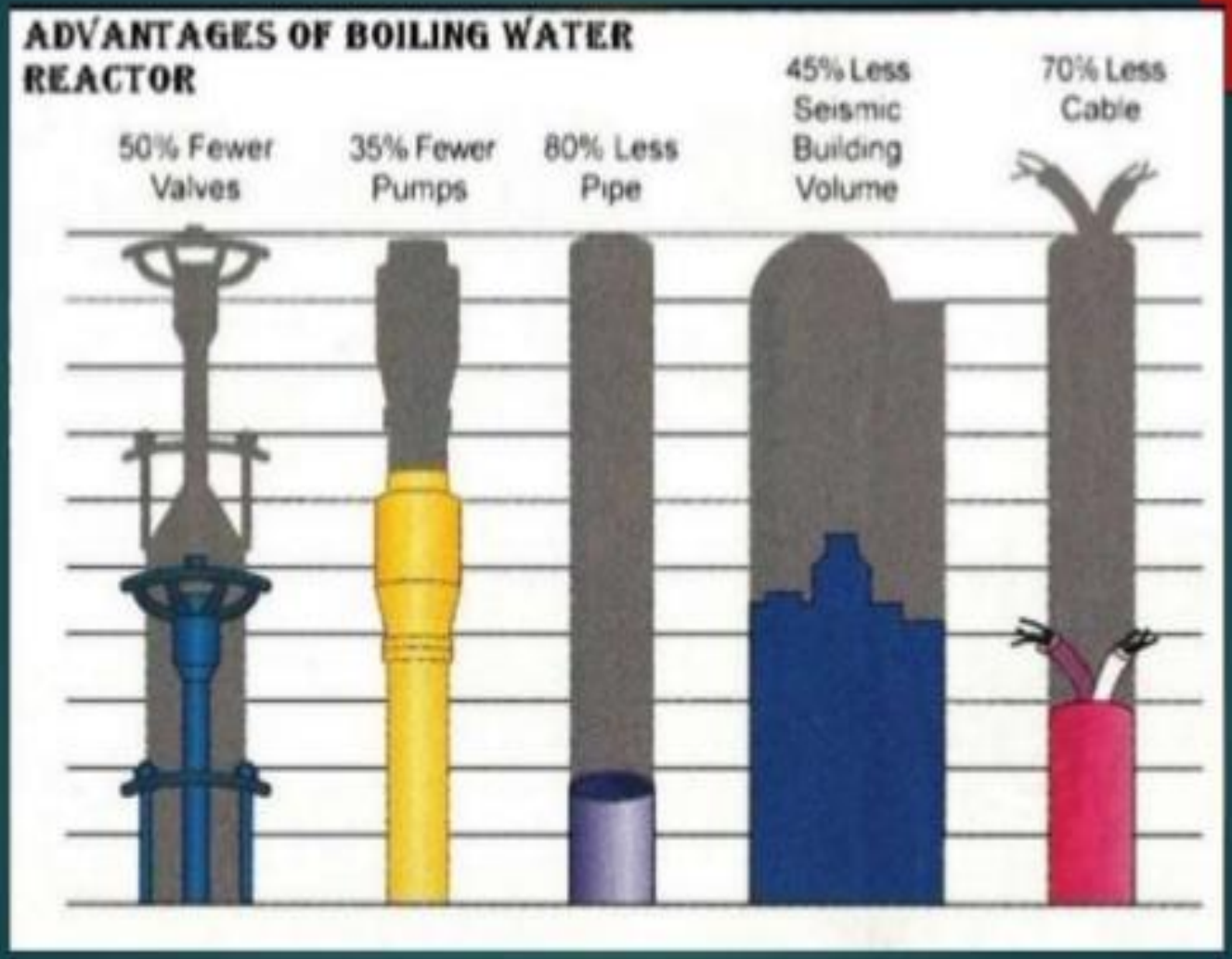
- The steamline directs the steam to the main turbine, causing it to turn the turbine generator, which produces electricity.
- The unused steam is exhausted to the condenser, where it is condensed into water.
- The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the reactor vessel.

Boiling Water Reactor (BWR)

- The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps.
- These pumps and other operating systems in the plant receive their power from the electrical grid.
- If offsite power is lost, emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators.

Boiling Water Reactor (BWR)

- Boiler water reactor contain between 370-800 fuel assemblies.
- The cooling water is maintained at about 75 atm (7.6 MPa, 1000–1100 psi) so that it boils in the core at about 285 °C (550 °F).


ADVANTAGES OF BOILING WATER REACTOR
50% Fewer Valves
35% Fewer Pumps
80% Less Pipe
45% Less Seismic Building Volume
70% Less Cable

Disadvantages

- Possibility of radioactive contamination in the turbine mechanism.
- Safety precautions are needed which can turn out to be costly.
- Wasting of steam and resulting of lower thermal efficiency.
- Only 3% - 5% by mass can be converted to steam per pass.

References

1. https://nptel.ac.in/course.html
2. Power Plant engineering by R.k Rajput
3. Power Plant engineering by P.C Sharma