

Electrical Power Engineering

4. Nuclear power station:

*A generating station in which nuclear energy is converted into electrical energy is known as a **nuclear power station**.*

In nuclear power station, heavy elements such as Uranium (U^{235}) or Thorium (Th^{232}) are subjected to nuclear fission* in a special apparatus known as a *reactor*. The heat energy thus released is utilised in raising steam at high temperature and pressure. The steam runs the steam turbine which converts steam energy into mechanical energy. The turbine drives the alternator which converts mechanical energy into electrical energy.

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Schematic arrangement of nuclear power station:

Figure (3) shows a schematic arrangement of nuclear power system. The plant has the following auxiliaries:

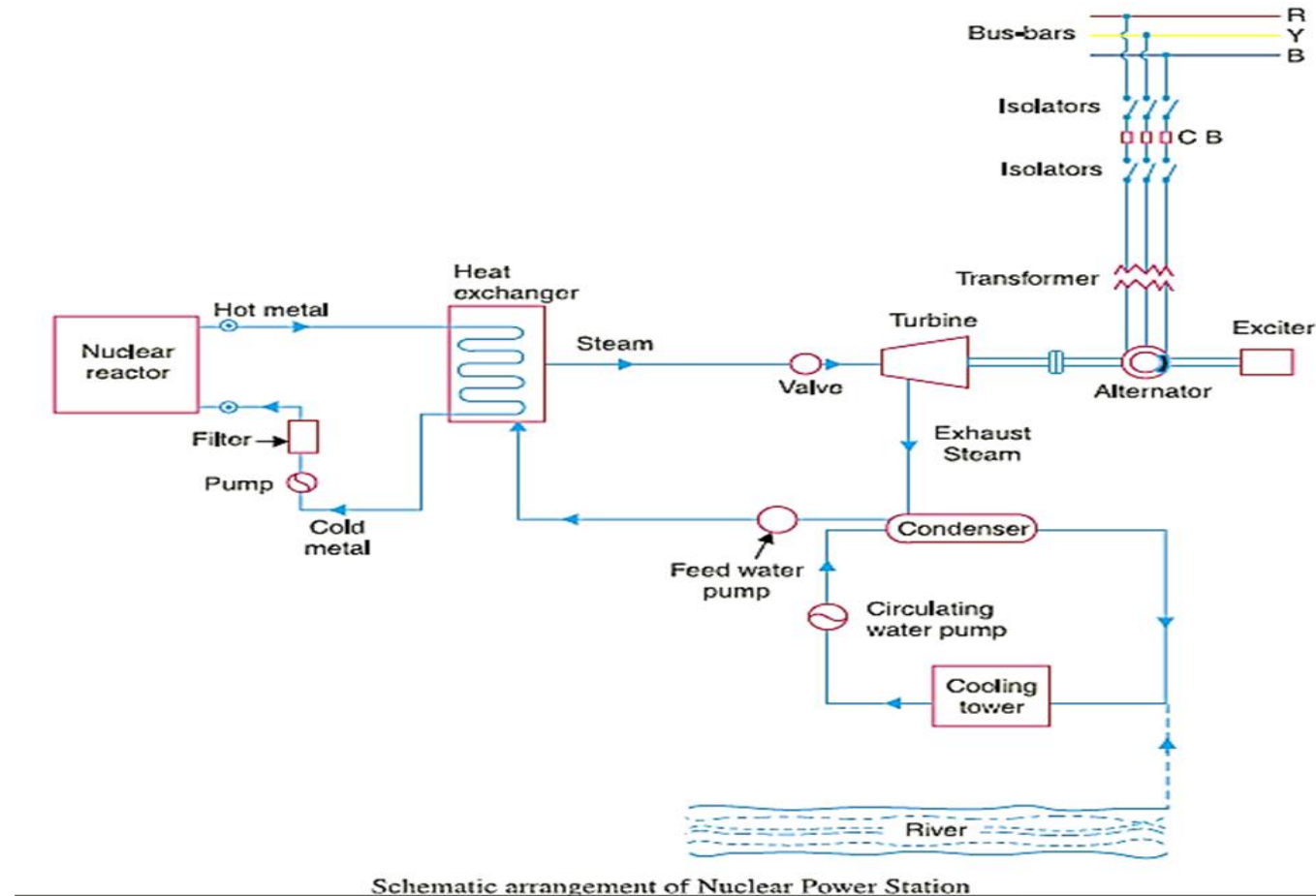


Figure (3) Schematic arrangement of nuclear power system

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- (i) **Nuclear reactor.** It is an apparatus in which nuclear fuel (U^{235}) is subjected to nuclear fission. It controls the *chain reaction** that starts once the fission is done. If the chain reaction is not controlled, the result will be an explosion due to the fast increase in the energy released.

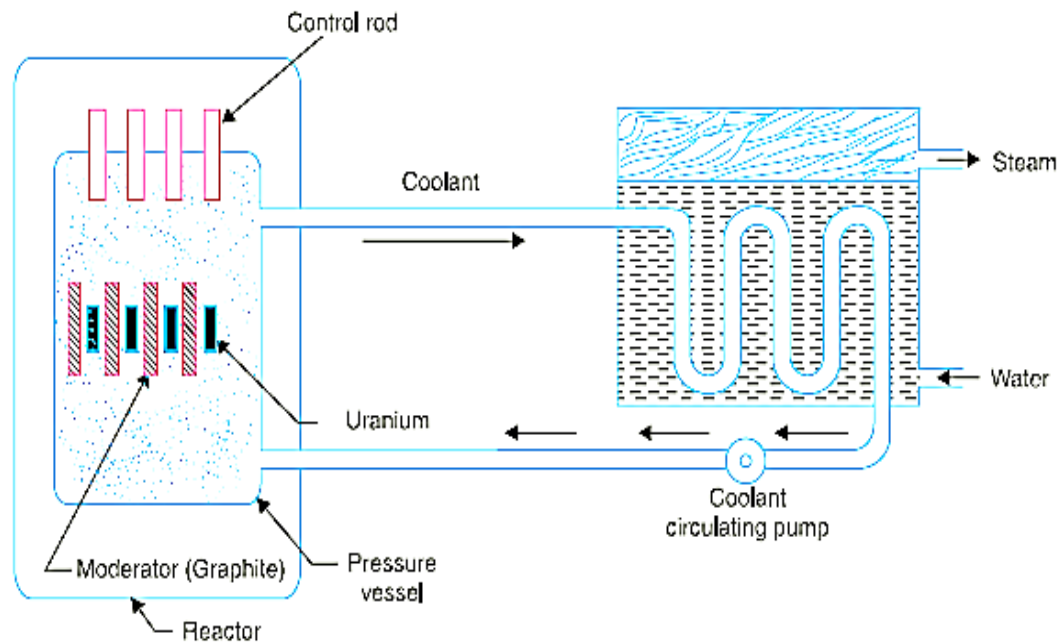


Figure (4) Nuclear Reactor

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- (ii) **Heat exchanger.** The coolant gives up heat to the heat exchanger which is utilised in raising the steam. After giving up heat, the coolant is again fed to the reactor.
- (iii) **Steam turbine.** The steam produced in the heat exchanger is led to the steam turbine through a valve. After doing a useful work in the turbine, the steam is exhausted to condenser. The condenser condenses the steam which is fed to the heat exchanger through feed water pump.
- (iv) **Alternator.** The steam turbine drives the alternator which converts mechanical energy into electrical energy. The output from the alternator is delivered to the bus-bars through transformer, circuit breakers and isolators.

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Choice of Site:

The following points should be kept in view while selecting the site for a nuclear power station :

- (i) *Availability of water.* As sufficient water is required for cooling purposes, therefore, the plant site should be located where ample quantity of water is available, e.g., across a river or by sea-side.
- (ii) *Disposal of waste.* The waste produced by fission in a nuclear power station is generally radioactive which must be disposed off properly to avoid health hazards. The waste should either be buried in a deep trench or disposed off in sea quite away from the sea shore. Therefore, the site selected for such a plant should have adequate arrangement for the disposal of radioactive waste.
- (iii) *Distance from populated areas.* The site selected for a nuclear power station should be quite away from the populated areas as there is a danger of presence of radioactivity in the atmosphere near the plant. However, as a precautionary measure, a dome is used in the plant which does not allow the radioactivity to spread by wind or underground waterways.
- (iv) *Transportation facilities.* The site selected for a nuclear power station should have adequate facilities in order to transport the heavy equipment during erection and to facilitate the movement of the workers employed in the plant.

From the above mentioned factors it becomes apparent that ideal choice for a nuclear power station would be near sea or river and away from thickly populated areas.

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Advantages

1. The amount of fuel required is quite small. Therefore, there is a considerable saving in the cost of fuel transportation.
2. A nuclear power plant requires less space as compared to any other type of the same size.
3. It has low running charges as a small amount of fuel is used for producing bulk electrical energy.
4. This type of plant is very economical for producing bulk electric.
5. It can be located near the load centers because it does not require large quantities of water and need not be near coal mines. Therefore, the cost of primary distribution is reduced.
6. There are large deposits of nuclear fuels available all over the world. Therefore, such plants can ensures continued supply of electrical energy for thousands of years.
7. It ensures reliability of operation.

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Disadvantages

1. The fuel used is expensive and is difficult to recover.
2. The capital cost on a nuclear plant is very high as compared to other types of plants.
3. The erection and commissioning of the plant requires greater technical know-how.
4. The fission by-products are generally radioactive and may cause a dangerous amount of radioactive pollution.

Thanks