ENERGY RESOURCE AND MANAGEMENT
Unit-II
THERMAL POWER PANT

Energy planning aim involves finding a set of sources and conversion devices so as to meet the energy requirements/demands of all the tasks in an optimal manner .Making an energy planning decision involves a process of balancing ecological, social, technical, and economic aspects over space and time. This balance is important to the survival of nature and to the prosperity of energy dependent nations.

Selecting a proper site for a thermal power plant is important for its long term efficiency and a lot many factors come into play when deciding where to install the plant. Of course it may not possible to get everything which is desirable at a single place but still the location should contain an optimum mix of the requirements for the settings to be feasible for long term economic justification of the plant.

GUIDELINES FOR SITE SELECTION OF THERMAL POWER PLANTS

S. No.	Factors	Sub-Factors
1.	Availability of resources	Land availability, Water availability, Fuel availability, Skilled manpower availability
2.	Economical impact	Operation and maintenance cost, Payback period, Land acquisition cost, Investment cost, Future development limitations, Possibility of Site expansion
3.	Environment concern	Degradation of local air quality, Dust, Noise, Land use Impacts, Effect on water bodies
4.	Social concern	Job creation, Public acceptance, Number of relocation, Distance from public area
5.	Accessibility	Road/Rail/Airport accessibility, Transmission grid accessibility, Electricity consumption point, Urban area accessibility

1. AVAILABILITY OF RESOURCES

1.1 Land Availability

Power plant needs a wide range of land requirements. For example, coal plants tend to need larger areas to support rail lines, coal piles, and landfills. Natural gas-fired power plants may only need area for the generation facilities and support equipment. Needed information includes the site size (acres), and the portion of the site (acres) that would be occupied by plant buildings and systems. Generally, sites with ample space may be preferred. Land requirement for thermal power projects depends on many factors viz. unit size and number of units; type of coal (indigenous or imported); location (pit-head or coastal) etc. whereas Nuclear power plants require far less land area.

1.2 Water Availability

Many power plant technologies use water from lakes, rivers, municipal water utilities, or groundwater. Surface water is used for plant cooling and groundwater is used for plant processes. Generally, the presence of adequate and usable water resources at or near a site is preferred over sites with remote, inadequate, or low-quality water resources. Sites with no competing water uses are generally preferred to sites with many uses.

1.3 Fuel Availability

Fuel availability influences choices positively; its marginal utility is diminishing with supply. Without a higher level of availability, alternative fuels are unlikely to be adopted.

1.4 Skilled Manpower Availability

A power plant requires labor for construction and operation. Local communities can benefit from these employment opportunities. Generally, sites that can make use of local labor are more desirable. These sites would have a larger skilled work force within a short distance from the plant site.

2. ECONOMICAL IMPACT

2.1 Land Acquisition Cost

Each site will have unique land acquisition requirements and effects. Generally, sites that have lower land acquisition costs and require shorter acquisition times are more desirable.

2.2 Future Development Limitations

The construction of a plant at a particular site may create limitations on future development in the local area through its effect on land use or through its consumption of local PSD air increments, water resources, or water discharge capacity. Generally, sites that impose fewer limitations on future development may be more desirable.

2.3 Possibility of Site Expansion

A site might be able to support more generating capacity than proposed. It's usually more economical and environmentally acceptable to add generating capacity at an existing site than to build at a new site.. Often, an expandable site may be more desirable. But, a potential concern of local property owners is the effect of plant siting on nearby property values. Generally, sites that enhance property values or minimize the decrease in property values may be more desirable.

2.4 Payback Period

The returns on the investment are essential factors in determining whether a particular installation is worthwhile or not. Payback period is the time in which the initial cash outflow of an investment is expected to be recovered from the cash inflows generated by the investment.

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2.5 Operation and Maintenance Cost

The expenditure incurred on operation and maintenance of the project includes the expenditure on manpower, repairs, spares, consumables, insurance, and overheads.

The CERC (Central Electricity Regulatory Commission) has specified O&M Costs for thermal power stations on the normative parameters (Rs. lakh/MW), depending on the class of the machine installed by the power station. The normative O&M expenses allowed are:

2.6 Investment Cost

The expenditure incurred with expectation of capital appreciation, Profit, rents or some combination of these returns. Generally, sites that require less investment are more desirable.

3. ENVIRONMENT CONCERN

3.1 Degradation of Local Air Quality

Operating power plants that burn coal, oil, or natural gas emits air pollutants into the atmosphere requiring the plant be fitted with pollution control equipment to reduce emissions. Many of these Power plant air pollutants have been identified and are regulated by CENTRAL POLLUTION CONTROL BOARD (CPCB). Public exposure to air emissions (air pollution) is regulated by the CPCB through the National Ambient Air Quality Standards(NAAQS) for major air pollutants, including sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), ozone (O_3), particulate matter ($PM_{2.5}$ or PM_{10}), and lead (Pb). The CPCB is charged with enforcing the NAAQS.SO_2 has been a cause of acid precipitation, commonly known as “acid rain,” which can damage vegetation and acidify lakes. Species vulnerable to acidic conditions have trouble reproducing and, in some cases, die. NOx and volatile organic compounds (VOCs) are

components of ozone formation. Ozone is a principal component of smog and can result in respiratory health and other environmental effects. A more significant concern is the NOX and So2 emission from power plants that burn coal or natural gas. These compounds are part of a complex chemical reaction in the atmosphere that creates nitrate-based and sulfate-based fine particulates. Mercury (Hg) is naturally present in small quantities in the environment. Human activities have greatly increased the concentration of this pollutant in the air and water. Coal-fired power plants are the biggest category of mercury emitters. Mercury is very volatile and can travel around the wor*l*d in the atmosphere, repeatedly being deposited and re-emitted into the atmosphere. Mercury is deposited in lakes and rivers by rain, snow and surface runoff once deposited in waterways, bacteria can convert mercury into methyl mercury that can be easily absorbed by fish and other organisms. Eating contaminated fish is the primary pathway for human exposure to mercury. Ingested mercury can damage the nervous system, especially in children and fetuses.

3.2 Land Use Impacts

Industrial forests are a valuable commodity. Site evaluation should address the forest resources of the site and nearby lands, and the effects of plant construction and operation on these resources. Generally, more desirable sites have fewer impacts on these resources. Typically, active or vacant industrial lands may be more compatible, and urban residential lands may be less compatible with power plants. Generally, sites that are more compatible with present and planned land uses are more desirable.

3.3 Dust

The “nuisance” impacts of fugitive dust are of particular concern to nearby residents. “Fugitive" dust is PM (Particulate Matter) suspended in the air by wind action and human activities. It has not come out of a vent or a stack, and is usually not a by-product of burning. Fugitive dust particles are composed mainly of soil minerals (e.g. oxides of silicon, aluminum, calcium, and iron), but can also contain sea salt, pollen, spores, tire particles, etc. About half of fugitive dust particles (by weight) are big particles, larger than 10 microns in diameter (the average human hair is 70 microns in diameter).These larger particles settle out more quickly, on the ground.However, the other half are particles 10 microns or smaller, or PM10. Due totheir very small size and weight, PM10 particles can remain airborne for weeks. When inhaled, PM10 particles can travel easily to the deep parts of the lungs and may remain there, causing respiratory illness, lung damage, and even premature death in sensitive individuals. Generally, more desirable sites are those with fewer sources of fugitive dust and greater distances to adjacent residences and sensitive locations.

3.4 Noise

Noise is of particular concern to nearby residents. Information of interest includes noise caused by plant construction and operations, distance of noise sources from sensitive locations such as parks and residences, and applicability of local noise ordinances or other thresholds. Generally, more desirable sites maximize the distance between the noise source and the public, have landscape features that would absorb noise between the plant and the public, and have no receptors within any areas where noise guidelines or ordinances are exceeded. Sounds that are 85 dBA (decibels) or above can permanently damage your ears. The distance from the source to the boundary of the power plant property can dissipate some of this noise. Noises can be blocked or muffled by intervening landscape features like trees.

3.5 Effect on Water Bodies

There are potential operational impacts on wildlife and wildlife habitat besides effects from air and water quality changes due to the combustion process. They include impacts related to fuel such as coal dust runoff, impacts related to cooling such as fish caught in cooling water systems or the discharge of heated cooling water into streams or lakes, or other impacts such as bird mortality from striking structures or new power lines. Generally, sites that minimize negative impacts on wildlife from power plant operations are preferred.

4. SOCIAL CONCERN

4.1 Job Creation

The economic impact of a plant includes the jobs and purchases associated with the construction and operation of a plant. A cogeneration project may also help to keep existing industry jobs in the community. Generally, sites that generate or preserve more jobs in the local area may be more desirable.

4.2 Public Acceptance

The location of a power plant has many effects that are of interest to the local community. There are both advantages and disadvantages to be considered. Measures of local interest and concern include the current attitudes of local citizens and officials regarding a potential power plant in the local community, the local questions raised, the public input received, and public support or opposition to a particular site. Generally, a site where the public attitude is positive or supportive may be preferred.

4.3 Number of Relocation

The property owner impacts of a potential plant site are of significant concern for local communities. One concern is how many homeowners and businesses are located at the proposed site and would have to be moved if the plant were built. Generally, sites needing less relocation are more desirable.

4.4 Distances from Public Area

The intent of buffering is to minimize the visual and noise effects of the plant by increasing the distance to neighbors through use of surrounding land that provides visual and sound barriers. "Buffer area" refers to land between the plant facilities and adjacent property owners, especially residential property owners. Generally, sites with more or better buffer areas may be more desirable.

5. ACCESSIBILITY

5.1 Road/Rail/Airport Accessibility

Power plant construction and operation can require road, rail, or barge access to the site. The number and location of site entrances and the distances to and quality of nearby roads and rail lines are important. Sites with access solely from heavily traveled roads are less desirable than sites on less heavily traveled routes. However, closeness to major highways is desirable. The objective is to allow easy access to the site without causing traffic congestion or safety problems.

The roads in a power station can be divided into the following types:-

- All main plant roads shall be 10 meter wide.
- All secondary plant roads shall be 5 meter wide provided with 1.5 meter wide hard shoulders on either Side and shall be for access to plant auxiliary areas and buildings.
- Peripheral roads along the boundary wall shall have adequate nos. of watch towers as per requirement.

5.2 Transmission Grid Accessibility

An electrical grid is an interconnected network for delivering electricity from suppliers to consumers. It consists of generating stations that produce electrical power, high-voltage transmission lines that carry power from distant sources to demand centers, and distribution lines that connect individual customers.

5.3 Electricity Consumption Point

A power plant must be located near the load to which it is supplying the power. However a plant a plant cannot be located near all loads. As such C.G of the load is determined with reference to two arbitrarily axis.

CONCLUSION

Site selection is a vital issue that must be analyzed deeply in order to have efficient power Generation from technical and economic point of view without damaging environment and Society. Selection of unsuitable location for power plant will lead to increased costs, waste of energy and resources, and increased environmental pollution, which has a tremendous negative impact on society. Therefore, it is required to analyze any location before the installation of power plant. So, this paper tries highlighting the main factors which helps in the Selecting the location of Thermal Power Plant.

Working of Thermal Power Plant

A **thermal power station** is a power plant in which heat energy is converted to electric power. In most of the world the turbine is steam-driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine, the steam is condensed in a condenser and recycled to where it was heated; this is known as a Rankine cycle. The greatest variation in the design of thermal power stations is due to the different heat sources, fossil fuel dominates here, although nuclear heat energy and solar heat energy are also used. Some prefer to use the term *energy center* because such facilities convert forms of heat energy into electrical energy. Certain thermal power plants also are designed to produce heat energy for industrial purposes of district heating, or desalination of water, in addition to generating electrical power. Globally, fossil-fuel power stations produce a large part of man-made CO_2 emissions to the atmosphere, and efforts to reduce these are varied and widespread.

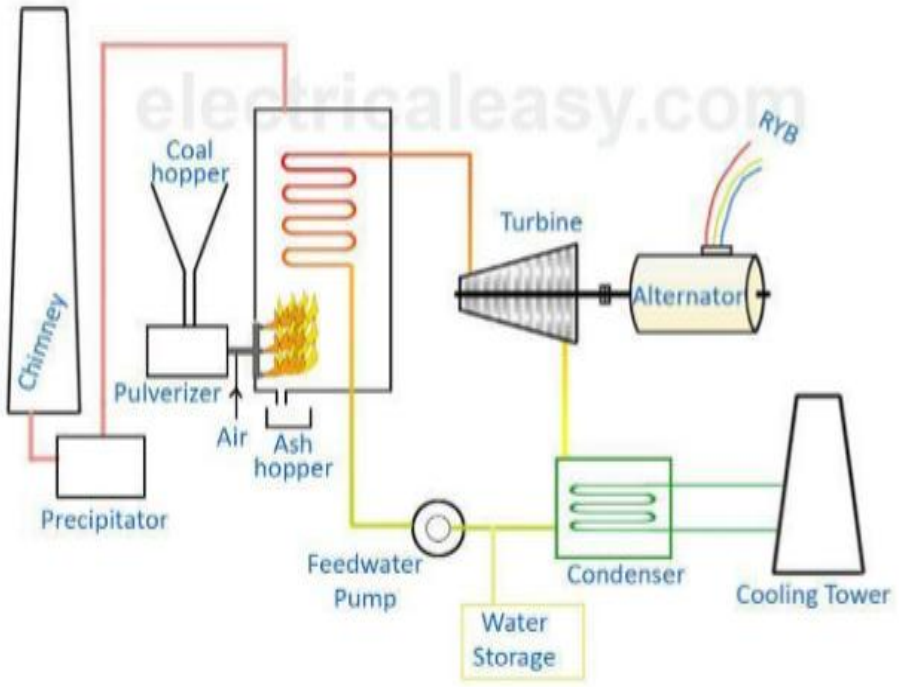

Fig. Thermal Power Plant Layout

Coal: In a coal based thermal power plant, coal is transported from coal mines to the generating station. Generally, bituminous coal or brown coal is used as fuel. The coal is stored in either 'dead storage' or in 'live storage'. Dead storage is generally 40 days backup coal storage which is used when coal supply is unavailable. Live storage is a raw coal bunker in boiler house. The coal is cleaned in a magnetic cleaner to filter out if any iron particles are present which may cause wear and tear in the equipment. The coal from live storage is first crushed in small particles and then taken into pulverizer to make it in powdered form. Fine powdered coal undergoes complete combustion, and thus pulverized coal improves efficiency of the boiler. The ash produced after the combustion of coal is taken out of the boiler furnace and then properly disposed. Periodic removal of ash from the boiler furnace is necessary for the proper combustion.

Boiler: The mixture of pulverized coal and air (usually preheated air) is taken into boiler and then burnt in the combustion zone. On ignition of fuel a large fireball is formed at the center of the boiler and large amount of heat energy is radiated from it. The heat energy is utilized to convert the water into steam at high temperature and pressure. Steel tubes run along the boiler walls in which water is converted in steam. The flue gases from the boiler make their way through superheater, economizer, air preheater and finally get exhausted to the atmosphere from the chimney.

Steam turbine: High pressure super heated steam is fed to the steam turbine which causes turbine blades to rotate. Energy in the steam is converted into mechanical energy in the steam turbine which acts as the prime mover. The pressure and temperature of the steam falls to a lower value and it expands in volume as it passes through the turbine. The expanded low pressure steam is exhausted in the condenser.

Condenser: The exhausted steam is condensed in the condenser by means of cold water circulation. Here, the steam loses it's pressure as well as temperature and it is converted back into water. Condensing is essential because, compressing a fluid which is in gaseous state requires a huge amount of energy with respect to the energy required in compressing liquid. Thus, condensing increases efficiency of the cycle.

Alternator: The steam turbine is coupled to an alternator. When the turbine rotates the alternator, electrical energy is generated. This generated electrical voltage is then stepped up with the help of a transformer and then transmitted where it is to be utilized

Feed water pump: The condensed water is again fed to the boiler by a feed water pump. Some water may be lost during the cycle, which is suitably supplied from an external water source.

Advantages:

1. Fuel cost of thermal power plant is relatively low.
2. We can produce thermal energy almost everywhere in the world.
3. Heat production System is simple compared to other system.
4. Overall system cost effective.
5. Easy mechanism.
6. Same heat could be reused.
7. Easier Maintenance of power station.

8. Use of water is prominent here, therefore, any places with ample supply of water is a perfect location for installing a thermal power station.
9. Thermal power plant requires comparatively small space to be installed.

Disadvantages:

1. Huge production of Carbon-dioxide (CO_2) in the atmosphere.
2. Exhausted gases harms outside environment badly.
3. Low overall efficiency.
3. Thermal engines requires huge amount of lubricating oil that is very expensive.
4. Nuclear thermal power plant demands excessive amount of water for cooling purpose.
5. Coal type thermal power plant requires comparatively larger duration before it supplies generated power to the grid.
6. This type of power station ultimately responsible for raise in sea water level.

HYDROELECTRIC POWER PLANT

Site selection of hydro power plant:

1. Availability of water
2. Water storage
3. Geological investigation
4. Water pollution
5. Sedimentation
6. Environmental effect
7. Access to site

1. **Availability of water -** The river run off data pertain to many years should be available so that and estimate of the power potential of the project and the made. The data should include minimum Flo and maximum flow and their periods.
2. **Water storage -** Because of white fluctuation in stream flows storage is needed most hydroelectric project to store the water during high flow periods and use it during the leading flow periods. The storage capacity can be calculated from the hydrograph.

3. **Geological investigation**

   It is need to see that the foundation roof from the demand and other structure is stable and strong enough to with stand water thrust and other stress.

4. **Water pollution**

   Polluted water may cause excessive corrosion and damage to metallic structure. This may make the operation of the plant unreliable and uneconomical so it is necessary to see the water is of good quality.

5. **Sedimentation**

   The capacity of storage reserve wire is reduced dew to the gradual deposition of snit. Snit may cause damage to turbine plate.

6. **Environmental effect**

   Hydro project submerge use areas and many villages the environmental effect are also importation. The site should ensure safe soundings; avoid health hazard and presser important cultural and storage aspect of the area.

7. **Access to site**

   A hydro electric plant installed at the suitable location should be connected through the rail and road facilities so that row material and heavy machinery can be transfer at the suitable location very easily it is also a important factor for selecting the suitably location for hydroelectric plant.

Working of Hydro Power Plant:

In **hydro power plant** we use gravitational force of fluid water to run the turbine which is coupled with electric generator to produce electricity. This power plant plays an important role to protect our fossil fuel which is limited, because the generated electricity in hydro power station is the use of water which is renewable source of energy and available in lots of amount without any cost.

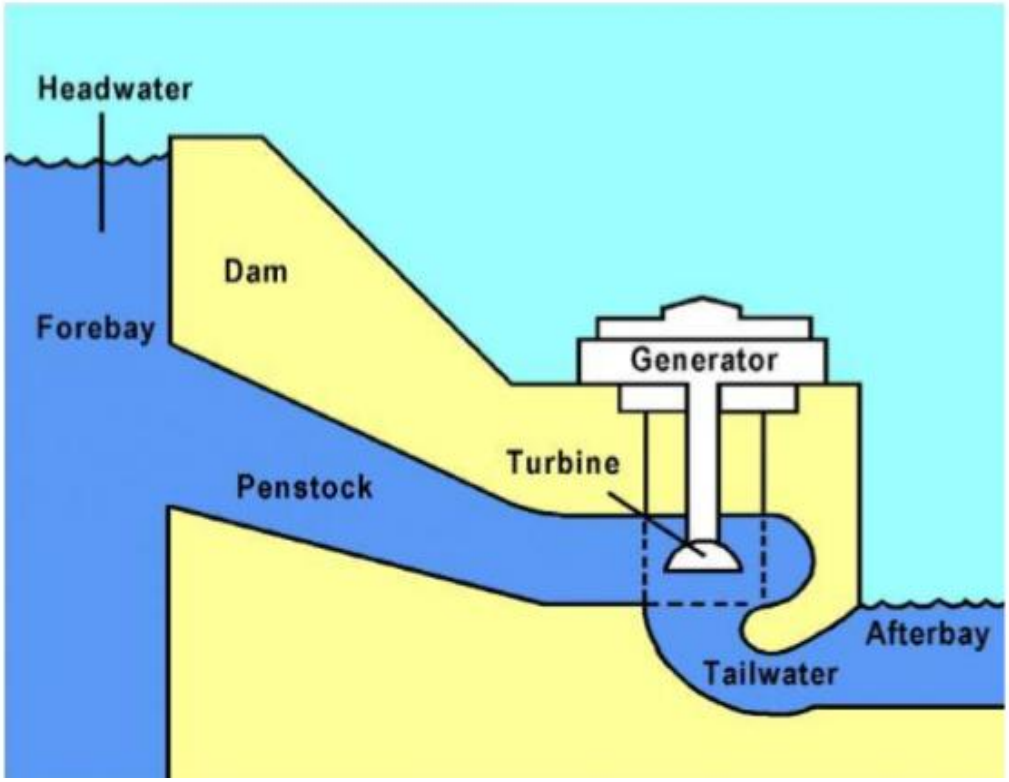

Fig. Hydro Power Plant

To generate electricity, water must be in motion. This is kinetic (moving) energy. When flowing water turns blades in a turbine, the form is changed to mechanical (machine) energy. The turbine turns the generator rotor which then converts this mechanical energy into another energy form called electricity. Since water is the initial source of energy, we call this hydroelectric power or hydropower for short. At facilities called hydroelectric power plants, hydropower is generated. Some power plants are located on rivers, streams, and canals, but for a reliable water supply, dams are needed. Dams store water for later release for such purposes as irrigation, domestic and industrial use, and power generation. The reservoir acts much like a battery, storing water to be released as needed to generate power.

The dam creates an Ahead or height from which water flows. A pipe (penstock) carries the water from the reservoir to the turbine. The fast-moving water pushes the turbine blades, something like a pinwheel in the wind.

The waters force on the turbine blades turns the rotor, the moving part of the electric generator. When coils of wire on the rotor sweep past the generator=s stationary coil (stator), electricity is produced.

Once the electricity is produced, it must be delivered to where it is needed -- our homes, schools, offices, factories, etc. Dams are often in remote locations and power must be transmitted over some distance to its users. Vast networks of transmission lines and facilities are used to bring electricity to us in a form we can use. All the electricity made at a power plant comes first through transformers which raise the voltage so it can travel long distances through power lines. (Voltage is the pressure that forces an electric current through a wire.) At local substations, transformers reduce the voltage so electricity can be divided up and directed throughout an area. Transformers on poles (or buried underground, in some neighborhoods) further reduce the electric power to the right voltage for appliances and use in the home. When electricity gets to our homes, we buy it by the kilowatt-hour, and a meter measures how much we use.

Advantage;

1. Once a dam is constructed, electricity can be produced at a constant rate.
2. If electricity is not needed, the sluice gates can be shut, stopping electricity generation. The water can be saved for use another time when electricity demand is high
3. Dams are designed to last many decades and so can contribute to the generation of electricity for many years / decades.
4. The lake that forms behind the dam can be used for water sports and leisure / pleasure activities. Often large dams become tourist attractions in their own right.
5. The lake's water can be used for irrigation purposes.
6. The buildup of water in the lake means that energy can be stored until needed, when the water is released to produce electricity.
7. When in use, electricity produced by dam systems do not produce green house gases. They do not pollute the atmosphere.

Disadvantage:

1. Dams are extremely expensive to build and must be built to a very high standard.
2. The high cost of dam construction means that they must operate for many decades to become profitable.
3. The flooding of large areas of land means that the natural environment is destroyed.
4. People living in villages and towns that are in the valley to be flooded, must move out. This means that they lose their farms and businesses. In some countries, people are forcibly removed so that hydro-power schemes can go ahead.
5. The building of large dams can cause serious geological damage. For example, the building of the Hoover Dam in the USA triggered a number of earth quakes and has depressed the earth's surface at its location.
6. Although modern planning and design of dams is good, in the past old dams have been known to be breached (the dam gives under the weight of water in the lake). This has led to deaths and flooding.
7. Dams built blocking the progress of a river in one country usually means that the water supply from the same river in the following country is out of their control. This can lead to serious problems between neighboring countries.
8. Building a large dam alters the natural water table level. For example, the building of the Aswan Dam in Egypt has altered the level of the water table. This is slowly leading to damage of many of its ancient monuments as salts and destructive minerals are deposited in the stone work from 'rising damp' caused by the changing water table level.

DIESEL POWER PLANT

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.** In a diesel power station, diesel engine is used as the prime mover. The diesel burns inside the engine and the products of this combustion act as the working fluid to produce mechanical energy. The diesel engine drives alternator which converts mechanical energy into electrical energy.

Used when:

- Demand of power is less,
- sufficient quantity of coal and water is not available,
- Transportation facilities are inadequate

This plants supply power to hospitals, radio stations, cinema houses, and telephone exchanges.

Site selection of diesel power plant

The following Factors should be considered while selecting the site for a diesel power plant:

1. **Foundation sub-soil condition:** the condition of sub-soil should be such that a foundation at a reasonable depth should be capable of providing a strong support to the engine.
2. **Access to the site:** the site should be so selected that it is accessible through rail and road.
3. **Distance from that load centre**: the location of the plant should be near the load centre. This reduces the cost of transmission lines and maintenance cost. The power loss is minimized.
4. **Availability of water:** Sufficient quantity of water should be available at the site selected.
5. **Fuel transportation:** The site selected should be near to the source of fuel supply so that transportation charges are low.

Diesel Power Plant Main Components

- Diesel engine
- Air filters
- Super chargers
- Engine starting system
- Fuel system
- Lubrication system
- Cooling system
- Governing system
- Exhaust system

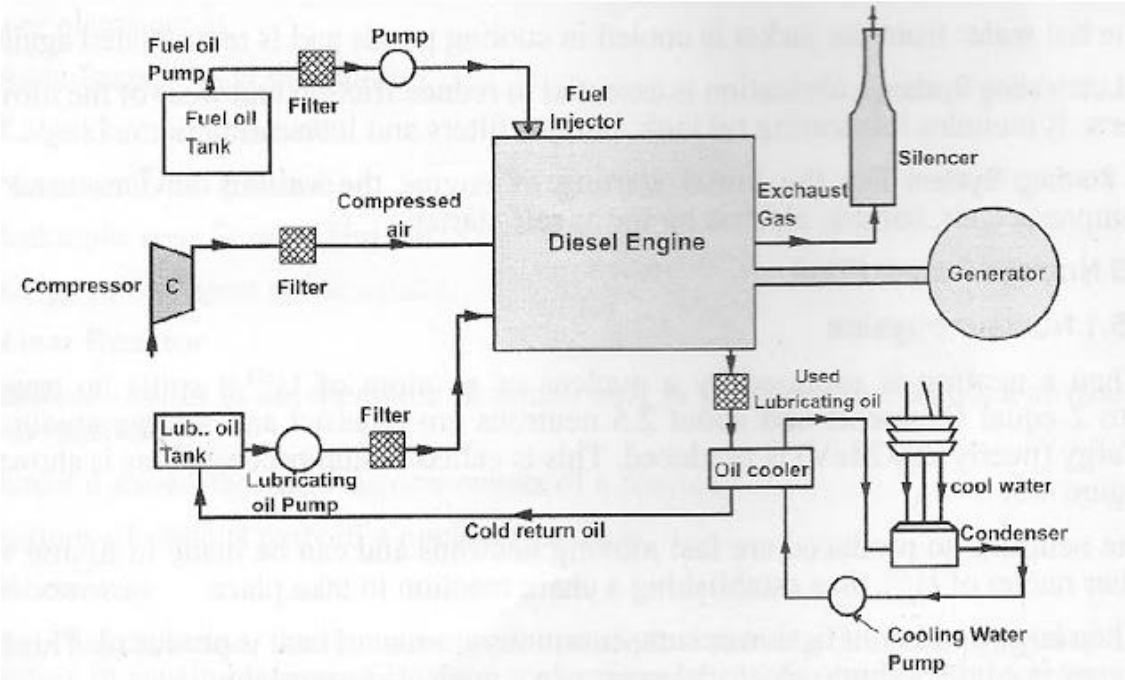

Fig. Diesel Power Plant Layout

Diesel engine

Diesel engine is one of the main components present in the diesel power plant. Mainly the engines are classified in to two types they are two stroke engine and four stroke engine. In the diesel engine the engine is straight away joined to the generator to develop power. In the engine the air entered in the cylinder must be compressed. Fuel must be injected by the end of the compression stroke. After the burning of the fuel the burnt gases expand and apply pressure on the piston. To the generator the shaft of the

engine is straightly attached to the engine. After the completion of the combustion the burnt gases are ejected in the atmosphere.

Air filters

Air filters are used to remove the dust particles present in the air during the entrance in to the engine. Air filters are a dry air filter type which consists of wool, felt or cloth. In case of the oil bath type filters the air is brushed over a bath of oil so the dust must be elements that get coated.

Super chargers

The super changers are used to increase the air pressure which is provided to the engine. Then the power of the engine is improved.

Engine starting system

In the diesel power plant diesel engine used is not self-starting. Starting of the engine includes the air tanks along with the air compressor. In the cold conditions the engine is started by delivering the air.

Fuel system

The fuel system contains the fuel transfer pump, fuel pump, storage tank, heaters and strainers. With the help of the Pumps the diesel from the storing tank is drawn and with the help of the filter it is supplied to the small day tank. Day tank delivers the day-to-day fuel essential for the engine. In place of the high placed flows the day tank is used so that the diesel movements the engine takes place under gravity. Again the diesel filtered before it is injected into the engine with the help of fuel injection pump. With the help of the fuel injection system some functions are performs they are:-

- Initially the fuel must be filtered
- At the time of injection of the fuel correct quantity is to be injected in to the system.
- Injection process must take place at a particular time
- The fuel supply must be regulated
- In the combustion chamber atomized fuel must be separated properly.
- According to the loads of the plants the fuel must be supplied.

Lubrication system

The lubrication system must include oil tanks, coolers, pipes and oil pumps. The main aim is in moving parts. It is used to reduce the friction and reduce tear and wear of the engine components. Like cylinder walls and piston. Due to the friction the Lubrication oil must be gets heated of and the moving parts are cooled earlier reflow. In the lubrication system the oil is forced from the oil tank through the oil chiller. The oil is cooled with the cold water which enters the engine. After cooling of the hot oil the moving parts are returned in to the lubricating oil tank.

Cooling system

Inside the engine cylinder the high temperature of the burning fuel is around 1500 to 2000 C. In case we lower this temperature the water is dispersed through the engine. The water jacket covers the engine. And the heat from the piston, cylinder, and combustion chamber must be passed by the flowing water. The level of the hot water in the jacket is delivered through the heat exchanger. In the heat exchanger, the heat is carried away by the water which is circulated over the heat exchanger and the water is cooled in the cooling tower

Governing system

The governing system is used to control the speediness of the engine. This is completed by changing the fuel stream permitting it to the engine load

Exhaust system

The exhaust gases approaching out of the engine are very loud. To reduce the sound a silencer is used.

Advantages of Diesel Power Plant

1. The design and layout of the plant are quite simple.
2. It occupies less space as the number and size of the auxiliaries is small.
3. It can be located at any place.
4. It can be started quickly and it can pickup load in a short time.
5. There are no standby losses.
6. It requires less quantity of water for cooling.
7. The overall cost is much less than that of steam power station of same capacity.
8. The thermal efficiency of the plant is higher than that of a steam power station.
9. It requires less operating staff.

Disadvantages of Diesel Power Plant

1. The plant has high running charges as the fuel (diesel) used is costly.
2. The plant doesn't work satisfactorily under overload conditions for a longer period.
3. The plant can only generate small power.
4. The cost of lubrication is generally high.
5. The maintenances charges are generally high

APPLICATION OF DIESEL POWER PLANT

They are quite suitable for mobile power generation and are widely used in transportation systems consisting of railroads, ships, automobiles, and aero planes. They can be used for electrical power generation in capacities from 2 to 50 MW. They can be used as peak load plants for some other types of power plants.

Industrial concerns where power requirement are small say of the order of 500 kW, diesel power plants become more economical due to their higher overall efficiency.

NUCLEAR POWER PLANT

Site Selection of Nuclear Power Station

1. **Availability of water:**

Although very large quantity of water is not regulated as hydro-electric power plant, but still sufficient supply of neutral water is obvious for cooling purposes in nuclear power station. That is why it is always preferable to locate this plant near a river or sea side.

2. Disposal of water:

The by-products or wastes of nuclear power station are radioactive and may cause severe health hazards. Because of this, special care to be taken during disposal of wastes of nuclear power plant. The wastes must be buried in sufficient deep from earth level or these must be disposed off in sea quite away from the sea share. Hence, during selecting the location of nuclear plant, these factors must be taken into consideration.

3. Distance from populated area:

As there is always a probability of radioactivity, it always preferable to locate a nuclear station sufficiently away from populated area.

4. **Transportation facilities:**

During commissioning period, heavy equipments to be erected which to be transported from manufacturer site. So, good railways and road ways availabilities are required. For availability of skilled manpower good public transport should also be present at the site.

Working of Nuclear Power Plant

The basic principle of nuclear power station is same as steam power station. Only difference is that, instead of using heat generated due to coal combustion, here in nuclear power plant, heat generated due to nuclear fission is used to produce steam from water in the boiler. This steam is used to drive a steam turbine. This turbine is the prime mover of the alternator. This alternator generates electrical energy. Although, the availability of nuclear fuel is not plenty but very less amount of nuclear fuel can generate huge amount of electrical energy. This is the unique feature of a nuclear power plant. One kg of uranium is equivalent to 4500 metric tons of high grade coal. That means complete fission of 1 kg uranium can produce as much heat as can be produced by complete combustion of 4500 metric tons high grade coal. This is why, although nuclear fuel is much costlier, but nuclear fuel cost per unit electrical energy is still lower than that cost of energy generated by means of other fuel like coal and diesel. To meet

up conventional fuel crisis in present era, nuclear power station can be the most suitable alternatives.

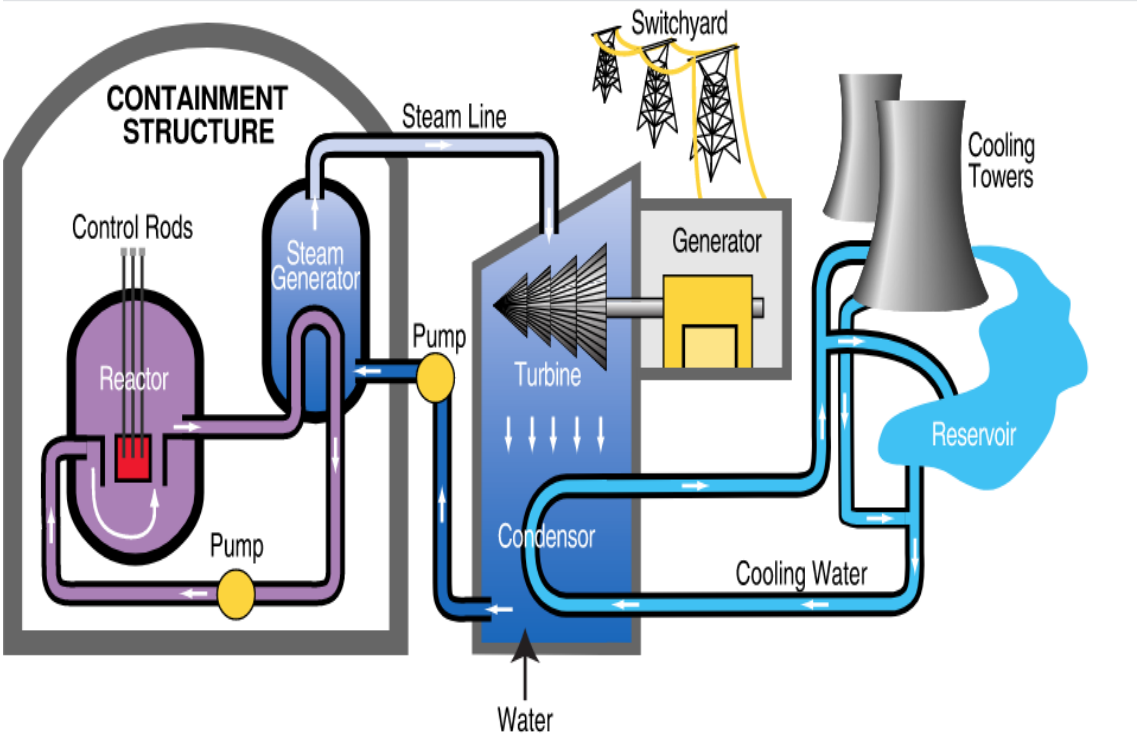

Fig. Nuclear Power Plant

Different Components of Nuclear Power Station

A nuclear power station has mainly four components.

1. Nuclear reactor,
2. Heat exchanger,
3. Steam turbine,
4. Alternator

1. **Nuclear Reactor**

In nuclear reactor, Uranium 235 is subjected to nuclear fission. It controls the chain reaction that starts when the fission is done. The chain reaction must be controlled otherwise rate of energy release will be fast, there may be a high chance of explosion. In nuclear fission, the nuclei of nuclear fuel, such as U235 are bombarded by slow flow of neutrons. Due to this bombarding, the nuclei of Uranium is broken, which causes release of huge heat energy and during breaking of nuclei, number of neutrons are also emitted. These emitted neutrons are called fission neutrons. These fission neutrons cause further

fission. Further fission creates more fission neutrons which again accelerate the speed of fission. This is cumulative process. If the process is not controlled, in very short time the rate of fission becomes so high, it will release so huge amount of energy, there may be dangerous explosion. This cumulative reaction is called chain reaction. This chain reaction can only be controlled by removing fission neutrons from nuclear reactor. The speed of the fission can be controlled by changing the rate of removing fission neutrons from reactors. A nuclear reactor is a cylindrical shaped stunt pressure vessel. The fuel rods are made of nuclear fuel i.e. Uranium moderates, which is generally made of graphite cover the fuel rods. The moderates slow down the neutrons before collision with uranium nuclei. The controls rods are made of cadmium because cadmium is a strong absorber of neutrons. The control rods are inserted in the fission chamber. These cadmium controls rods can be pushed down and pull up as per requirement. When these rods are pushed down enough, most of the fission neutrons are absorbed by these rods, hence the chain reaction stops. Again, while the controls rods are pulled up, the availability of fission neutrons becomes more which increases the rates of chain reaction. Hence, it is clear that by adjusting the position of the control rods, the rate of nuclear reaction can be controlled and consequently the generation of electrical power can be controlled as per load demand. In actual practice, the pushing and pulling of control rods are controlled by automatic feedback system as per requirement of the load. It is not controlled manually. The heat released during nuclear reaction, are carried to the heat exchanger by means of coolant consist of sodium metal.

2. **Heat Exchanger**

In heat exchanger, the heat carried by sodium metal, is dissipated in water and water is converted to high pressure steam here. After releasing heat in water the sodium metal coolant comes back to the reactor by means of coolant circulating pump.

3. **Steam Turbine**

In nuclear power plant, the steam turbine plays the same role as coal power plant. The steam drives the turbine in same way. After doing its job, the exhaust steam comes into steam condenser where it is condensed to provide space to the steam behind it.

4. **Alternator**

An alternator, coupled with turbine, rotates and generates electrical power, for utilization.

Advantages of Nuclear Power Station

1. As we said, the fuel consumption in this power station is quite low and hence, cost for generating single unit is quite less than other conventional power generation method.
2. A nuclear power station occupies much smaller space compared to other conventional power station of same capacity.
3. This station does not require plenty of water; hence it is not essential to construct plant near natural source of water. This also does not required huge quantity of fuel; hence it is also not essential to construct the plant near coal mine, or the place where good transport facilities are available. Because of this, the nuclear power station can be established very near to the load centre.

Disadvantages of Nuclear Power Plant

1. The fuel is not easily available and it is very costly.
2. Initial cost for constructing nuclear power station is quite high.
3. Erection and commissioning of this plant is much complicated and sophisticated than other conventional power station.
4. The fission by products is radioactive in nature, and it may cause high radioactive pollution.
5. The maintenance cost is higher and the man power required to run a nuclear power plant is quite higher since specialty trained people are required.
6. Sudden fluctuation of load cannot be met up efficiently by nuclear plant.
7. As the byproducts of nuclear reaction is high radioactive, it is very big problem for disposal of this by products. It can only be disposed deep inside ground or in a sea away from sea share.