

# DIESEL ELECTRIC STATION

## 8<sup>th</sup> lecture

*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 the alternator which converts mechanical energy into electrical energy. As the generation cost is considerable due to high price of diesel, therefore, such power stations are only used to produce small power. Although steam power stations and hydro-electric plants are invariably used to generate bulk power at cheaper cost, yet diesel power stations are finding favour at places where demand of power is less, sufficient quantity of coal and water is not available and the transportation facilities are inadequate. These plants are also used as standby sets for continuity of supply to important points such as hospitals, radio stations, cinema houses and telephone exchanges.

## INTRODUCTION

The oil engines and gas engines are called Internal Combustion Engines. In IC engines fuels burn inside the engine and the products of combustion form the working fluid that generates mechanical power. Whereas, in Gas Turbines the combustion occurs in another chamber and hot working fluid containing thermal energy is admitted in turbine.

Reciprocating oil engines and gas engines are of the same family and have a strong resemblance in principle of operation and construction.

The engines convert chemical energy in fuel in to mechanical energy.

A typical oil engine has:

1. Cylinder in which fuel and air are admitted and combustion occurs.
2. Piston, which receives high pressure of expanding hot products of combustion and the piston, is forced to linear motion.
3. Connecting rod, crankshaft linkage to convert reciprocating motion into rotary motion of shaft.
4. Connected Load, mechanical drive or electrical generator.
5. Suitable valves (ports) for control of flow of fuel, air, exhaust gases, fuel injection, and ignition systems.
6. Lubricating system, cooling system

In an engine-generator set, the generator shaft is coupled to the Engine shaft.

The main differences between the gasoline engine and the diesel engine are:

- A gasoline engine intakes a mixture of gas and air, compresses it and ignites the mixture with a spark. A diesel engine takes in just air, compresses it and then injects fuel into the compressed air. The heat of the compressed air lights the fuel spontaneously.

- A gasoline engine compresses at a ratio of 8:1 to 12:1, while a diesel engine compresses at a ratio of 14:1 to as high as 25:1. The higher compression ratio of the diesel engine leads to better efficiency.

- Gasoline engines generally use either carburetion, in which the air and fuel is mixed long before the air enters the cylinder, or port fuel injection, in which the fuel is injected just prior to the intake stroke (outside the cylinder). Diesel engines use direct fuel injection to the diesel fuel is injected directly into the cylinder.

The diesel engine has no spark plug, that it intakes air and compresses it, and that it then injects the fuel directly into the combustion chamber (direct injection). It is the heat of the compressed air that lights the fuel in a diesel engine.

The injector on a diesel engine is its most complex component and has been the subject of a great deal of experimentation in any particular engine it may be located in a variety of places. The injector has to be able to withstand the temperature and pressure inside the cylinder and still deliver the fuel in a fine mist. Getting the mist

circulated in the cylinder so that it is evenly distributed is also a problem, so some diesel engines employ special induction valves, pre-combustion chambers or other devices to swirl the air in the combustion chamber or otherwise improve the ignition and combustion process.

One big difference between a diesel engine and a gas engine is in the injection process. Most car engines use port injection or a carburetor rather than direct injection. In a car engine, therefore, all of the fuel is loaded into the cylinder during the intake stroke and then compressed. The compression of the fuel/air mixture limits the compression ratio of the engine, if it compresses the air too much, the fuel/air mixture spontaneously ignites and causes knocking. A diesel compresses only air, so the compression ratio can be much higher. The higher the compression ratio, the more power is generated.

Some diesel engines contain a glow plug of some sort. When a diesel engine is cold, the compression process may not raise the air to a high enough temperature to ignite the fuel. The glow plug is an electrically heated wire (think of the hot wires you see in a toaster) that helps ignite the fuel when the engine is cold so that the engine can start.

Smaller engines and engines that do not have such advanced computer controls, use glow plugs to solve the cold-starting problem.

We recommend diesels due to their:

- (a) Longevity-think of an 18 wheeler capable of 1,000,000 miles of operation before major service)
- (b) Lower fuel costs (lower fuel consumption per kilowatt (kW) produced)
- (c) Lower maintenance costs-no spark system, more rugged and more reliable engine,

Today's modern diesels are quiet and normally require less maintenance than comparably sized gas (natural gas or propane) units. Fuel costs per kW produced with diesels is normally thirty to fifty percent less than gas units.

1800 rpm water-cooled diesel units operate on average 12–30,000 hours before major maintenance is required. 1800 rpm water-cooled gas units normally operate 6–10,000 hours because they are built on a lighter duty gasoline engine block.

3600 rpm air-cooled gas units are normally replaced not overhauled at 500 to 1500 hours.

Because the gas units burn hotter (higher btu of the fuel) you will see significantly shorter lives than the diesel units.

Diesel engine power plants are installed where

1. Supply of coal and water is not available in desired quantity.
2. Where power is to be generated in small quantity for emergency services.
3. Standby sets are required for continuity of supply such as in hospital, telephone exchange.

It is an excellent prime mover for electric generator capacities of from 100 hp to 5000 hp. The Diesel units used for electric generation are more reliable and long - lived piece of equipment compared with other types of plants.

**Definition of Diesel Electric 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.

For generating electrical power, it is essential to rotate the rotor of an alternator by means of a prime mover. The prime mover can be driven by different methods. Using diesel engine as prime mover is one of the popular methods of generating power. When prime mover of the alternators is diesel engine, the power station is called diesel power station. The mechanical power required for driving alternator comes from combustion of diesel. As the diesel costs high, this type of power station is not suitable for producing power in large scale in our country. But for small scale production of electric power, and where, there is no other easily available alternatives of producing electric power, diesel power station are used.

**Advantages**

- (i) The design and layout of the plant are quite simple.
- (ii) It occupies less space as the number and size of the auxiliaries is small.
- (iii) It can be located at any place.
- (iv) It can be started quickly and can pick up load in a short time.
- (v) There are no standby losses.
- (vi) It requires less quantity of water for cooling.
- (vii) The overall cost is much less than that of steam power station of the same capacity.
- (viii) The thermal efficiency of the plant is higher than that of a steam power station.
- (ix) It requires less operating staff.

**Disadvantages**

- (i) The plant has high running charges as the fuel (*i.e.*, diesel) used is costly.
- (ii) The plant does not work satisfactorily under overload conditions for a longer period.
- (iii) The plant can only generate small power.
- (iv) The cost of lubrication is generally high.
- (v) The maintenance charges are generally high.

**Uses of Diesel Electric Station:**

1. Central Station
2. Standby Plant
3. Peak Load Plant
4. Emergency Plant
5. Mobile Plant
6. Nursery Plant
7. Supply Units for Cinemas, Hospitals etc.

### **Selection of Site for a Diesel Power Station:**

#### 1. Near to Load Center:

As far as possible the plant should be installed near to load center, to reduce transmission & distribution cost of electrical energy.

#### 2. Availability of Land:

For erection of diesel power plant, land should be available near to load center at low cost.

#### 3. Availability of Water:

The soft water is freely available for the purpose of cooling.

#### 4. Foundations:

As we know that, the diesel engines or a machine produces vibrations. So provide good foundation to erect the diesel engine.

#### 5. Fuel Transportation:

The diesel plant is far away from fuel mines. So to provide fuel to the plant arrange good transportation facility like road, rail etc.

#### 6. Local Conditions:

For increasing the demand of power & future expansion space available.

7. Noise Pollution: The plant should away from populated areas, because it produces noise.