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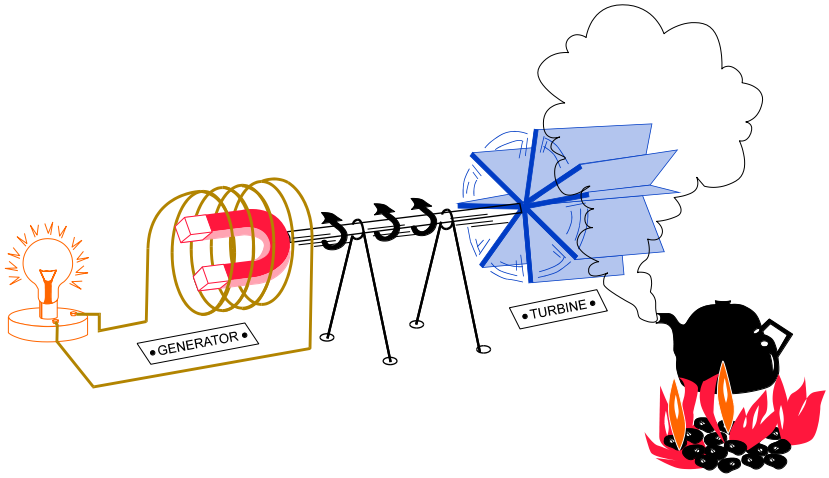
Fact Sheet

BASIC PRINCIPLES OF ELECTRICITY



How electricity is generated
The generation of electricity is the conversion of other forms of energy into an electrical current.

Generators
In 1831, Michael Faraday's experiments with electricity and magnetism resulted in the first electric generator. In a generator, mechanical energy is changed into electrical energy by spinning a magnet inside a coil of wire.

The lines of force between the north and south poles of the magnet are cut by the wires in a coil and this produces the electric current in the coil itself. The electro-magnet used in power stations is made of many turns of covered copper wire wound around an iron core. The magnet is referred to as the rotor and the coil as the stator.

Some form of mechanical energy such as the movement of steam, water, gas or wind is required to keep the magnet turning. This is accomplished by applying the mechanical force of the moving steam, water, gas or wind to a turbine wheel connected to a shaft, which in turn is connected to the magnet.

Electricity from coal
In most modern power stations in South Africa, coal is burned to heat water and convert it into steam. The steam is directed onto the blades of a turbine to make it rotate. This in turn rotates the magnetic rotor inside the coil to generate electricity.

Once the steam has passed through the turbines, it must be cooled and condensed. The cooling process turns the steam back into water so that it can be pumped back to the boiler for reheating. In the boiler it will be turned into steam again and will restart the cycle.

Many of Eskom's coal-fired power stations are built right next to coal mines. The coal is transported from the mine to the power station on overland conveyor belts. This saves time and money and helps keep the cost of electricity down.

Electricity from the atom
In the case of nuclear power stations, water is heated not by burning coal, but by the heat released in a nuclear reaction. The amount of heat can be increased or decreased by controlling the rate at which uranium atoms are split. This is done by means of what is known as "control rods" that function similarly to the way an accelerator of a car causes the car to speed up or slow down. A "moderator", composed of highly purified water and boron, circulating in the primary circuit, also assists in controlling reactivity.

The heat from the primary circuit is transferred to a separate secondary circuit where water is turned into steam. The steam produced from heating the water in the second circuit is used to rotate the turbines in exactly the same way as in a coal-fired power station. The steam is then condensed and returned for re-use.

Electricity from water

- **Conventional hydroelectric schemes**

A conventional hydroelectric power station is usually built on a river or next to a dam on a river. The gravitational potential energy of the water from the river or dam, due to it's height above the turbine, is first converted into kinetic energy (due to the movement of the water down towards the turbines) and then converted into electrical energy.

Water flows through a waterway to the hydro turbine, rotating the shaft and magnetic rotor to which it is connected. Once its force has been used to generate the electricity, the water is channeled back into the river below the power station.

- **Pumped storage schemes**

Pumped storage hydroelectric power stations are used in areas with inadequate water supplies. A pumped storage scheme consists of an upper and a lower dam with a power station/pumping plant situated between the two.

When there is a demand for electricity, water flows from the upper dam turning the turbines in the power station to generate electricity. During periods of low electricity demand the water collected in the bottom dam is pumped back to the upper dam so that it can be used again.

Electricity from gas

In Eskom's gas turbine power stations a fuel/air mixture is ignited to form a hot, high velocity gas. The gas turns the turbine which is connected to the rotor by means of a shaft. Where available, natural gas can be used as an alternative to liquid fuels such as diesel or kerosene.

Power Lines

Electricity is transported along power lines from the power stations to the areas where it is needed. It is transmitted at high voltages to minimise losses that occur over long distances and to limit the number of power lines required. The voltage is a measurement of electrical potential.

Transformers

Transformers are used to raise or lower voltage. Transformers at the power stations increase the voltage of the electricity for transmission on the power lines. When it has reached its destination, transformers in sub-stations near towns and cities decrease the voltage to a level where it can be used in factories and homes.

The voltage in our homes is 220/240 V (volts) whereas the voltage of the main transmission system is 400 000 V (400 kilovolts).

The National Grid

The network of power lines that links the power stations to the cities, towns, rural and residential areas where electricity is used, is called the national grid. All electricity that Eskom generates is fed into this grid for national distribution.

Control Centre

Electricity cannot be stored. It must be used as it is generated. Computers in special control centres monitor how much electricity is needed throughout South Africa. The power stations adjust the amount of electricity they generate according to the instructions from the control centres.

MEASUREMENTS TO REMEMBER

Ampere = the rate of flow of an electric current
Volt = a measurement of electrical potential
Watt = measurement of electrical power
Ohm = resistance against the flow of charge that the electrical conductor must overcome

Produced by: Generation Communication
GX 0004 Revision 14 (June 2024)

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