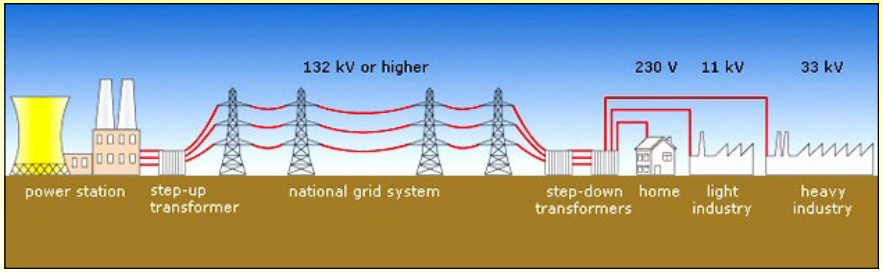
UNIT 1	GCSE PHYSICS	1.4.2	The National Grid

- Electricity is distributed from power stations to consumers along the National Grid.
- Transformers are an essential part of the National Grid.
- For a given power, increasing the voltage reduces the current required and this reduces the energy losses in the cables.
- The uses of step-up and step-down transformers in the National Grid.

TRANSMISSION OF ELECTRICITY

- Electrical energy is generated in **power stations** and it is then transmitted to domestic, commercial and industrial consumers via the **NATIONAL GRID**. This is a huge network of **cables, transformers and pylons** which link the power stations to homes and buildings all over the country.



- Power stations deliver **alternating current** to the national grid at a frequency of **50 Hz** and a voltage of **25 000 V**.
- **STEP-UP TRANSFORMERS** are then used to increase the voltage to a very high value (up to **400 000 V**) for cross-country transmission along power lines carried by pylons.
- **STEP-DOWN TRANSFORMERS** are used to decrease the grid voltage to **230 V** for use in homes, schools, shops etc.
- The electricity is transmitted at **HIGH VOLTAGE** so that for any given **power (= voltage x current)**, the **CURRENT** will be **LOW** and so the **ENERGY LOSS** due to heating of the cables will be **MINIMISED**.

REASON FOR TRANSMISSION AT HIGH VOLTAGE

- **Electrical power = Voltage x Current**
- **So for any given power, the greater the voltage, the smaller is the current.**
- **And the smaller the current is, the lower is the energy loss due to Heating of the cables.**

REASON FOR USING ALTERNATING CURRENT INSTEAD OF DIRECT CURRENT

- **TRANSFORMERS have to be used to STEP-UP and STEP-DOWN the voltage.**
- **Transformers only work with ALTERNATING CURRENT.**

OVERHEAD POWER LINES OR UNDERGROUND CABLES?

As we have seen, electricity is transmitted from power stations to the consumer using the national grid. This consists of thousands of miles of cables suspended high above the ground by huge metal pylons.

It is a very familiar feature of our landscape and it certainly does the job it was designed for, but as always, there are some disadvantages.

DISADVANTAGES OF OVERHEAD POWER TRANSMISSION

- **VISUAL POLLUTION**
  They are a definite blot on the landscape.

- **HEALTH RISK**
  The electric currents in the overhead cables produce electric and magnetic fields and there is some evidence which indicates that continual exposure to these fields has a detrimental effect on people's health. Those at greatest risk are people whose homes are located close to these power lines.

The alternative mode of power transmission would be to bury the cables deep underground, but there are valid reasons why this is not a viable solution.

DISADVANTAGES OF UNDERGROUND POWER TRANSMISSION

- **MUCH MORE EXPENSIVE THAN OVERHEAD CABLES.**
  This would mean that electrical energy would be even more expensive than it is already.
- **MORE DIFFICULT TO MAINTAIN AND REPAIR.**
  If there was any fault in the line, the cables would have to be dug out, a time-consuming and expensive job.
- **DIFFICULT TO BURY AT POINTS WHERE THE CABLES CROSS RIVERS, CANALS, ROADS AND MOTORWAYS.**
- **INCREASED HEALTH RISK.**
  Underground cables would be closer to people than overhead cables, so the health risk from the electric and magnetic fields would be even greater.

- **HOMEWORK QUESTION**

1 Each town in Britain used to have its own power station. Nowadays electricity is supplied by a system called the **NATIONAL GRID.**

(a) Why is the National Grid system better than each town having its own supply?

(b) Electricity in power stations is generated at 25 000 V. **Explain** why :

(i) It is then transmitted via the National Grid system at **much higher voltage.**
(ii) It is supplied to homes at **230 V.**

(c) What is the **full name** of the device used to **increase** the voltage of the electricity prior to transmission.

(d) What is the **full name** of the device used to **decrease** the voltage of the transmitted electricity before it is supplied to homes.