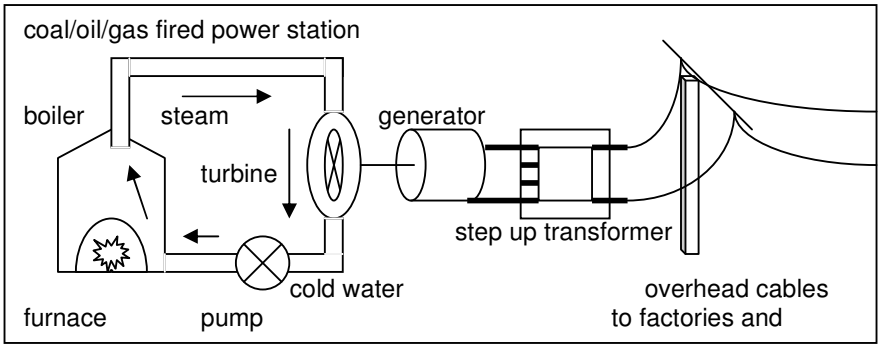
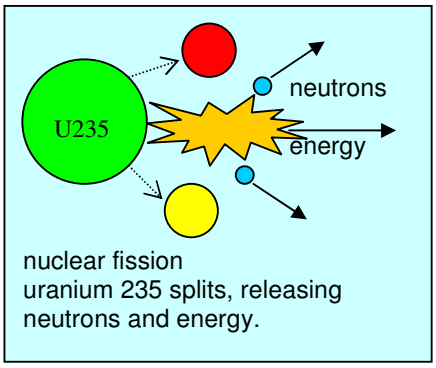
-the electricity is fed to a step up transformer to raise the voltage.
-this reduces energy lost by heat in the wires.
-the electricity is then taken across country in overhead power cables.
-it is then stepped down for factories and houses.

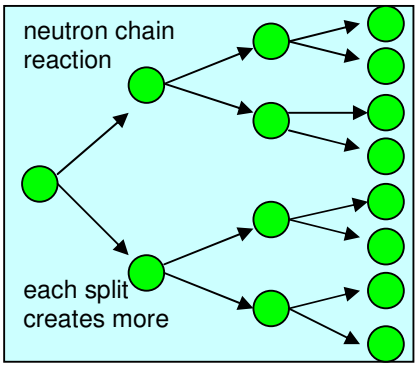



**** flow chart of energy change?

neutron chain reactions

-uranium 235 is the fuel for nuclear power stations, the process is **fission**.
-naturally uranium atoms can split up, giving out neutrons and some energy.
-if a neutron is captured by another uranium atom, it splits **spontaneously**.
-the number of neutrons given out varies each time from one to about ten.
-the splitting of uranium atoms by neutrons given out from splitting uranium atoms is called the **neutron chain reaction**. See diagram below.




-suppose two neutrons are given out and both are captured by other atoms.
-one uranium atoms splitting will cause two new ones to split.
-if each of these gives out two neutrons, four new atoms will split.
-each time the number of atoms that split is doubled, 2, 4, 8, 16 etc.
-suppose each splitting occurs every millisecond, how long would it take for a mole of uranium atoms to split?
-if n is the number of milliseconds then $2^n$ = one mole = $6 \times 10^{23}$ .
-n is about 70 so it will take 70ms or about 0.07 sec!
-remembering that energy is given out each time, then a lot of energy would be released in a very short time. This is the basis of the atom bomb.
-for each disintegration about 200MeV are released which is about $3.2 \times 10^{-11}$ J.
-if one mole of uranium disintegrates, that releases about $2 \times 10^{12}$ J.
-this works out to be about $8 \times 10^{12}$ J/kg
-0.008% of mass is lost so $E = mc^2 = 0.00008 \times 235 \times (3 \times 10^8)^2$ which is about
$8 \times 10^{13}$ J/kg.

-how many kg/s are needed to power a 200MW station?
$n = P/k = 2 \times 10^{8} / 2 \times 10^{13} = 10^{-5}$ kg/s or 0.01g/s!!!
-this is not much, so it is clear that uranium is a very concentrated source.

energy changes in a nuclear power station

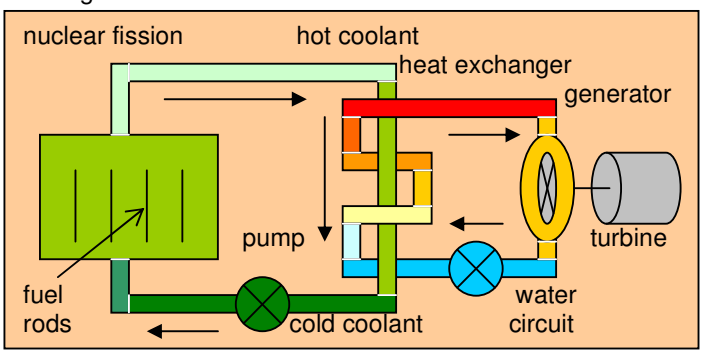
-a nuclear power station starts with nuclear fission energy from uranium.
-this becomes heat energy in warming the coolant, which in turn heats the water to steam to turn the turbines and this becomes kinetic energy.
-the turbines turn the coil in a generator and this generates electrical energy.

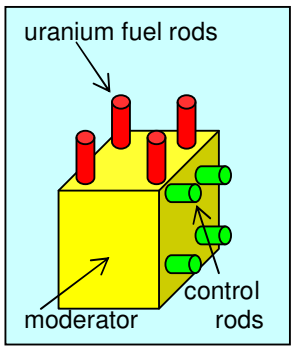
moderators and control rods

-uranium atoms will only split if they capture **slow neutrons**.
-the neutrons released in the chain reaction are of all velocities.
-a material that can slow down neutrons is called a **moderator**.
-thus a moderator will increase the speed of the chain reaction.
-moderator materials such as graphite surround the fuels rods to slow down the neutrons.
-fuel rods are usually made to be long and thin, but placed close together.
-with this large surface area, most neutrons escape without reacting.
-neutrons that escape from one rod can enter another.
-this increases the chance of further splitting.
-to avoid this reaction getting out of control, a neutron absorbing material is moved between or away from the fuel rods such as boron.
-the material used to absorb neutrons is called the **control rods**.

heat exchanger

-the coolant in nuclear power stations is not always water.
-some stations use pressurised water, others carbon dioxide.
-liquid sodium is also used-being a metal it is a good conductor.
-as the coolants are in contact with fuel rods, they become contaminated.
-heat is transferred from the coolant to the water used to turn the turbines via a **heat exchanger**.
-in a heat exchanger the coolant pipes and turbine pipes are in contact, allowing the heat to be transferred without contact between the two fluids.




origin of fossil fuels

-coal oil and gas are the fossil fuels.
-oil is formed from the dead remains of sea animals.
-the remains of animals sink to the ocean floor to be covered by sediments.
-over millions of years and increased pressures, the remains become oil.
-gas, such as methane is also created and trapped underground with the oil.
-coal is formed from the dead remains of plants and trees.
-in swamp/rain forest conditions, dead trees and plants form a layer.