Nuclear Power in One Page

Unlike conventional power sources, **nuclear power generation** dœs not involve the burning of fossil fuels (coal, gas or oil). Instead, heat is created by the **controlled fission** of heavy elements such as Uranium or Plutonium,

Fission involved the 'splitting' of big atoms. In the process of doing this, the split causes the emission of an amount of energy as heat. This is created based on Einstein's famous equation, $E=mc^2$. In such an event, a tiny amount of the mass of an atom's nucleus is lost, which is released as a disproportionately large amount of energy (because of the 'speed-of-light squared' element of the equation). If you can get this energy release to happen continuously, and in a controlled manner, then a lot of sustained heat can be generated. It can then be used to create steam, which in turn drives electricity generators. This is basically how atomic power stations work.

Of course, if the energy release is uncontrolled then you get something different: the heat generated causes the core itself to get immensely hot, and eventually creating a dangerous 'melt-down' (which is what happened at Chernobyl). Or even worse, if caused deliberately, a massive runaway release of energy creates an atomic explosion.

Consequently, all nuclear cores need careful moderation (using elements like boron) to stop the reaction speeding up, and also sophisticated systems to keep them cool (using water or gas).

Nuclear fuels are quite rare. The correct type of Uranium (U235) is hard to come by in nature, and needs to be extracted from vast amounts of mined 'yellow cake' ore. Hence Plutonium is often used instead. Plutonium can also be created in the cores of Uranium-based reactors, then extracted to create more nuclear cores. The problem is, Plutonium is a very poisonous substance. It can also be used to create nuclear bombs. Hence security when handling Plutonium is very tight indeed, with a constant threat of accidents, loss by theft, or terrorist attack.

Nuclear cores do not last forever. Eventually, the materials become spent and no more viable heat can be generated. But the core remains highly radioactive (sometimes for thousands of year), as do the irradiated structures surrounding it, the buildings, shielding, and the coolants. The big problem is what to do with all this deadly waste material? For a while in the UK, waste was stored in deep ponds of water at Sellafield in Cumbria. But these ponds are filling up, and eventually the waste will need to be stored in thick concrete 'coffins' deep underground. Finding an appropriate site for this has been difficult. Storage needs to be somewhere geologically stable, away from urban centres, and isolated from the water table. I must also be guarded for many generations into the future.

Yet, even given these problems, nuclear power is a very green source of energy. Until a better solution can be reached, it remains one of the key options for our future energy needs.