What is a fission reactor and how does it work?[1]

At the centre of all nuclear power stations is the nuclear reactor. Within the reactor "core", uranium or plutonium fuel rods are arranged. The fuel rods are surrounded by a "moderator". The moderator slows the neutrons down so they can hit other uranium atoms to create a fission chain reaction. The moderator is usually water or graphite.

The amount of energy released inside a nuclear reactor can be controlled by using "control rods". These are made from substances such as boron steel or silver and fit between the fuel rods. The lowering or raising of the rods regulates the absorption of the neutrons. Lowering them reduces the number of neutrons available to cause fission of uranium and if they are lowered completely, the reactor will shut down.

The heat energy released by the nuclear fission process is continually removed from the reactor core by a "coolant". The coolant flows at a high temperature from the core to a heat exchanger (or "boiler"), where it converts water into steam.

The steam drives wheels called turbines. Electricity is produced and then converted to a suitable voltage by a transformer and sent to the National Grid.

How have nuclear fission reactors in the UK changed?

	First generation UK reactors (From mid 1950s- 1960s)	**Second generation UK reactors** (From early 1960s)	**Third generation UK reactors**
Name:	Magnox (Magnesium Non-Oxidising cladding material)	AGR (Advanced Gas-Cooled Reactor)	PWR (Pressurised Water Reactor) CANDU – none in the UK (Pressurised Heavy Water Reactor)
Description:	Gas-Cooled Reactor: pressurised carbon dioxide-cooled, graphite-moderated reactors.	Gas-Cooled Reactor: pressurised carbon dioxide cooled, graphite moderated reactors.	Pressurised Water Reactor: uses water or heavy water (D_2O) for coolant and for neutron moderator.
Fuel:	Uranium metal	Uranium oxide pellets	Uranium metal
Moderator:	Graphite	Graphite	Water/Heavy water
Coolant:	Carbon-dioxide	Carbon-dioxide	Water/Heavy water
Life span:	20-25 years (all have exceeded this by 20 years or more)	60 years	60 years
Discussion:	The fuel efficiency of the older Magnox reactors is about half that achieved by the AGRs. The cladding limits the maximum temperature of the reactor, which reduces the plant's thermal efficiency- electricity generated/heat generated ratio.	Allows higher temperatures than PWR. But the fuel use is less efficient, countering the thermal efficiency advantage. To get the same power output as a PWR, the reactor core has to be larger.	Greater fuel efficiency, reducing the amount of fuel used and waste produced. Some designs have inherent- safety features that require no operational intervention These help to prevent accidents if malfunction occurs.

[1] Adapted from *Nuclear Energy Past, Present and Future*, M. Grimston, published by Nuclear Industry Association