Nuclear Reactor Safety

To be able to list and explain the safety features of a nuclear reactor
To be able to explain how an emergency shut-down happens in a nuclear reactor
To be able to state and explain the methods of nuclear waste disposal

Nuclear Reactor Safety

There are many safety features and controls in place designed to minimise the risk of harm to humans and the surrounding environment.

Fuel Used

Using solids rather than liquids avoids the danger of leaks or spillages. They are inserted and removed from the reactor by remote controlled handling devices.

Shielding

The reactor core (containing the fuel, moderator and control rods) is made from steel and designed to withstand high temperatures and pressures.

The core itself is inside a thick, leak proof concrete box which absorbs escaping neutrons and gamma radiation.

Around the concrete box is a safety area, not to be entered by humans.

Emergency Shut-down

There are several systems in place to make it impossible for a nuclear disaster to take place:

If the reactor needs stopping immediately the control rods are inserted fully into the core, they absorb any neutrons present and stop any further reactions from happening.

Some reactors have a secondary set of control rods held up by an electromagnet, so if a power cut happens the control rods fall into the core.

If there is a loss of coolant and the temperature of the core rises beyond the safe working limits an emergency cooling system floods the core (with nitrogen gas or water) to cool it and absorb any spare neutrons.

Nuclear Waste Disposal

There are three levels of waste, each is produced, handled and disposed of in different ways:

High-level Radioactive Waste

What it is? Spent fuel rods from the reactor and unwanted, highly radioactive material separated from the spent fuel rods.

How do we get rid? The spent fuel rods are taken from the reactor and stored in cooling ponds with in the power station to allow most of the short-term radioactivity to die away. It is then transported to a processing plant. Here it is encased in steel containers and kept under water.

The cladding is eventually removed and the fuel rods are separated into unused uranium and plutonium and highly radioactive waste.

The uranium and plutonium is kept in sealed container for possible future use.

The waste is converted into powder, fused into glass blocks, sealed in air-cooled containers for around 50 years before being stored deep underground in a stable rock formation.

Time scale? Up to a year in the cooling ponds. Radioactive waste can remain at dangerous levels for thousands of years.

Intermediate-level Radioactive Waste

What it is? Fuel element cladding, sludge from treatment processes, contaminated equipment, hospital radioisotopes and containers of radioactive materials.

How do we get rid? Sealed in steel drums that are encased in concrete and stored in buildings with reinforced concrete. Also stored deep underground in a suitable location that has a stable rock formation and low water flow.

Time scale? Thousands of years.

Low-level Radioactive Waste

What is it? Worn-out laboratory equipment, used protective clothing, wrapping material and cooling pond water.

How do we get rid? Sealed in metal drums and buried deep underground in a supervised repository. Treated cooling pond water is released into the environment.
Time scale? A few months.