Glossary of Nuclear Terms

Energy basics

Capacity factor	The percentage of time that a power plant works at full capacity. Nuclear plants work flat-out 80-90% of the time and can therefore be relied upon. Renewables such as solar have lower capacity factors, due to variable weather.
Energy density	The amount of energy that can be obtained from a given volume (e.g per cubic metre). Nuclear is the most energy-dense source of energy known. 1 gram of uranium contains the same amount of energy as 3 tonnes of coal!
Process heat	High temperature heat (700-1000C) can be used to enable industrial processes such as desalination and hydrogen production. Currently high-temperature process heat is a major source of global carbon emissions.

Fundamentals of nuclear energy

Atom	The basic unit of matter; the building blocks of the universe.
Burn up	The proportion of the fuel used up in a nuclear reaction. Higher burn up means that more of the fuel is used up and therefore less radioactive waste is left behind. Note that there is no combustion or fire involved: "burn up" is just an anachronistic term that has stayed in use.
Chain reaction	A self-sustaining reaction of nuclear fission. Neutrons released from each fission event hit other nuclei and cause them to fission as well. It is this process that enables continuous production of electricity from a nuclear power station.
Coolant	Nuclear coolants serve to remove heat from the reactor core and transfer it to electrical generators and the environment. This is necessary to produce electricity, and also to manage the nuclear reactor safely. Water is often used as a coolant. Liquid metals, molten salts and gases can also be used.
Core vessel	Almost all operating reactors sit inside a high-strength core vessel, often made from reinforced concrete. The vessel is designed to protect the core from outside incidents and to protect people from nuclear accidents.
Core	The heart of a nuclear reactor, where the fuel is used up in a nuclear reaction. Usually highly protected inside a resilient and tough core vessel.
Critical mass	The amount of nuclear material which is sufficient to maintain a self-sustaining chain reaction. Different nuclear fuels have different critical masses.
Criticality	The point at which the reaction becomes self-sustaining and constant. A nuclear reactor that has "gone critical" is well under control!
Enrichment	The process of increasing the concentration of usable fuel in a certain volume. Nuclear weapons need highly enriched materials.
Fast neutrons	Neutrons that have high energies and travel at high speeds. Because fast neutrons have high energies, they are capable of fissioning (breaking-down) the more stable elements, including some of the more troublesome nuclear wastes.
Fuel rod	In a standard nuclear reactor, nuclear fuel is made into precision-

	designed cylindrical pellets. These pellets are then stacked inside a hollow rod, which is then inserted into the reactor core. Molten Salt Reactors use liquid fuel and therefore do not use fuel rods.
Moderator	Material that slows down neutrons in a reactor to a low speed at which they are capable of splitting nuclei. Graphite, water and "heavy water" are all often used as moderators.
Neutron	Particles making up the nucleus, along with protons. High energy neutrons can collide with another atomic nucleus and cause it to split.
Nuclear fission	Splitting apart the nucleus of an atom, releasing energy. Neutrons can also be released during the process. The splitting of the nucleus creates new elements.
Nucleus	The core of an atom, where almost all the mass is located. The nucleus is made up of two key particles: protons and neutrons.
Proliferation	The risk of the development of nuclear weapons and spread of nuclear materials.
Reprocessing	Spent nuclear fuel contains a mix of radioactive and non-radioactive elements. Some of them are not hazardous. 99.5% of the radioactivity has disappeared within 6 months of the fuel being removed from the reactor. Reprocessing sorts the hazardous and the non-hazardous parts of the spent fuel, allowing nuclear engineers to isolate the long-lived radioactive materials, which are a tiny proportion of the total fuel mass. Thus the total amount of material needing to be stored for a long time is greatly reduced, and reusable fissile material can be recycled into new nuclear fuel. If the fuel is not separated this way, the whole fuel bundle - hazardous and non-hazardous - must be stored. France leads the world in reprocessing, recycling 40% of its nuclear fuel.
Thermal neutrons	Neutrons that have been slowed down by a moderator to the correct speed for fissioning uranium, thorium or other nuclear fuels. Almost all of the world's reactors use thermal neutrons.

Reactor types

Accelerator-driven Subcritical Reactor (ADSR)	A reactor, usually fuelled with thorium, where the reaction is driven by a particle accelerator beam. Advantages include the ability to shut off the reaction at short notice. Disadvantages include the cost and size of the particle accelerator.
Light Water Reactor (LWR)	LWRs are the most common type of nuclear reactor. They use ordinary ("light") water to moderate the reaction, and are cooled using water.
Pressurized Water Reactor (PWR)	A type of LWR, the PWR is the most common nuclear reactor in use around the world. PWRs use solid nuclear fuel which is cooled by pressurized water in a reactor core.
Molten Salt Reactor (MSR)	First invented in the 1950s alongside water-cooled reactors, MSRs use nuclear fuel dissolved into a liquid mixture. Molten salts are used as the coolant for the reaction, which is advantageous as they can be very hot and remain at atmospheric pressure. MSRs cannot meltdown and produce much less waste than LWRs, but more development is needed.
Burner reactor:	A reactor designed to consume and burn up nuclear fuels, which can be freshly mined uranium, or with certain reactor designs, existing stores of nuclear waste.
Breeder reactor:	A reactor that creates new fuel as it operates. It can also recycle fuel resulting in very high burn up of the fuel.

Fast reactor:	A special reactor that uses fast or high energy neutrons for the reaction. The fuel must be highly enriched. Fast Reactors are capable of breaking down some of the most troublesome nuclear wastes, and therefore could convert existing nuclear waste into clean energy.

Fuels

Uranium	A radioactive heavy metal used as nuclear fuel.
Thorium	A heavy metal similar to uranium, which can also be used as nuclear fuel. It is much more abundant than uranium and has some improved safety characteristics, e.g. higher melting point.
Molten Salts	Sodium chloride or standard table salt is well known, but metals can form salts with many other elements – uranium chloride, or thorium tetrafluoride for example. These salts melt at a range of temperatures, the ones used in reactors usually at a few hundred degrees centigrade.

Waste basics

Half-life	The amount of time for a quantity to fall by half. In the case of radioactive material, the time taken for half of the material to undergo radioactive decay.
Nuclear waste(s)	Nuclear waste is classified into Low, Intermediate and High level waste. Low level waste includes things like old boots, gloves and radiation suits. Intermediate level waste includes things such as waste products from fuel manufacture. High level waste (HLW) includes Spent Nuclear Fuel -- HLW is only 0.5% of total waste but contains 99.5% of the total radioactivity.
Spent Nuclear Fuel	Nuclear fuel that has been used up is known as "spent". Unlike fossil fuels, where the fuel is converted to waste gases (air pollution), nuclear fuel stays put as it is burned, but its composition changes. Spent fuel consists of the leftover material from the initial fuel, and any other products of the nuclear reaction. The composition of spent nuclear fuel depends partly on the "burn up", which in turn varies with the reactor type used (much like mpg varies with different car engines). Light Water Reactors often have large wastes as a lot of the fuel cannot be burned. Thorium fuels can be almost entirely consumed and so leave far less waste. Typically, 99.5% of the spent nuclear fuel's radioactivity decays within 50 years.
Actinides	Radioactive metals including Uranium, Thorium and Plutonium. Minor actinides such as neptunium and curium are produced as a by-product of nuclear reactions.