

Electrical Generation & Environment Glossary of Terms

A Factfile provided by the Institution of **Engineering and Technology**



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Cover images (clockwise from top left)

- Coal fired power station
- Nuclear power station
- Gas fired power station, Majorca, Spain
- Wind turbine (being assembled on site)

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Summary of Units

Energy Units

k	kilo	1000 or 10^3
M	mega	1000000 or 10^6
G	giga	1000000000 or 10^9
T	tera	1000000000000 or 10^{12}
P	peta	1000000000000000 or 10^{15}
E	exa	1000000000000000000 or 10^{18}

Prefixes

Power

W watt, the international unit of power

Energy

J joule, the international unit of energy
1 joule per second = 1 watt

Also

C calorie
1 calorie = 4.19 J (The dietary calorie, denoted by C, is 1000 calories)

Btu British Thermal Unit.
1 Btu = 1.06 kJ

Therm 100,000 Btu

Tce tonne of coal equivalent
the equivalent amount of energy to that contained in 1 tonne of coal
1 Tce = 27 GJ

toe tonne of oil equivalent
the equivalent amount of energy to that contained in 1 tonne of oil
1 toe = 3.6 MJ

kWh kilowatt-hour
the energy consumed by a load of one kilowatt in one hour of use (the unit in which electricity is charged to the customer)
1 kWh = 3.6 MJ

Units of Radioactivity and Radiation

Since the Chernobyl accident, the terminology by which radioactivity and radiation are measured has received considerable attention. It has also caused considerable confusion because of the different systems of units in use.

In the International System of units (SI), the simplest term is the measurement of radioactivity, the becquerel (Bq). If a sample of material undergoes one atomic decay in one second, then it is said to have an activity of one becquerel which itself, therefore, has the dimensions of 'per second'. A problem with the becquerel is that it is an extremely small unit. It has replaced the earlier unit, the curie (Ci), such that:

$$1 \text{ Bq} = 2.70270 \times 10^{-11} \text{ Ci} \text{ or } 1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq.}$$

Radioactive substances emit radiation and, since all radiation is a form of energy, what is important from a human point of view is the quantity of energy deposited in the body by the radiation. The SI unit of energy is the joule (J) and of mass, the kilogram (kg). If 1 J is deposited by the radiation in 1 kg of the body, the radiation absorbed dose is said to be 1 gray (Gy). This unit used to be known as the rad, where 1 Gy = 100 rad.

Different forms of radiation have different effects on the body and thus radiation absorbed dose is an incomplete measure. It is therefore replaced by the dose equivalent for which the unit is the sievert (Sv). This has the same dimensions as the gray, (i.e. joule per kilogram) but takes into account the different characteristics of the various forms of radiation. To obtain sieverts from grays the relevant authorities recommend multiplying by 1 for beta or gamma radiation, 10 for neutrons and 20 for alpha radiation. The sievert replaces the unit known as the rem, where 1 Sv = 100 rem.

Glossary of terms

Acid Rain

Rainfall and other forms of precipitation made more acidic than naturally as a result of absorption of industrial pollutants, particularly sulphur dioxide (SO₂)

Actinides

Isotopes of the element actinium produced in the fuel of a nuclear reactor during operation.

AGR

Advanced gas cooled reactor (AGR). A Type of nuclear reactor based on nuclear fission, Unique to the UK.

Aquifer

A geological formation in which underground rocks are porous enough to hold water permeating from the surface. If the aquifer is more than about 1km below the surface, the water can be warm enough to be a useful source of heat.

Barrage

A dam constructed across the mouth of a river estuary. It can include a roadway on top, locks for shipping, sluices to allow water flow and/or hydro turbines for electricity generation.

BATNEEC

Best Available Techniques Not Entailing Excessive Cost. A concept specified in the Environmental Protection Act 1990 to require power station operators to prevent or minimise the release of pollutants.

Becquerel (Bq)

The SI unit of nuclear activity. One becquerel equals one atomic decay per second.
1 curie (Ci) = 3.7 x 10¹⁰ Bq

Biomass

In this context, a source of organic material, except fossil fuels, which can be used as a source of energy, Includes: timber, sawdust, straw, sewage, cardboard etc.

Borosilicate Glass

Heat resistant glass containing the element boron

Bottom Ash

The ash left in the furnace after combustion of the coal in a coal fired power station.

Caesium¹³⁷

A long lived isotope of the element caesium produced in the fuel of a nuclear power station during operation

Carbon Dioxide (CO₂)

A gas found in the atmosphere which is absorbed by plants, exhaled by animals and produced when any organic material is burnt. Chemical formula is CO₂. It has been implicated in the 'greenhouse effect'.

Carbon Monoxide (CO)

A poisonous gas produced when coal or other fossil fuels are burnt with inadequate oxygen. Chemical formula is CO. Also the main constituent of coal gas or town gas.

Catalyst

A substance which aids or accelerates a chemical reaction between two or more other substances yet is left unchanged after the reaction has taken place.

Chemical Feedstock

The supply of raw materials for use in, for example, the chemical or pharmaceutical industries.

Chlorofluorocarbons (CFC)

Chlorofluorocarbons or CFCs are substances that were formerly used widely in the refrigeration industry and as an aerosol propellant. Strongly implicated in ozone depletion and the greenhouse effect. Their use is now restricted under the Montreal Protocol. Also called Freon.

Combined Cycle Gas Turbine (CCGT)

An electricity generation system in which natural gas or distillate fuel oil is burnt in a gas turbine to generate electricity. The hot exhaust gases then boil water to raise steam for use in a conventional steam turbine to generate more electricity.

Cosmic Rays

A generic term for radiation, particularly atomic nuclei, reaching the earth from the rest of the universe.

Critical

The state in which a reactor achieves a self-sustaining chain reaction.

Decommissioning

The process of removing equipment, such as a nuclear reactor, from service and restoring the land to its original state.

Dry Deposition

In this context, gases and solid particles, emitted from power stations and other industrial processes that settle on the ground.

Dounreay

The site of the UK's prototype fast reactor, though now closed down and currently being decommissioned.

Ecosystem

An ecological system. A system involving the interactions between a community and its non living environment.

Electromagnetic Radiation

A form of energy which includes gamma radiation, x-rays, visible light, ultraviolet and infrared light, radio and TV waves.

Electrostatic Precipitators

Devices fitted to power stations to extract solid and other dust particles from the flue gases.

Environment Agency (EA)

The Authority responsible for the monitoring and control of pollution in the UK, including discharges to air, or to rivers, lakes, coastal waters and groundwater.

Fast Reactor

A type of nuclear reactor, sometimes called a fast breeder reactor, still at the experimental prototype stage.

Filtration

The process by which harmful and other solids are removed from liquid or gaseous discharges

Fission

The process whereby an atomic nucleus splits into two or more parts. This is the basic process of most current nuclear power stations.

Flue Gas

The exhaust gas of a fossil fired power station emitted into the atmosphere from the chimney (also called the stack).

Flue Gas Desulphurisation

The removal of sulphur dioxide (SO₂) from the flue gas of fossil fired power stations.

Fly Ash

The ash extracted from flue gases by electrostatic precipitators.

Fossil Fuels

Organic fuels such as coal, oil and natural gas; composed of decayed organic material and laid down in geological formations of great age.

Freon

A commonly used trade name for chlorofluorocarbons (CFCs)

Gamma Radiation

Very high frequency electromagnetic radiation which produces an ionising effect in matter. Emitted by a radionuclide.

Gas Turbine

An internal combustion engine working on the turbine principle, fuelled by natural gas or kerosene.

Geothermal Energy

The earth's interior is composed of hot, molten rock which is normally only seen at the surface when volcanoes erupt. A geothermal energy device is any device that attempts to tap this underground heat energy.

Greenhouse Effect

A traditional greenhouse allows high frequency radiation from the sun to enter but prevents the lower frequency radiation resulting from re-radiation inside the greenhouse from escaping. This raises the temperature inside the greenhouse. A similar effect takes place in the earth's atmosphere with certain gases in the troposphere acting in the same way as the glass. The term is used to imply an enhanced greenhouse

effect resulting from a build-up of greenhouse gases above their natural levels due to man's activities.

Gypsum

A by-product of flue gas desulphurisation. Chemically it is hydrated calcium sulphate (CaSO₄•2H₂O)

Heavy Metal

A metallic element of high atomic weight. for example mercury, lead and uranium.

High Level Waste HLW

Highly radioactive fission products present in concentrations of 1 to 3% in the spent atomic fuel from a nuclear reactor. High level waste must be carefully contained and not released into the environment.

Hydrocarbons

General term for compounds that contain only hydrogen or carbon.

Hydroelectric Power

Power generated from the conversion of the pressure and kinetic energy of flowing water.

Inert Gas

Gases incapable of reaction with any other substance. Also known as the noble gases, they include helium, krypton and argon.

Infra-red Radiation

Electromagnetic radiation with a wavelength longer (and hence lower frequency) than that of visible light.

Integrated Pollution Control (IPC)

The integrated control of all releases to air, water and land. A concept introduced for the first time in the Environmental Protection Act 1990.

Intermediate Level Waste ILW

Radioactive waste less hazardous than high level waste which, in the UK, it is proposed to store in deep level facilities.

Ion Exchange Resin

Substance used to purify water.

Isotope

Isotopes of an element all have the same number of protons in the atomic nucleus, and therefore have the same chemical properties. However, they have different numbers of neutrons and therefore have different atomic weights and physical properties. For example U²³⁵ and U²³⁸ are isotopes of uranium.

Krypton³⁵

A stable isotope of the inert gas krypton.

Large Combustion Plants Directive (LCPD)

A directive issued by the European Commission in 1998, which requires member states to draw up programmes for the reduction of sulphur dioxide and nitrogen dioxide from large

combustion plant including power stations. Over the period between 2008 and 2015 LCPD will limit the operation of plants not fitted with state of the art equipment to minimise emissions of sulphur dioxide and nitrogen oxides. Such plants must be closed by 2015.

Light Weight Reactor

A type of nuclear reactor particularly favoured in the USA, using ordinary (or light) water as moderator and coolant.

Lignite

Also known as brown coal, a fossil fuel with thermal and chemical properties between those of peat and black coal.

Limestone

Composed of calcium carbonate. A naturally occurring rock widely found in the UK.

Low Level Waste LLW

The least radioactive form of nuclear waste. Usually disposed of by shallow burial.

Magnox

An early British gas cooled nuclear reactor so called after its magnesium alloy fuel cans.

Methane

A hydrocarbon gas formed when organic materials decay in the absence of oxygen. Chemical formula is CH₄. It is the main constituent of natural gas.

Milisievert

One thousandth of a sievert (Sv).

Natural Gas Liquids

Natural gas can be liquefied at high pressure. It is then also known as liquefied petroleum gas or LPG.

Neutron

Sub-atomic particle carrying no electrical charge.

Nitrites

Compounds containing oxygen and nitrogen, normally found combined with a metallic element such as calcium or sodium.

Nitric Acid

An acidic compound of nitrogen, oxygen and hydrogen.

Nitrogen Oxides

Compounds of nitrogen and oxygen which include nitrous oxide (N₂O), nitric oxide (NO) and nitrogen dioxide (NO₂). Often referred to as a group by the symbol NOx.

Ocean Thermal Conversion (OTEC)

Technology to exploit the temperature difference between the surface and the depths of oceans.

Opencast Mining

Mining for coal or other materials without tunnelling. The coal covering material, or overburden, is removed and the coal or

mineral is recovered by scraping.

Orimulsion

A fossil fuel originating in Venezuela. Basically an emulsion of bitumen and water, it can be burnt in power stations.

Oxidised Pyrites

Oxidised iron sulphate. May leach out of waste at coal mines thus polluting local water.

Ozone

Ozone (O₃) is a gas similar to, but molecularly different from, oxygen (O₂). At street level, (troposphere), it is formed by the action of sunlight on traffic exhaust fumes and is a harmful component of smog. In the stratosphere, (10-50 km above sea level), it occurs naturally and has a beneficial effect as the 'ozone layer'.

Ozone Layer

The stratosphere, some 10-15 km above the earth's surface contains a thin dispersion of ozone, with ozone molecules most concentrated at approx. 35 km. This is known as the ozone layer and acts as an important biological shield against the sun's ultraviolet radiation.

Particulates

Any solid material in granular or powder form.

Photosynthesis

The process occurring in plants by which the energy of sunlight is converted, with the aid of chlorophyll, into the sugars and starches which make up the structure of the plant. The energy is thus stored in a form which is available for future use by animals as food or by man as food or fuel.

Photovoltaic Effect

The process occurring in certain semi conductors in which electrons are excited by light of a certain wavelength, causing electrical power to be generated.

Plume

The pattern formed by flue gases when they leave the chimney.

Plutonium

A fissile metallic element which does not occur naturally. It is produced when the uranium isotope U²³⁸ absorbs additional protons and neutrons in its nucleus.

Pressurised Water Reactor (PWR)

A type of nuclear reactor particularly favoured in the USA and France. The only one in the UK for electricity generation is Sizewell B.

Radon

Naturally radioactive element (radon²²²), the heaviest of the inert gases.

Radiation

In the context of nuclear energy, radiation is the term used to

describe both electromagnetic wave emission (gamma rays) and the emission of sub-atomic particles during nuclear fission (alpha and beta waves).

Radionuclide

An unstable isotope that emits ionising radiation in the process of decay.

Regenerative Method

A technique for removing sulphur dioxide from the flue gases of coal and oil fired power stations.

Renewable Energy

A source of energy which is naturally replenished as it is consumed. For example, wind or solar energy.

Scottish Environmental Protection Agency (SEPA)

The Scottish Environmental Protection Agency (SEPA) has similar responsibilities to the Environment Agency (EA) but for Scotland only.

Sievert

The SI unit of radiation absorbed dose equivalent for body tissue.

Silicon

A naturally occurring element. One of the main constituents of sand.

Sodium Sulphate

A compound containing the elements, sodium, sulphur and oxygen, used in the Regenerative Method of flue gas desulphurisation.

Solar Energy

The energy contained in sunlight.

Stratosphere

The layer of the atmosphere above the Troposphere, extending approx. 40 km above it.

Stratospheric Ozone

The ozone layer.

Sulphur Dioxide

The most common oxide of sulphur, SO₂, produced by power stations when coal or oil containing sulphur is burnt.

Thorium

A radioactive element.

Tidal Power

Tides, the periodic rise and fall of water levels at the seashore, are caused by the moon's rotation about the earth. Tidal power devices extract energy from the resultant water flow.

Troposphere

The layer of the atmosphere extending some 8-16 km from the earth's surface. Its thickness varies according to latitude and the seasons.

Tropospheric Ozone

Ozone found in the lower atmosphere particularly as a result of the action of sunlight on vehicle exhaust gases. It is a major component of smog. It does not form part of the ozone layer which is in the stratosphere.

Ultraviolet Radiation

Electromagnetic radiation with a wavelength shorter than that of visible light.

Uranium

A heavy metallic element with 92 protons in the nucleus. The two most common isotopes of uranium are U²³⁵ and U²³⁸.

Vitrification

The process by which a substance is encased in glass.

Wave Power

The sea's surface is constantly moving due largely to the wind. A wave power device extracts the energy from this essentially up and down movement. It should not be confused with tidal power which depends on water flow rather than surface movement.

Wind Power

Electricity (or mechanical power) generated by wind turbines (windmills). This is a renewable energy source.

Further Information

- The IET factfiles on energy:
<http://www.theiet.org/factfiles/energy/index.cfm>



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