Radiation Accidents

Many radiation accidents in the fields of medicine and technology are caused by losses and careless disposal of radioactive material.

The reason for unnecessary exposures is frequently due to improper storage of disused radioactive sources. Unused sources have been found in scrapyards where they were 'discovered' by children, who were fond of finding pieces of e.g. good-looking silver-gray cobalt metal, which, in fact, was highly radioactive and dangerous.

Radiation accidents in large manufacturing plants and nuclearmedical sections of hospitals are frequently caused by non-existing elementary safety rules. In the case of existing safety rules they are often ignored. It is also essential that the maintenance personnel are suitably trained and aware of the radiation risks. Radiation protection regulations must be meticulously respected, otherwise accidental irradiations or even accidents may occur.

An example of gross human failure is the radiation accident in a hospital in Indiana, Pennsylvania/USA, in the year 1992: In the framework of brachytherapy an elderly lady was irradiated with an iridium source, and it was forgotten to remove the source after the treatment. When the patient excreted the catheter containing the source four days later, the catheter, including the source, was thrown into the garbage by a nurse. The patient died the following day without realizing that the death could have been related to the excess radiation. During the time of storage and garbage collection many people were accidentally exposed to radiation over a period of 90 days. The loss of the iridium source was only discovered when radiation monitors in the waste-management facility triggered an alarm.

Only in recent times, after the period of the Cold War has it become public how many radiation accidents occurred in military operations in the past. These include plane crashes with nuclear weapons on board, sunk nuclear-operated submarines, or the loss of missiles or satellites which carried radioactive materials.such reactors 'incidents' of different severities occasionally occur.

The most severe accident in a nuclear reactor to date happened in Chernobyl in 1986. This catastrophe was the result of a flawed electro-technical experiment at an inherently unsafe reactor which was badly carried out. In this fatal experiment a large fraction of the radioactive inventory was released into the environment. The watercooled graphite-moderated reactor contained a total of 150 tons of natural uranium, with a total activity of 3.2×1019 Bq, including the fission products in the reactor core. The gaseous components (radioactive 85Kr (3.3 × 1016 Bq) and 133Xe (1.7 × 1018 Bq)) escaped completely from the reactor. The fractions of the other fission products which were released (iodine 131, cesium 137, strontium 90, lanthanum 140, . . .) can be estimated to be about 50%.

Radiuation Protection Glosarry

Element : material whose atoms all have the same number of protons.

u: atomic mass unit.

Proton : atomic particle, mass 1 u , charge +1 unit.

Electron: atomic particle, mass 1/1840 u , charge −1 unit.

Neutron: close combination of proton and electron, mass 1 u, electrically neutral.

Atom: central nucleus of protons and neutrons, around which electrons occupy orbits. **Atomic number (*Z*):** number of protons.

Mass number (*A*) : number of protons plus number of neutrons.

Radioactive decay: transformation of an unstable atomic nucleus into a more stable one, usually accompanied by the emission of charged particles and □□- rays.

Alpha (□) radiation: helium nuclei, two protons and two neutrons, mass 4 units, charge + 2 units.

Beta (□) radiation: high-speed electrons which originate in the nucleus, mass 1/1840 u, charge −1 (electron).

Gamma (□) radiation: electromagnetic radiation, very short wavelength, mass 0, charge 0.

Electron volt : energy gained by an electron in passing through an electric potential of 1 volt.

Natural radioactive series consist of naturally occurring radioactive substances; the three series are thorium, uranium–radium and actinium.

Induced radioactivity: radioactivity caused by bombarding stable atoms with nuclear particles, for example by neutrons in a nuclear reactor.

Half-life: time required for one half of the nuclei of a radioactive species to decay:

Curie (Ci): former unit of radioactivity defined as 3.7 10^{10} dis /s. 1 Ci ∫ 10^3 mCi ∫ 10^6 μCi

Becquerel (Bq) : SI unit of radioactivity, defined as 1 dis /s.