II. RADIOACTIVITY

RADIOACTIVE RADIATION

Chemical elements with unstable atomic nuclei can collapse. This so called radioactivity releases energy in form of radiation that sends out rays. This process happens stochastic and therefore irregular.

Natural radiation
Naturally organism in the world are exposed to three different kinds of radiation:

- Cosmic radiation from outer space. The atmosphere and the magnetic fields of our earth mainly stop it.
- Terrestrial radiation from the earth.
- The absorption of potassium in the body releases also a bit of radiation from the inside.

Radioactive radiation
Fission of plutonium and uranium for the production of energy also generates radioactive radiation. This radiation cannot completely be isolated from the environment even if there are tight security measures. The processing of nuclear fuel rods enormously increases the radioactive radiation of this material.

There are different categories of radioactive radiation:

- α-radiation: consists of positive charged helium nuclei – so called α-particles. It has a very small penetration because of its huge mass and big reactivity with material. Paper can absorb it. It has a range of in-between 4 and 6 cm. α-radiation from the outside it not dangerous for organic bodies.
- β-radiation: This radiation has a range of several meters. A 1 mm thick aluminum can absorb its rays, but they still can penetrate a few cm into the body and cause skin damages.
- γ-radiation: These rays are energy-rich electromagnetic waves with short wavelength. They have a very large penetration and can primly be absorbed by several mm lead. There is no specification for the range of γ-radiation. It penetrates far into organic bodies and can be damaging or destructive for cells depending on the dose.

Effects
The effects of radioactive radiation depend mainly on the time of irradiation and the sensibility of the organic body. More factors are the absorbed dose and the range of the radiation.
Radiant sources, which are absorbed by the body, cause more critical effects. So cells and DNA sequences can also be damaged or destroyed by α- and β-rays respectively.

Nuclear fission chain reaction
Radioactive material can cause a nuclear fission chain reaction, i.e. a nuclear explosion, if there is a so-called ‘Critical Mass’. Exceeding the Critical Mass increases the neutron radiation very fast. Freely flying neutrons fission more and more uranium atoms and cause a chain reaction. Richard Feynmen calculated the Critical Mass of a uranium bomb to 50 kg of pure uranium. Uranium for a nuclear bomb is supposed to have a purity of 98%. A bomb of plutonium needs a Critical Mass of 21 kg. Different explosive mechanism can reduce the point for a Critical Mass.