Radiation Basics: A Brief Overview of Radiation

Radiation is a form of energy that occurs naturally in the physical world. It is the emission and propagation of energy through space or through matter in the form of particles or waves. There are two types of radiation: ionising and non-ionising. Ionising radiation is capable of breaking up atoms or molecules into pairs of oppositely charged particles or ions; non-ionising radiation does not have this capability.

Types of radiation

There are many forms of radiation. They include neutron, microwave, RF (radio frequency), laser, infrared, and ultraviolet radiation. This article focuses on the four main types of radiation:

- Alpha
- Beta
- Gamma
- X-ray

Type of radiation	Description
Alpha	• A heavy, short-range positively charged particle, an ejected helium nucleus. • Most alpha radiation is not able to penetrate human skin. • It travels only a short distance/approx. 3 centimetres in air. • It cannot penetrate clothing. • Alpha-emitting materials can be harmful to humans if inhaled, swallowed, or absorbed through open wounds.
Beta	• A light, short-range negative particle, an ejected electron. • Beta radiation may travel several feet/approx. 3 metres, • It can penetrate human skin. • High levels of beta contaminants that remain on the skin for a prolonged period of time may cause injury to the skin. They are also harmful if inhaled or swallowed.
Gamma and X-Ray	• Gamma and X-ray radiation are electromagnetic energy, a ray/photon. • They have much greater penetration power. • Both types can travel many feet/metres in air. • They can penetrate most materials. • They are mainly an external hazard to humans. • There are high and low levels of gamma radiation, but the primary concern is the length of time of the exposure.

Figure 1: Typical handheld devise - (SE International - Monitor4)

Figure 2: Example of a handheld scanning device

Emergency Response - What To Do

Radiation can be daunting to most individuals. However, some basic knowledge will help in determining the action required when exposed to changing levels of radiation.

In a radiation emergency response situation two types of monitoring devices can be used: a rate meter/general purpose Geiger counter (*Figure 1*) or a dosimeter. The Geiger counter shows the rate at which the radiation is being received; a dosimeter shows the amount/dose being received.

Taking Measurements

The four main types of ionising radiation can be measured using a Geiger counter. Gamma and X-rays are registered in milli-Roentgens per hour (mR/hr), micro-Sieverts (μSv/hr), or milli-Sieverts (mSv/hr); alpha and beta in counts per minute (CPM) or counts per second (CPS).

It is important to precisely know what is being measured and to understand the limitations of detection equipment. Failing to do so may result in drawing misleading conclusions from the readings.

Around the House - Potential Sources

Potential source	Risk
Smoke detectors	Can contain a sealed radioactive isotope as part of the smoke sensing mechanism. There is no danger to the individual if the container is sealed.
Camping lantern mantles	Uncommon, but some lantern mantles are made with radioactive Thorium. Care should be taken not to inhale or ingest the fine ash left when the mantle is burnt out.
Clocks, Watches, and Timers	Old dials may be painted with radium to make them glow in the dark. These days Tritium is generally used to obtain the same effect. Tritium is also radioactive but emits low energy radiation which cannot penetrate the lens of the timepiece.
Jewellery	Some gold used to encapsulate radium and radon for medical purposes was improperly reprocessed and entered the market as radioactive rings and other types of gold jewellery. Some gems are irradiated by an electron beam or in an accelerator to enhance their colour. Irradiated gems are normally held until no residual activity remains.
Rock Collections	Many natural formations contain radioactive materials. Rock collectors should vent the rooms in which their collection is stored and avoid inhaling the fine dust particles emitted.
Pottery	Some types of pottery can be glazed with uranium oxide. Although rare nowadays, some pieces are still in circulation.

To measure the level of radiation, the detector needs to be directed toward the source (*Figure 2*). To establish the type of radiation present, the following procedures should be carried out:

Alpha: When a sheet of paper is placed between the window and the source, and the indication stops, the radiation is most likely to be alpha.

Beta: If the indication stops, decreases or changes when a piece of aluminium or glass is placed between the instrument and the source, the radiation is most likely to be beta. Most common isotopes emit both beta and gamma radiation. This is why the indication would decrease or change but not stop.

Gamma: If there is an indication of radioactivity, it is most likely to be gamma or high energy beta. If the alpha/beta tests have been performed and there is no change or only a very slight change in the indication, the source is primarily emitting gamma radiation.

Some important precautions should be adhered to when taking readings:

- The equipment should not touch any suspected radioactive substance.
- Skin contamination and ingestion should be avoided.
- When leaving a radioactive area, any protective clothing should be removed and properly disposed off.
- In case of suspected contamination it is recommended to take a shower and to consult a doctor.

Figure 3: Robust & Rugged Detection Device (SE Int - INSPECTOR Extreme)

Microwaves and Radon - The Myths

Instruments designed for the detection of ionising radiation do not detect emissions from microwaves; they are non-ionising radiation sources. With regards to Radon, non-ionising detectors can be used. However, the tests should be performed by a trained professional.

Summary

There is no set safe level of radiation. It depends on the decision of the individual taking the readings and his/her knowledge of radiation and its effects. It is important that the most appropriate detection device is selected to meet the requirements of the application and the type of radiation (Figure 3).

It is vital that data on normal background radiation levels are available prior to an emergency response situation. Background radiation (Naturally Occurring Radioactive Material NORM) is emitted from a variety of natural and artificial sources with the majority coming from natural sources in the earth, in the atmosphere and from space. Only a small percentage of the total radiation exposure comes from man-made sources. The availability of background radiation data will help to determine whether there is an increase in radiation levels in case of an emergency situation.

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