Return to Session 1

RADIATION PROTECTION PRINCIPLES

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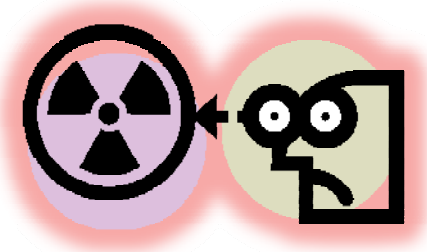
Radiation Hazards & Risk

- Hazards: source or condition with a potential to cause harm (man and environment) and property or a combination
- Risk : is the probability of an incident and its impact
- Knowledge of hazards & risk important in deciding its management



Radiation Protection
Vs
Radiation Safety

- Radiation Protection: negative connotation
- Radiation Safety: positive connotation

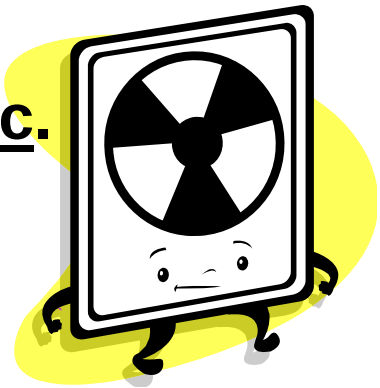
RADIATION PROTECTION PRINCIPLES

Radiation protection principles are related to the source and individual.

There are two systems of radiation protection;

- **Proposed and continuing practice that cause exposure,**
- **Intervention that reduces exposure.**

Both systems are used in three types of exposures, i.e. workers, medical and public.

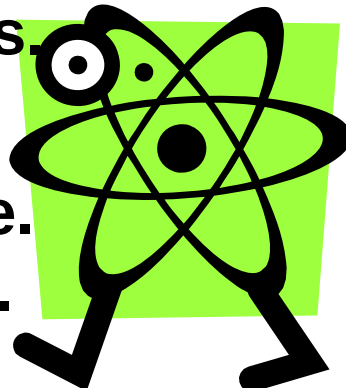


Objectives of Radiation Protection

- Prevent the occurrence of deterministic effect by restricting doses to individuals below the relevant thresholds.
- Reduce induction of stochastic effect.

Deterministic effect is the effect where the intensity of effect increases with dose. There are thresholds for deterministic effects.

Stochastic effect is the probability of occurrence is proportional to the dose. No threshold can be invoked for them.



Principles of Radiation Protection System

- Radiation Safety begins with Principles of Radiation Safety(Protection) Systems
- 3 Principles:
  - **Justification of practice**
  - **Optimization of protection and safety**
  - **Dose Limit**

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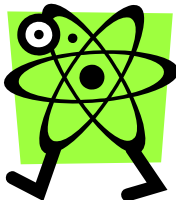
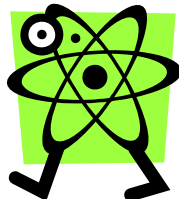


Principles of Radiation Protection Systems

Justification of Practice

In proposed and continuing practices, the justification of practice must be such that the work uses radiation because it gives benefit (or gain) to the exposed individuals or to society that exceeds radiological risk.

Justification in intervention provides more benefit in comparison to if there were no intervention.



Principles of Radiation Protection Systems

Optimization of Protection and Safety

Based on the principles of ALARA (*As Low As Reasonably Achievable*).

For any given radiation source within a practice, the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures should be kept to as low as reasonably achievable, taking economic and social factors into considerations.

Principles of Radiation Protection Systems

Dose Limit

Dose limit is used to apply controls on each individual's accumulation of dose.

Dose limits are not :

- **a line of demarcation between "safe" and "dangerous",**
- **the sole measure of the stringency of a system of protection.**

Dose limits do not include medical exposures and natural background radiation.

Principles of Radiation Protection Systems

Annual Dose Limits (ADL)

There are different categories of dose limits for :

- **radiation workers;**
- **members of the public;**
- **trainees of radiation;**
- **planned special exposures; and**
- **female pregnant workers.**

Principles of Radiation Protection Systems

1. ADL for Occupational Exposure

Application	ADL (mSv)
Annual dose limit for the whole body exposure of worker	**20**
Female pregnant worker: dose to the foetus accumulated over the period of time between confirmation of pregnancy and the date of birth	**< 1**
Partial body exposure of a worker :	
i. Limit for the effective dose-equivalent	**50**
ii. Limit on average dose in each organ or tissue	**500**
iii. Limit for lens of the eyes	**150**
iv. Limit on equivalent dose for the hands and feet	**500**

Radiation Safety

- Radiation sources should ONLY be used when it gives net benefit with tolerable risk to those using it and those that will be affected by its usage
- Dose received should be ALARP
- Dose limit should be a minimum requirement to be fulfilled

Radiation Protection Principles

- Should one has to use it the easiest protection principles are:
  - **Time**
  - **Distance and**
  - **shielding**

Radiation Protection Principles

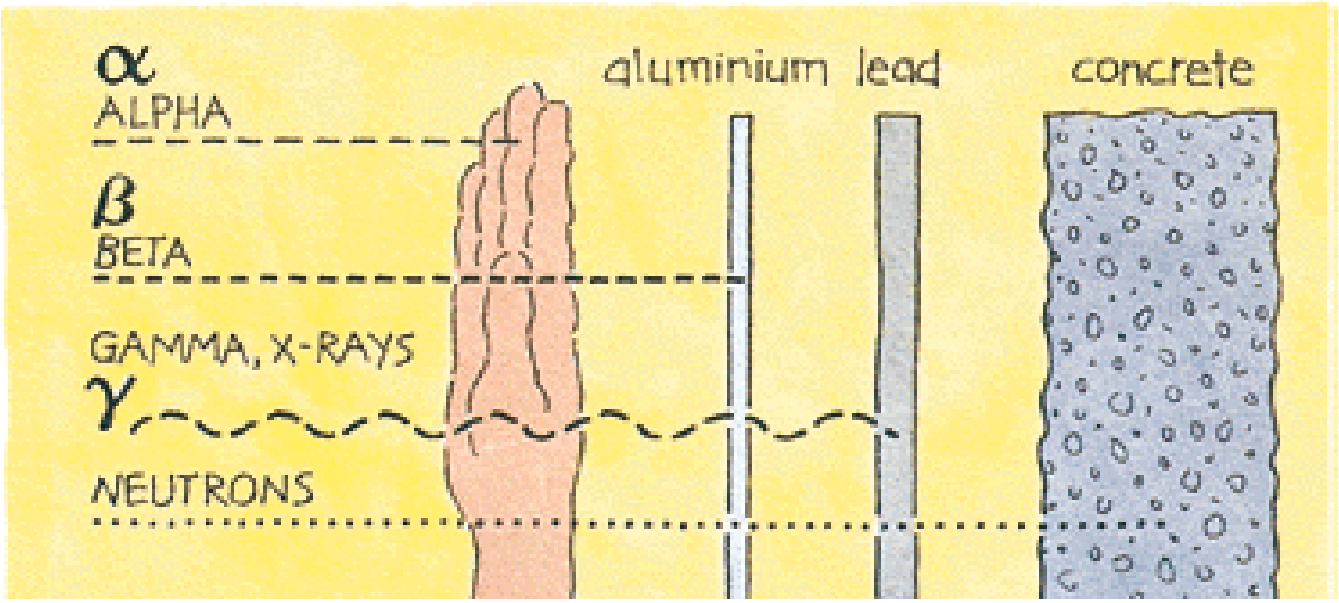
TIME

Dose = Dose rate x time

The longer the exposure time the higher is the dose received and vice versa.

Radiation Protection Principles

SHIELDING



Radiation Protection Principles

DISTANCE

Reduction of radiation dose inversely proportional the square of the distance or it follows the inverse square law equation.

$$\frac{I_1}{I_2} = \frac{d_1^{\,2}}{d_2^{\,2}}$$

where I_1 and I_2 are radiation intensities at distances d_1 and d_2 respectively.

Radiation Protection Principles

Additional protection against internal exposure

Control of Internal Exposure

Internal exposure is attributed to radiation exposures from radionuclides inside the body.

There are three modes of entry by radionuclides into the body; i.e. inhalation, ingestion and penetration through the skin.

Protection against such radiation hazards may be overcome through:

- ✓ the use of personal protective equipment,
- ✓ having proper facilities to handle unsealed sources
- ✓ having procedures to safely handle them.

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Conclusion