

Analytical X-Ray Safety Training

6. X-Ray Safety in the Lab



Training Outline

- history
- sources and uses of X-Rays
- legislation
- biological and health effects
- **X-Ray safety in the lab**
 - exposure
 - SOPs
 - security
 - emergencies
 - summary
- references
- quiz

Control of Exposure

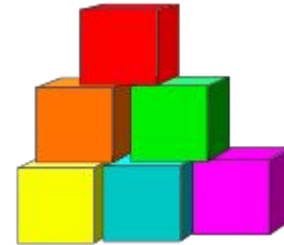
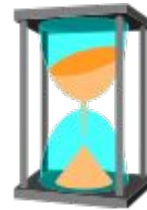
ALARA = As Low As is Reasonably Achievable

The ALARA Principle is a philosophy of radiation safety that every reasonable effort should be made to minimize dose. This guiding philosophy has actually been incorporated in regulations for all entities that possess radioactive material.

The ALARA provision in regulations facilitates proactive measures for radiation protection and safety.

Radiation Protection Basics

- amount and type of radiation exposure
- time
- distance
- shielding



Radiation Protection Basics

Exposure to X-Ray radiation is reduced if:

- **TIME** exposed to source is decreased
- **DISTANCE** from source is increased
- **SHIELDING** from source is increased

Comparisons on Shielding Requirements for X-Rays



Dose equivalent

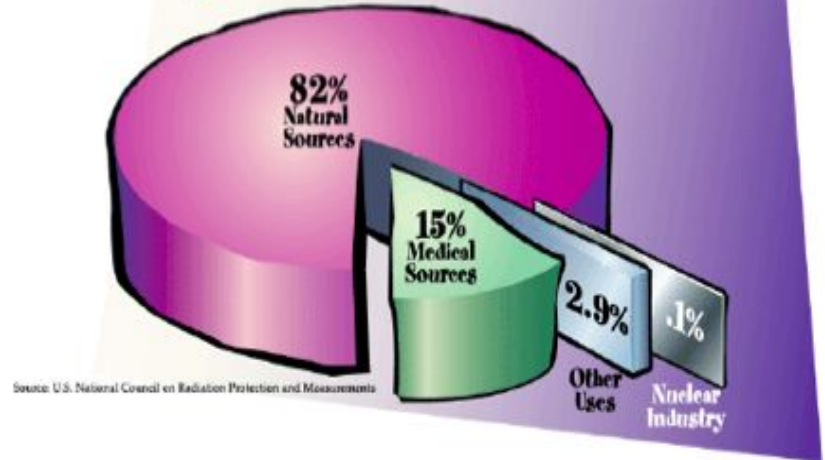
= radioactive energy deposited in human tissue

- unit of measure is Sievert (Sv)
- old units still used are called rem
 - 1 Sv = 100 rem 1 mSv = 100 mrem
- in North America, the dose from natural sources is between 2 to 3 mSv per year (=200-300 mrem per year)
- maximum allowable occupational exposure X-Ray Worker = 50 mSv/y

Background Radiation

- natural and manmade sources
- radon ~ 55% of natural sources
- 11% from medical X-Rays

Sources of Radiation



Control of Exposure

DOSIMETRY

- devices monitor and record ionizing radiation doses (occupational exposure)
- must distinguish from background radiation



Control of Exposure - TLD Badges

- record cumulative whole body dose (mSv)
- prevent over-exposure
- worn at the chest or waist levels
- each badge is assigned to a specific individual and *cannot be* shared by others
- worn only at work and not taken off campus

Storing TLD Badges

- badge must not be left in an area where it could receive a radiation exposure when not worn by the individual (e.g. on a lab coat or left near a radiation source)
- store badges in a dark area with low radiation background (in low light away from fluorescent or UV lights, heat and sunlight)
- lost or damaged badges should be reported immediately to the Radiation Safety Officer and a replacement badge will be issued



Control of Exposure

- results from exposure monitoring are maintained and evaluated by the Radiation Safety Officer
- radiation monitoring results for each individual are recorded in the National Dose Registry in Ottawa
- **historical doses at Ryerson averaged < 0.1 mSv (the reporting threshold of badge)**

Leak Test

- annual leak test recommended or after equipment has been moved or modified.
- dose rate must not exceed 5 uGray/h 5 cm from any accessible external surface
- contact Radiation Safety Officer to arrange test

Signs & Labels

- X-Ray warning signs or devices posted in visible location on equipment and door
- energized equipment



SOPs for Equipment

Standard operating procedures are required to be developed by Supervisor for each individual X-Ray device:

- used under guidance and supervision of authorized users
- beam shall be directed toward an unoccupied area (i.e. a wall)
- limit dimensions of beam
- adequate shielding
- energized equipment never unattended in unlocked area
- no repairs or sample adjustment when equipment energized

Causes of Accidents

Accidents (i.e., exposure to individuals) caused by exposure to X-Ray beam from either direct contact of primary beam or exposure to leakage or scatter

- lack of training
- improper equipment configuration
- handling samples when machine energized

Security

- only authorized users may have access to X-Ray devices
- energized equipment must be attended at all times
- lock lab door when equipment not attended

Emergencies

- report any incidents of excessive exposure or theft to Radiation Safety Officer
- after hours call Security and Emergency Services at 416-979-5040 or 80 from any internal phone
- if safe to do, de-energized equipment by turning power supply
- prevent further access by locking lab door

Continue to: References