



# The Basics of Ionizing Radiation

Produced by the Canadian Nuclear Safety Commission for First Responders

## Types of Ionizing Radiation

### Alpha ( $\alpha$ ):

- Heavy charged particle
- Internal hazard
- Travels 2-5 cm in air, stopped by a piece of paper

### Beta ( $\beta$ ):

- Light charged particle
- Mainly internal hazard, can cause skin burns
- Travels up to 4-5 m in air, stopped by a piece of plastic

### Gamma ( $\gamma$ ):

- Electromagnetic wave
- External hazard
- Travels several metres in air, requires dense material for shielding

### Neutron (n):

- Uncharged particle
- External hazard
- Travels several metres in air, hydrogen-rich material (water/wax) best for shielding

## Engineering Units:

p (pico)	= $10^{-12}$	= 0.000000000001
n (nano)	= $10^{-9}$	= 0.000000001
$\mu$ (micro)	= $10^{-6}$	= 0.000001
m (milli)	= $10^{-3}$	= 0.001
k (kilo)	= $10^3$	= 1 000
M (mega)	= $10^6$	= 1 000 000
G (giga)	= $10^9$	= 1 000 000 000
T (tera)	= $10^{12}$	= 1 000 000 000 000

## Activity:

37 TBq (terabecquerel)	= 1 kCi (kilocurie)
37 GBq (gigabecquerel)	= 1 Ci (curie)
37 MBq (megabecquerel)	= 1 mCi (millicurie)
37 kBq (kilobecquerel)	= 1 $\mu$ Ci (microcurie)
37 Bq (becquerel)	= 1 nCi (nanocurie)

## Dose:

1 Sv (sievert)	= 100 rem (rem)
1 mSv (millisievert)	= 100 mrem (millirem)
1 $\mu$ Sv (microsievert)	= 100 $\mu$ rem (microrem)
1 nSv (nanosievert)	= 100 nrem (nanorem)

## Contamination vs. Radiation

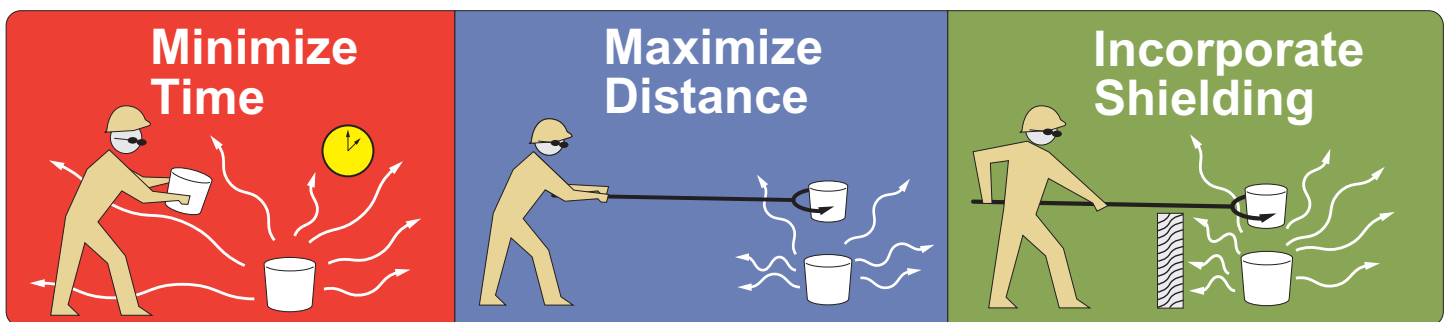
Radiation is emitted from any material that is radioactive. Radiation exposure occurs when a person is in a radiation field. Contamination occurs when control is lost over radioactive material and it ends up in places it should not be.

Contamination is either loose (easily spread) or fixed. Generally speaking, the amount of radioactive material found on a contaminated surface is too low to be considered an external hazard. However, contaminated persons should be decontaminated as quickly as possible. Personal protective equipment (PPE) is worn to protect against the hazards of contamination.

## Radiation Protection

IT IS RECOMMENDED THAT PERSONAL ALARMING DOSIMETRY EQUIPMENT SHOULD BE WORN AT ALL TIMES AND IS CONSIDERED AS PART OF YOUR PPE. Wear dosimetry under a LEVEL A suit and on the outside of all other types of PPE (ideally in a plastic bag to prevent contaminating it).

Remember the ALARA Principle: As Low As Reasonably Achievable



Remember: DOSE = DOSE RATE x TIME

**Minimum PPE:** Tyvek® overalls, two layers of nitrile or latex gloves, rubber boots and respiratory protection (N95, SCBA or full-face respirator).

Note: If there is no risk of airborne contamination, then respiratory protection can be removed.

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