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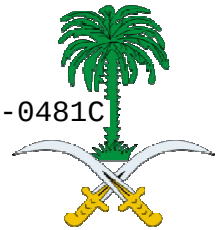

As Low As Reasonably Achievable (ALARA)

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
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under contract DE-AC04-94AL85000.

NNSA

Sandia National Laboratories

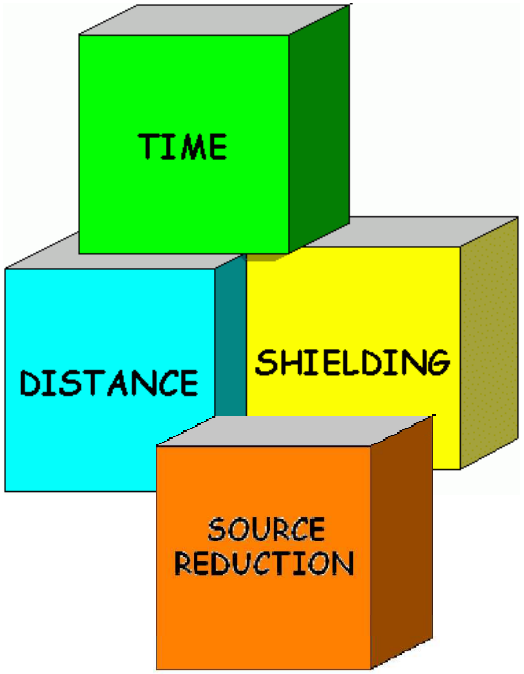
Topics

- ALARA Concept
- Reducing External Exposure to Radiation
- Types of Radioactive Contamination
- Reducing Internal Exposure to Radioactive Material
- Contamination Control Overview
- Radiological Postings

ALARA

ALARA = As Low As Reasonably Achievable

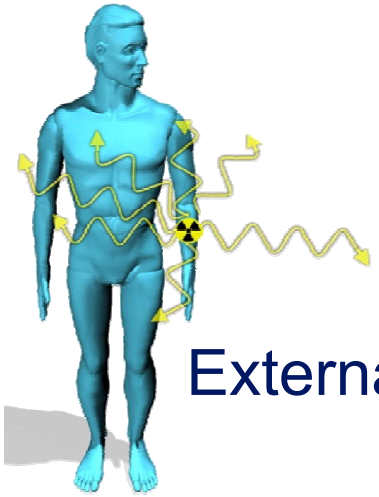
- An approach that strives to manage and control doses (both individual and collective) to as low as is reasonably achievable
- Assumes that any exposure involves some risk
- No exposure without commensurate benefit



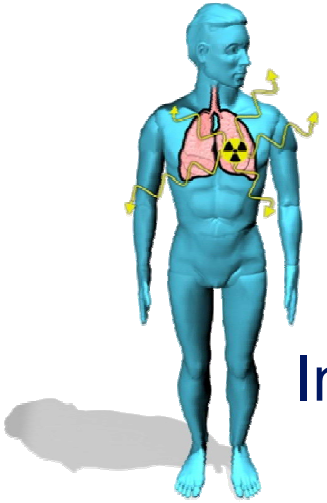
ALARA Responsibilities

ALARA is the responsibility of each individual:

- Seek assistance from a Radiation Protection Specialist about the radiological conditions and protective measures
- The ALARA principle includes reducing both **external** and **internal** exposure



External



Internal

Reducing External Exposure

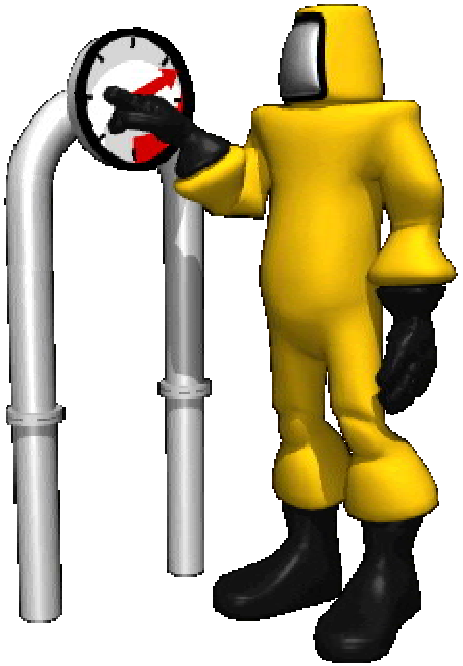
Protective measures to reduce external exposure:

- **Time**
- **Distance**
- **Shielding**
- **Source Reduction**

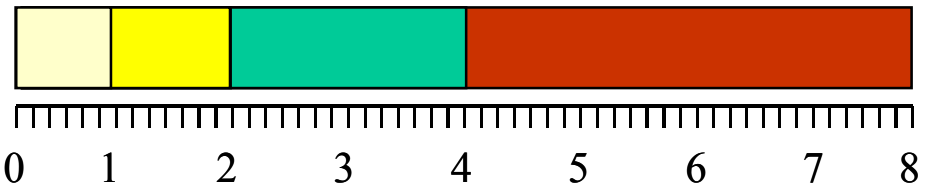
Time

Minimize time in a field of radiation

1 mSv/hour field



Time in Area = **8 hours**



mSv received

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Time Reduction Techniques

- Pre-plan for emergencies involving radioactive materials (practice drills)
- Work efficiently and swiftly
- Have all necessary equipment readily available
- Rotate personnel if qualified replacements are available
- Minimize time spent in areas where radioactive material is present

Distance

Maximize distance from a source of radiation

$$\text{Dose Rate}_a = \text{Dose Rate}_b \, (D_b^2/D_a^2)$$

2 Distance = Dose Rate / 4

Point Source

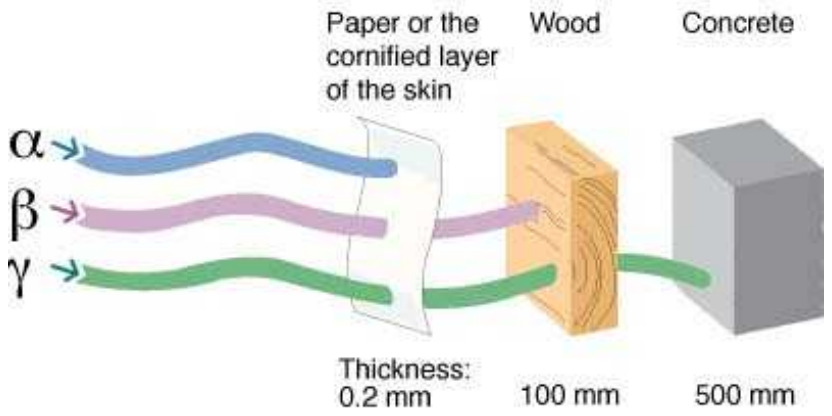
25 μSv/hr
Distance = 4 m

100 μSv/hr
Distance = 2 m

Shielding

The use of shielding will reduce the dose rate that you are exposed to:

- Lead, concrete, steel and DU are effective gamma and x-ray shields



- Plastic, aluminum, and wood are effective beta shields
- Water is an effective neutron shield
- Paper, clothing, skin and air are effective alpha shields

Source Reduction Methods

- Decontaminate

- Remove contaminated materials from the area

Types of Radioactive Contamination - Fixed

Radioactive contamination can be fixed, removable (also called “loose”), or airborne.

Fixed Contamination - contamination that can not be readily removed from surfaces.

Detected by direct frisking of the item / surface

Types of Radioactive Contamination - Removable

Removable Contamination - contamination that can be readily removed from surfaces:

- May be transferred by casual contact
- Air movement may cause removable to become airborne
- Measured by wiping the area with a piece of paper and then counting the sample

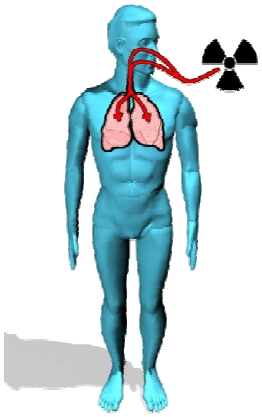
Types of Radioactive Contamination - Airborne

Airborne Contamination - contamination suspended in air - dusts, fumes, particulates, mists, vapors, or gases:

- Radiation Protection Personnel have equipment designed to sample the air for airborne contamination
- Air is pulled through a filter paper, and the paper is counted using a contamination monitoring instrument

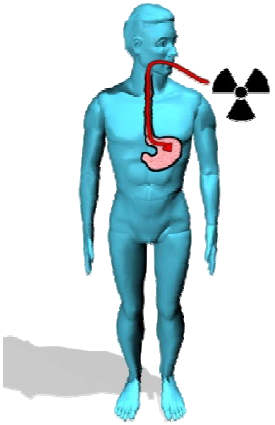
Internal Exposure Pathways

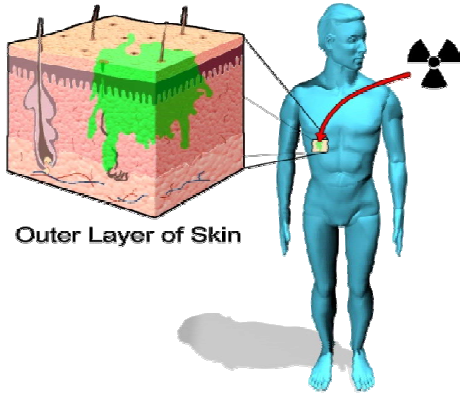
Internal dose results from radioactive material being taken into the body through:



Inhalation

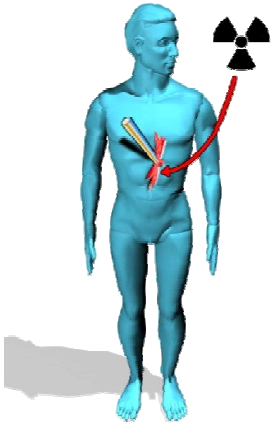
Ingestion





Absorption

Injection



Methods to Reduce Internal Exposure

- Wear respiratory protection
- Do not eat, drink, smoke, chew or touch face in contaminated areas
- Seal the openings of protective clothing with tape
- Keep wounds protected and clean

Protective Clothing

Protective clothing keeps contamination off your skin and personal clothing

- Disposable coveralls usually effective but may not protect against all hazardous materials
- Same standard guidelines routinely used in hospitals for protection from microbiological contamination are sufficient for protection from radiological contamination
- For DU, gloves are normally sufficient

Inside Radiological Areas

- Keep your dose ALARA using time, distance, and shielding
- When inside a contaminated area, exit as soon as possible if sustain a wound or a breach in your protective clothing occurs
- When leaving a contaminated area, monitor personnel and equipment for contamination as soon as possible

Surveying for Contamination

When a person or item leaves an area with a potential for contamination, procedures should be put into place to control the contamination and prevent its spread.

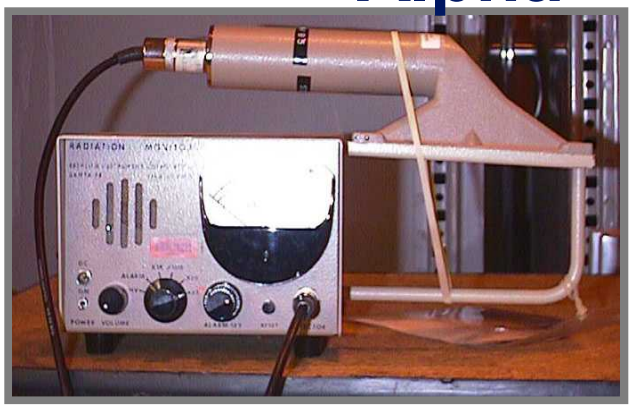
These include:

- a survey of personnel
- a survey of equipment

Hand-Held Frisking Equipment

Alpha + Beta

Alpha



Beta

Alpha

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Frisking Procedure

- Visually inspect frisker to verify that:
  - instrument is on
  - instrument is on the lowest scale
  - audio output can be heard

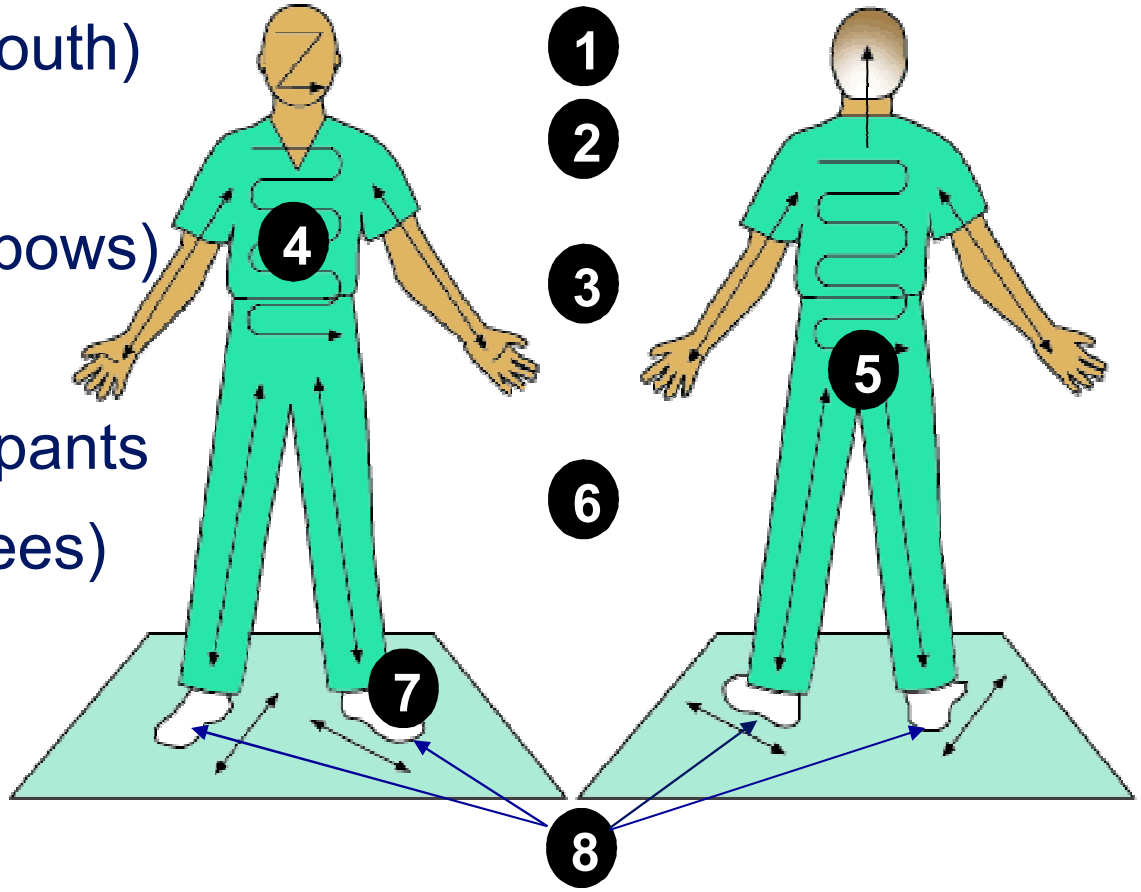
Frisking Procedure (Cont.)

- Verify background radiation level is low
- Frisk hand prior to picking up probe
- Hold probe close to surface (within 1 cm)
- Move probe slowly (2-5 cm per second)
- Conduct a whole body frisk
- Pause if count rate increases

- Request assistance if contamination is detected

Whole-Body Frisk Recommended Order

1. head (pause at mouth)
2. neck/shoulders
3. arms (pause at elbows)
4. chest/abdomen
5. back/hips/seat of pants
6. legs (pause at knees)
7. shoe tops
8. shoe bottoms



Note: Whole-body frisk should take at least 2-3 minutes

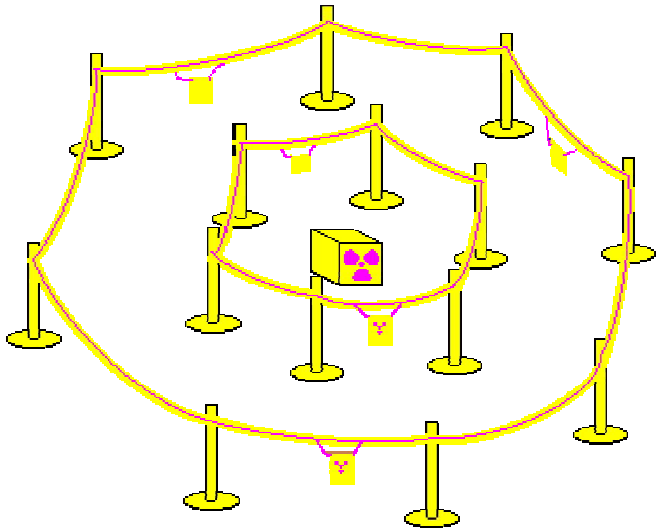
Radiological Postings

An administrative control designed to:

- Alert personnel to the presence of radiation or radioactive materials
- Inform workers of radiological conditions to aid in minimizing exposure
- Provide radiological area entry requirements
- Help prevent the spread of contamination

Radiological Postings

Areas controlled for radiological purposes are posted with a magenta, three-bladed warning symbol (or "trefoil") on a yellow background



Yellow and magenta ropes, tapes, chains, or other barriers are used to mark the boundaries

Radiological Postings

Radiological posting information includes:

- Radiological warning words, such as “Caution, Danger, or Extreme Danger" to indicate the level of hazard
- Trefoil symbol
- Listing of all radiological hazards in the area

Postings may also contain information on:

- Specific radiation dose rate or contamination level
- Entry requirements

Radiation Levels 1 mSv/h General Area

Radiological Postings

Obey radiological controls entry requirements:

- Always be aware of the postings and the information provided

Radiological Postings

Radiological areas may be one of three general types:

Radiological Postings

- When entering a Radiation or High Radiation Area, wear a personnel monitoring dosimeter if possible
- A Radiation Protection Specialist with a dose rate meter should accompany you

Radiological Postings

When entering a Contamination Area, seal the openings of your clothing with tape

When entering an Airborne Radioactivity Area, seal the openings of your clothing with tape and use a respirator, if available

New IAEA Radiation Warning Symbol

On February 15, 2007 the IAEA published a new radiation warning symbol:

- This new symbol will supplement, not replace the existing trefoil symbol
- The intent is to have an easy to understand symbol regardless of the individuals training