SAND2007-0656P

Lesson 3

ALARA

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
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Lesson 3 – ALARA

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

ALARA

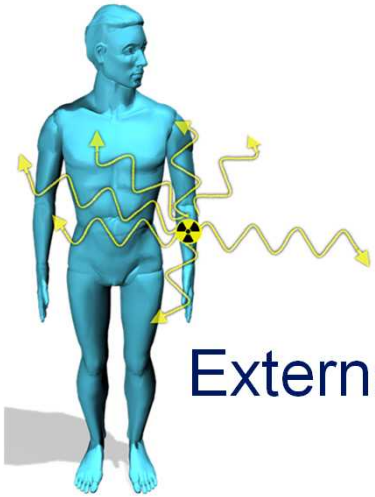
ALARA = As Low As Reasonably Achievable

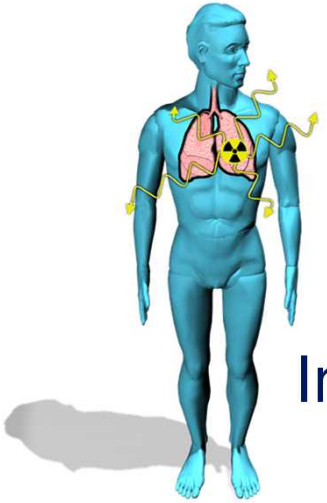
- An approach that strives to manage and control doses (both individual and collective) to as low as is reasonably achievable
- Assumes that any exposure involves some risk
- No exposure without commensurate benefit

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.





Reducing External Exposure

Protective measures to reduce external exposure:

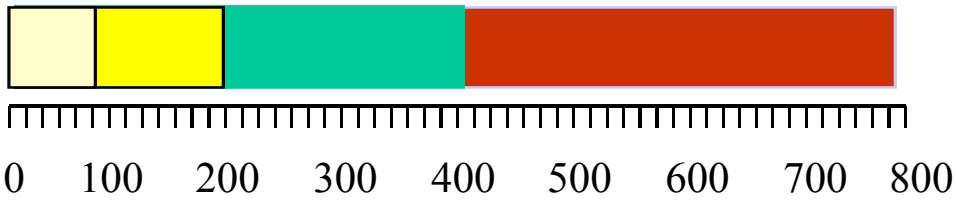
- Time
- Distance
- Shielding
- Source Reduction

Time

Minimize time in a field of radiation

100 mrem/hour field

Time in Area = **8 hours**



mrem received

Time Reduction Techniques

- Pre-plan the task prior to performance
- Work efficiently and swiftly
- Have all necessary tools before starting the task
- Perform as much work outside the area as possible
- Never loiter in Radiation Areas
- Do the job right the first time

Distance

Maximize distance from a source of radiation

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

2 x Distance = Dose Rate / 4

400 mrem/hr

6400 mrem/hr

Point Source

Distance = 8

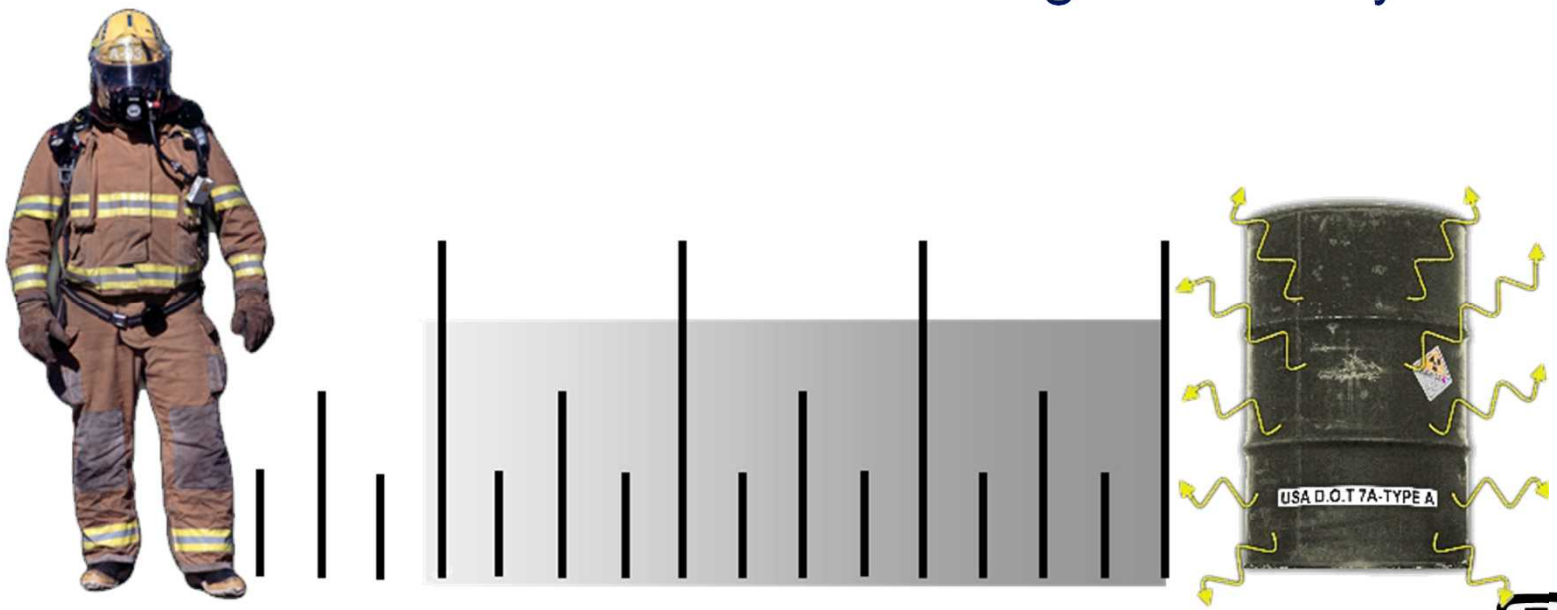
100 mrem/hr

Distance = 4 feet

1 foot

Methods to Increase Distance

- Always maximize the distance between you and any source(s) of radiation
- Be familiar with radiological conditions in the area
- Use remote handling devices when possible
- Move to lower dose rate areas during work delays



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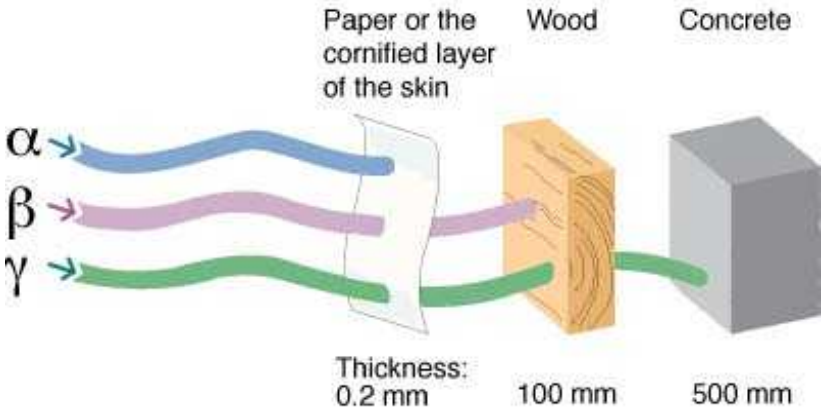
Shielding

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

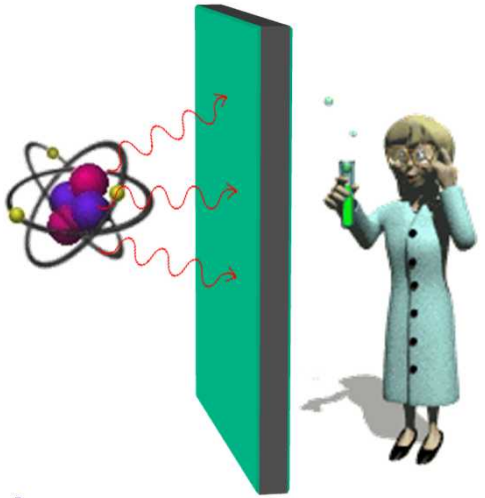
- Lead, concrete, and steel are effective gamma and x-ray shields

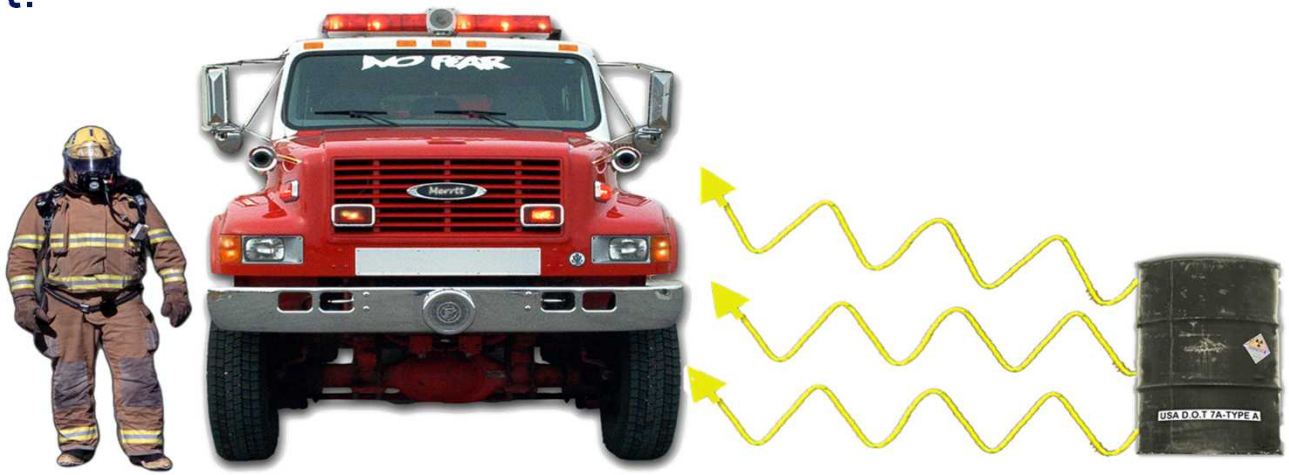


- Plastic, aluminum, and wood are effective beta shields
- Water is an effective neutron shield
- Paper, clothing, skin and air are effective alpha shields

Proper Uses of Shielding

- Take advantage of permanent fixtures and equipment which may provide some shielding.
- Work behind barriers when possible; and
- Carefully pre-plan your approach and exit.

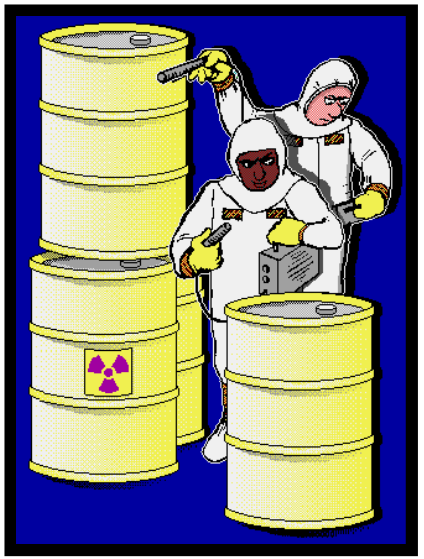




Source Reduction Methods

- ✓ Decontaminate

- ✓ Move high radiation sources out of the area



- ✓ Wait for decay of short-lived isotopes

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

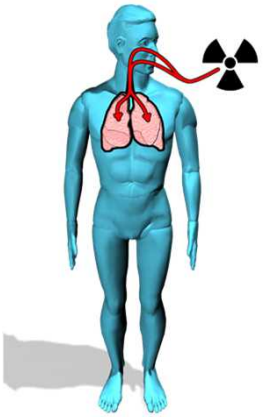
Types of Radioactive Contamination - Airborne

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

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

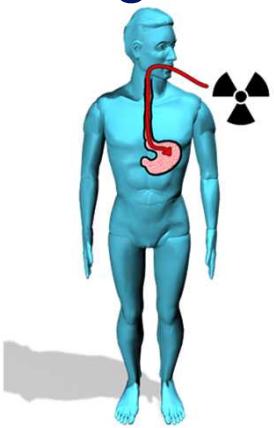
Internal Exposure Pathways

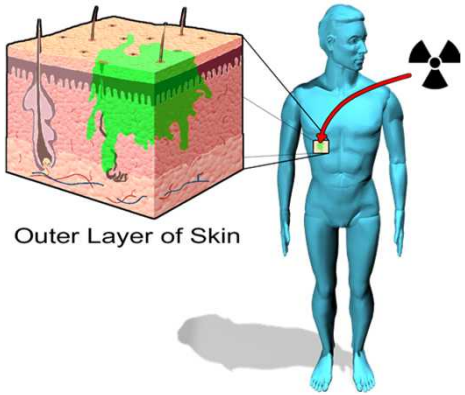
Internal dose results from radioactive material being taken into the body through:



Inhalation

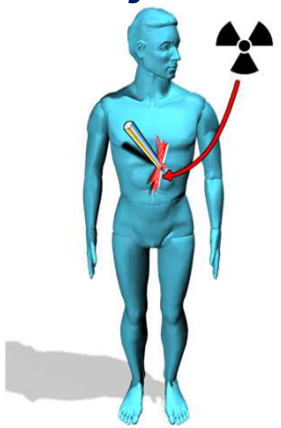
Ingestion





Absorption

Injection



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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

Respiratory Protection

Respiratory protection should be considered when entering an area where airborne contamination is likely.

Emergency Respiratory Protection

Description	Collection Efficiency
Man's cotton handkerchief, 16 thickness	94 %
Man's cotton handkerchief, 8 thickness	88 %
Toilet paper, 3 thickness	91 %
Bath towel, 2 thickness	85 %
Cotton shirt, 2 thickness	65 %

Ref. Army Chemical Corps

Protective Clothing

Protective clothing keeps contamination off your skin and personal clothing

- Disposable coveralls are usually effective but may not protect against all hazardous materials

Protecting Personnel

- When inside a contamination area, exit if a wound or a breach in your protective clothing occurs
- While inside an airborne area, do not remove your respirator unless you can't breathe
- When leaving a contamination area, monitor for contamination upon exit (if 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

Automated Frisking Equipment (Alpha, Beta & Gamma)

Automated Frisking Equipment PCM -1B


ADIATION MONITOR
NEW MEXICO
COUNTS PER MINUTE
100
200
300
400
500
5
10
15
20
25
KV
eberline
ALARM
DC
ON
ALARM
X1K X10C
X10
X1
POWER
VOLUME
ALARM SET
RESET
DETECTOR

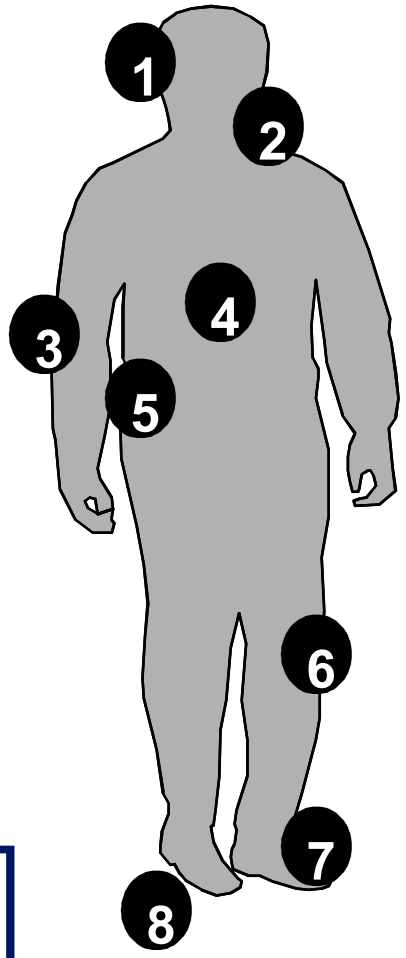
Frisking Procedure (Cont.)

- 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

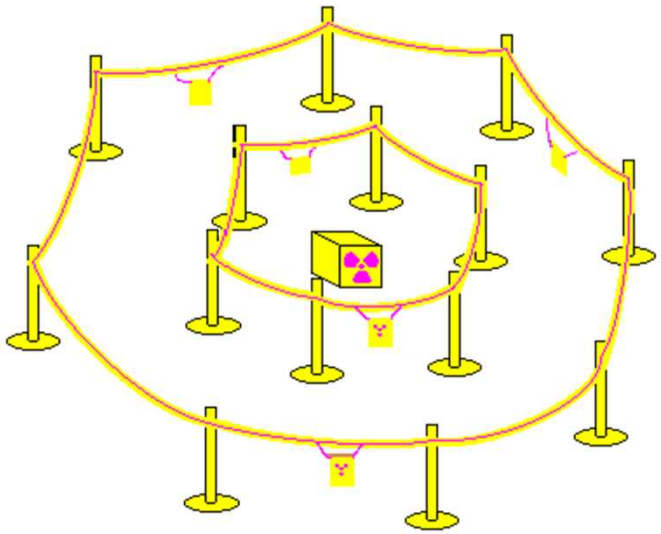
Radiological Postings

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 10 mR/hr General Area

Radiological Postings

First responders do not have to obey radiological controls entry requirements **during an emergency**.

- However, in ALL cases you should 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