IAEA Post Graduate Educational Course in Radiation Protection and Safety of Radiation Sources

Intervention for Chronic and Emergency Exposure Situations

Basic Concepts of Emergency Preparedness



Personal Protective Equipment, Devices and Procedures

Lecture

Introduction

- In a radiation emergency, emergency workers could be exposed to radiation or become contaminated
- Personal protective equipment have to be used to avoid or minimise the risks of contamination and exposure
- The lesson presents personal protective equipment and train the student in proper dressing and undressing, and explain the functions of a contamination control point

Content

- BSS recommendations
- Personal protective equipment
  - Measuring devices
  - Contamination control barriers
- Anti-contamination clothing
  - Dressing
  - Undressing
- Contamination control point
- Summary

BSS Recommendations

- BSS establishes that employers, registrants and licensees shall ensure, for all workers, that
  - ... appropriate protective devices and monitoring equipment be provided and arrangements made for its proper use
  - ... suitable and adequate human resources and appropriated training in protection and safety be provided, as well as periodic retraining and updating as required in order to ensure the necessary level of competence ...

BSS Recommendations (cont'd)

- BSS also establishes that workers shall:
  - ... use properly the monitoring devices and protective equipment and clothing provided
  - ... accept such information, instruction and training concerning protection and safety as will enable them to conduct their work in accordance with the requirements of the Standards ...

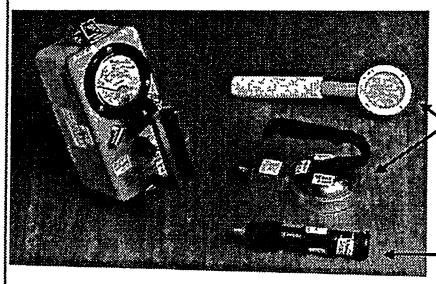
Personal protective Equipment and Devices

- Measuring Devices
  - Dose rate meters
  - Contamination monitors
  - Personal dosimeters
- Contamination Control Barriers
  - Anti-Contamination Clothing
  - Respiratory protection

Dose Rate Meters and Contamination Monitors

- Used for general radiation monitoring applications
- Could be based on Geiger-Müller (GM) detectors, proportional counters, ionisation chambers or solid state detectors (sodium-iodine crystals)
- Contamination measurements usually require calibration for specific radionuclide

Geiger-Müller (GM) Detector



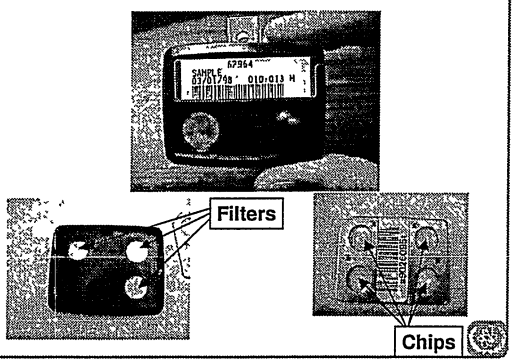
Personal Dosimeters

- Types:
  - Passive: TLD or film body badges
  - Active: Pocket ion chamber and electronic pocket dosimeters
- None of the above dosimeters can detect low energy beta emitters
- Passive dosimeters cannot be used for contamination surveys
- Alarms and turn back values

Thermo Luminescent Dosimeters - TLD

- Crystalline material
- Excited electrons remain in metastable state until heated
- Heating releases electrons
- Reusable but no permanent record
- Dose rate response curve is flat
- Dose response does not saturate

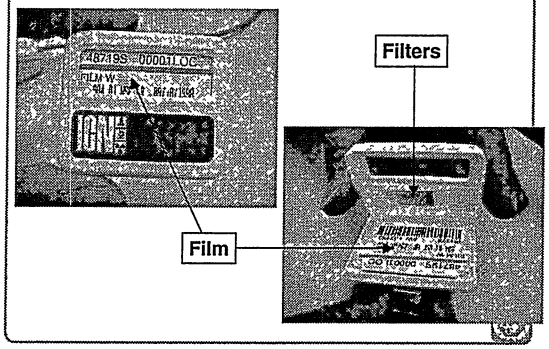
Thermo Luminescent Dosimeters - TLD



Film Badges

- X and gamma rays affect film like light
- Ionizing radiation "exposes" silver bromide and darkens film
- Permanent record (can be re-read)
- Not reusable
- Dose response saturates based on film
- Dose response is flat

Film Badges



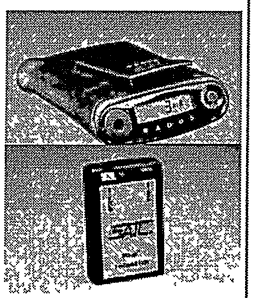
Pocket Ion Chambers - PIC

- Must be charged before use
- Must be set to zero before use
- Radiation exposure causes discharge
- Read by looking at the hairline indicator against scale
- No permanent record



Electronic Personal Dosimeter

- Similar to PIC
- Reads dose or dose rate
- Alarms for dose or dose rate
- No permanent record



Contamination Control Barriers

- External
  - prevent contamination of the skin
  - help minimize the spread of contamination
  - do not provide protection against external exposure
- Internal
  - prevent contamination from entering the body
  - require specialized equipment

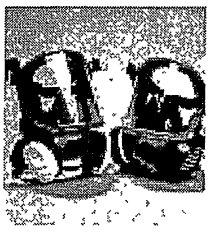
External Barriers = Anti-C's

- Cotton Gloves
- Overalls
- Shoe Covers
- Vinyl Gloves
- Hood
- Foul weather gear



Internal Barriers = Respirators

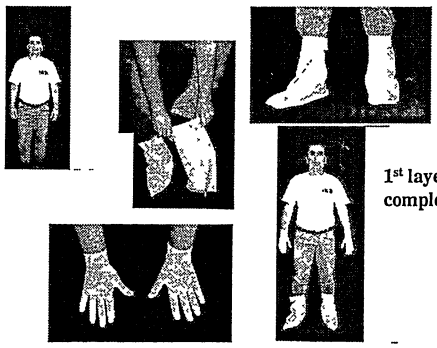
- Dust filters
- Half-face respirator
- Full-face respirator
- Self contained breathing apparatus
- Air Supplied Hoods



Donning Anti-Contamination Clothing
Demonstration and Drill

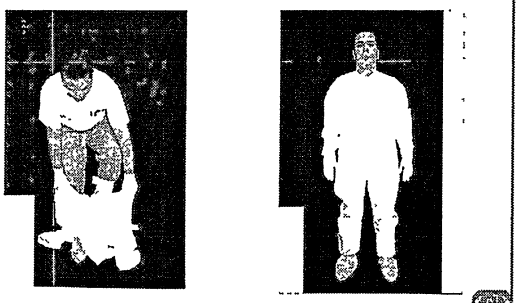
- There are three layers of protection
  - First layer: gloves and overshoes
  - Second layer: cotton overall, second gloves and overshoes, cotton hood, passive dosimeter
  - Third layer: plastic overall, third gloves and overshoes, respirator (mask) and direct reading dosimeter

Donning Anti C's: 1st Layer

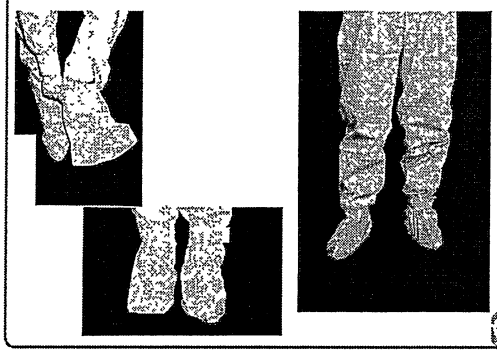


1st layer is complete

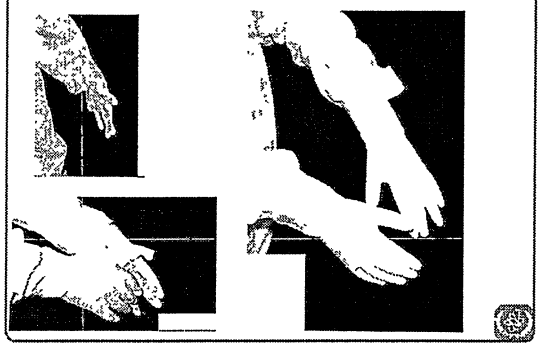
Donning Anti C's: 2nd Layer



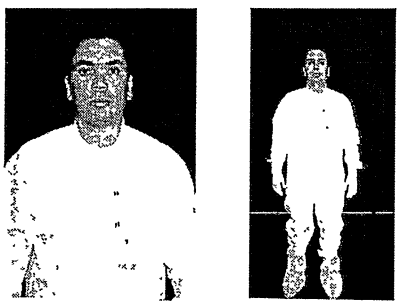
Donning Anti C's: 2nd Layer (cont'd)



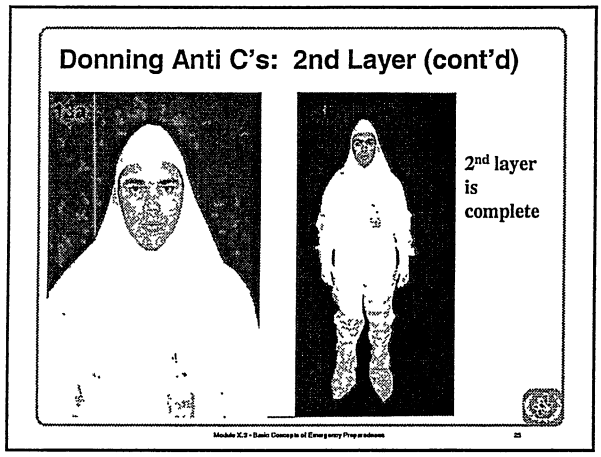
Donning Anti C's: 2nd Layer (cont'd)

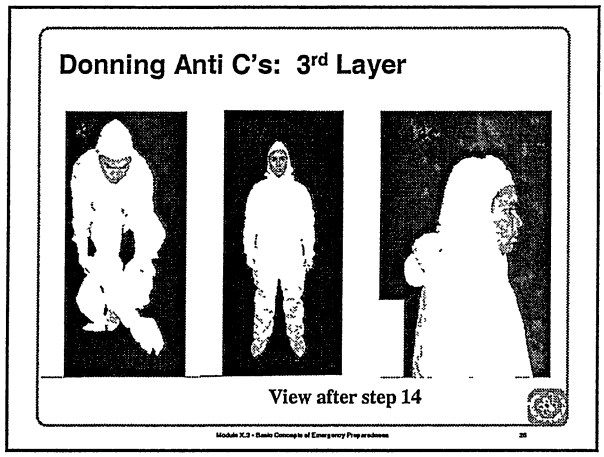


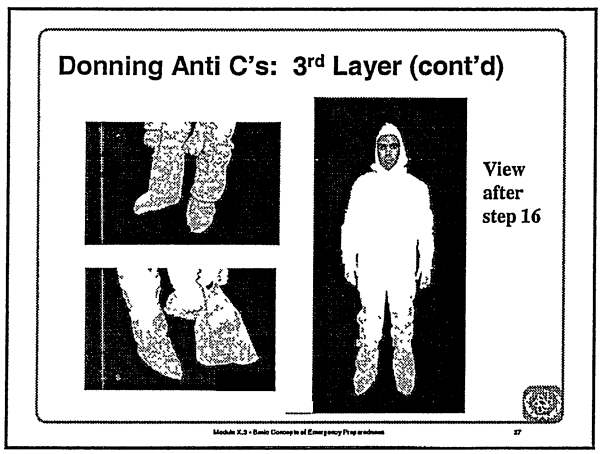
Donning Anti C's: 2nd Layer (cont'd)

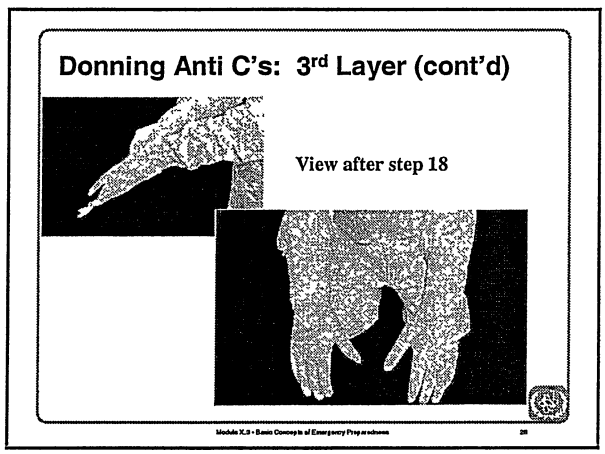


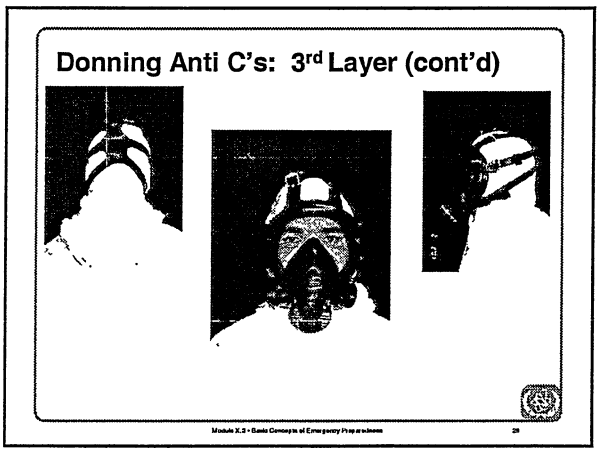
View after step 12

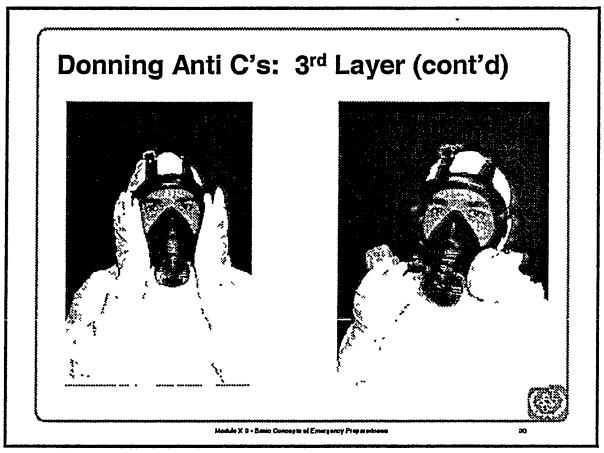

Donning Anti C's: 2nd Layer (cont'd)
2nd layer is complete


Donning Anti C's: 3rd Layer
View after step 14

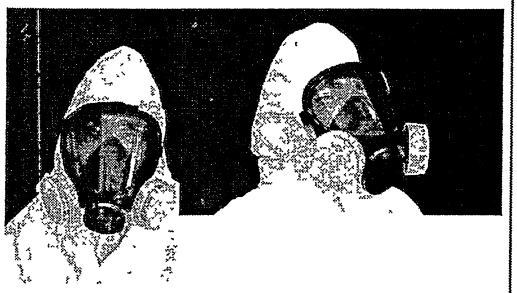

Donning Anti C's: 3rd Layer (cont'd)
View after step 16


Donning Anti C's: 3rd Layer (cont'd)
View after step 18

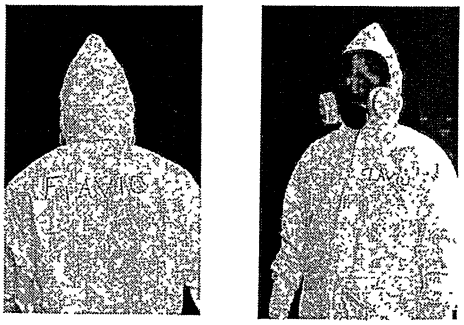

Donning Anti C's: 3rd Layer (cont'd)


Donning Anti C's: 3rd Layer (cont'd)

Donning Anti C's: 3rd Layer (cont'd)



Donning Anti C's: 3rd Layer (cont'd)



Donning Anti C's: 3rd Layer (cont'd)

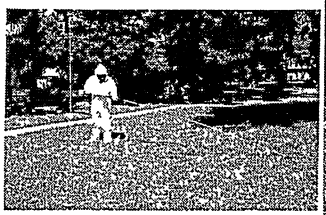


Donning Anti C's - Overview

- First Layer
- Second Layer
- Attach dosimeters
- Third Layer
- Put on respirator
- Attach alarm dosimeter

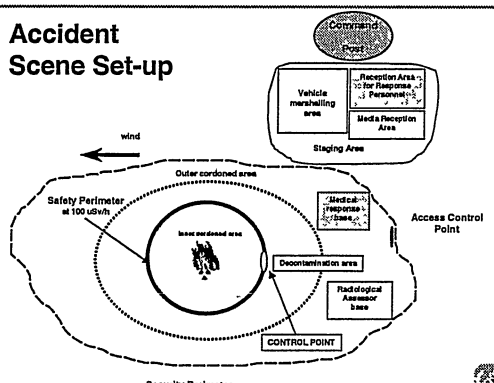


Emergency Worker

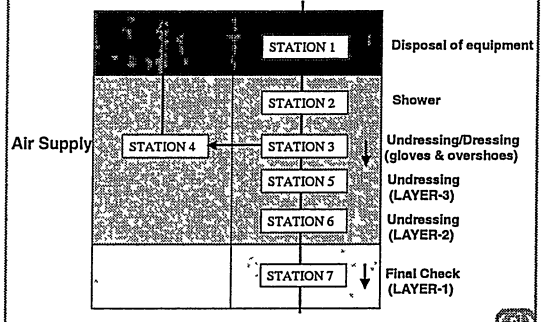




Accident Scene Set-up



Control Point – Hazmat Procedure



Removing Anti-C's

- Remove Anti-C's in the following order
  - Outer overshoes
  - Outer gloves
  - Direct reading dosimeter
  - Inner overshoes
  - Inner overalls
  - Respirator
  - Inner gloves

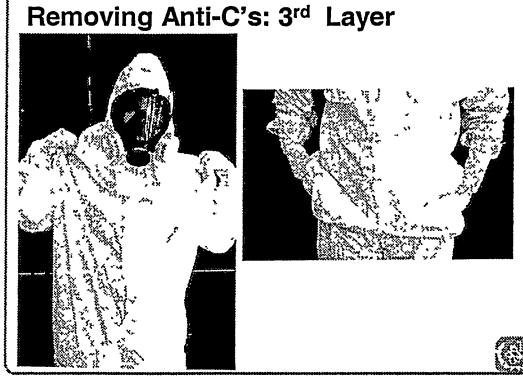
Removing Anti-C's: 3rd Layer



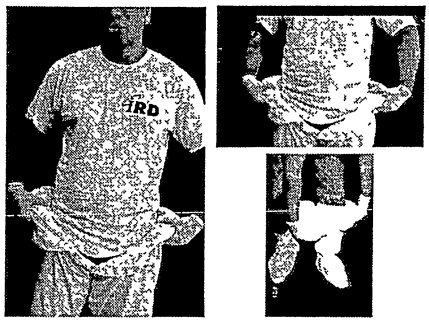
Removing Anti-C's: 3rd Layer



Removing Anti-C's: 3rd Layer



Removing Anti-Cs: 2nd Layer



Removing Anti-Cs: 1st Layer





You are free to go

Summary

- Personal protective equipment protects the worker from both external and internal contamination
- The presence of radiation can be detected only through radiation monitoring
- A Control Point has always to be set up

Where to Get More Information

See references on cover page