



Contamination Control



Objectives



- Discuss the terms “removable and fixed surface contamination”, state the difference between them, and common methods used to measure each.
- Discuss the components of an effective contamination control program, and common methods used to accomplish them.



Objectives



- Discuss the basic goal of a contamination control program and actions that contribute to its success.
- Discuss the basic principles of contamination control and give examples of implementation methods.
- List the basic factors which determine protective clothing requirements for personnel protection.



Objectives



- Discuss some of the methods for personnel decontamination.
- Discuss some of the methods for decontaminating areas and tools/equipment
- Discuss how to handle personnel who are injured and radiologically contaminated.



BASIC GOAL OF CONTAMINATION CONTROL



- Minimize contaminated areas
- Maintain contamination levels As Low As Reasonably Achievable





TYPES OF CONTAMINATION



- Contamination is radioactive material in an unwanted or undesirable location (i.e., on the floor of a work area, on a worker's clothing, on the outside of a radioactive package, etc.)
 - Fixed
 - radioactive material that **CANNOT** be readily removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or laundering.
 - Removable
 - radioactive material that **CAN** be removed from surfaces by non-destructive means, such as casual contact, wiping brushing, or washing.



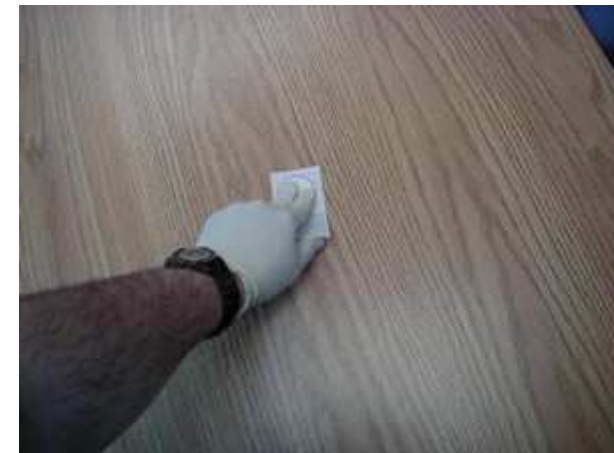
METHODS OF MEASUREMENT



- REMOVABLE CONTAMINATION

- Disk Smear Surveys

- To determine activity of nuclides present
 - units of Bq/cm² or Bq/area smeared
 - IAEA contamination limits are identified in *Application of the Concepts of Exclusion, Exemption and Clearance* [IAEA Safety Guide RS-G-1.7,]





TYPES OF CONTAMINATION



- REMOVABLE CONTAMINATION
 - Large area wipes
 - used as indication of removable surface contamination
 - Disk smears required if contamination levels are to be quantified
- Direct Survey Instruments
 - Used to measure presence of contamination on floor or other surfaces
 - Will detect both fixed and removable contamination
 - Fixed = Total - Removable



EFFECTIVE CONTAMINATION CONTROL PROGRAM



- AREA & EQUIPMENT SURVEYS

- Large Area Wipes

- Typically use Large cloth
 - Sticky rollers sometimes used
 - » good for discrete particle surveys



- Intended use

- Detect low levels of removable contamination over large surface areas
 - » Collection efficiency reduced if too large of an area surveyed

RULE of THUMB: 2.5 times largest dimension of swipe material



EFFECTIVE CONTAMINATION CONTROL PROGRAM



- AREA & EQUIPMENT SURVEYS

- Large Area Wipes (LAW)

- Intended use

- *Indication* of removable contamination
 - Build-up of removable contamination in areas where no contamination is expected
 - Indication of effectiveness of contamination controls
 - Presence of discrete particles





EFFECTIVE CONTAMINATION CONTROL PROGRAM



- Effective program includes:
 - Constant monitoring
 - Area and Equipment surveys
 - External personnel surveys
 - Personnel internal dosimetry



EFFECTIVE CONTAMINATION CONTROL PROGRAM



- CONSTANT MONITORING
 - Continuous Air Monitor (CAM)
 - Provides both visual and audible information to warn personnel of airborne conditions

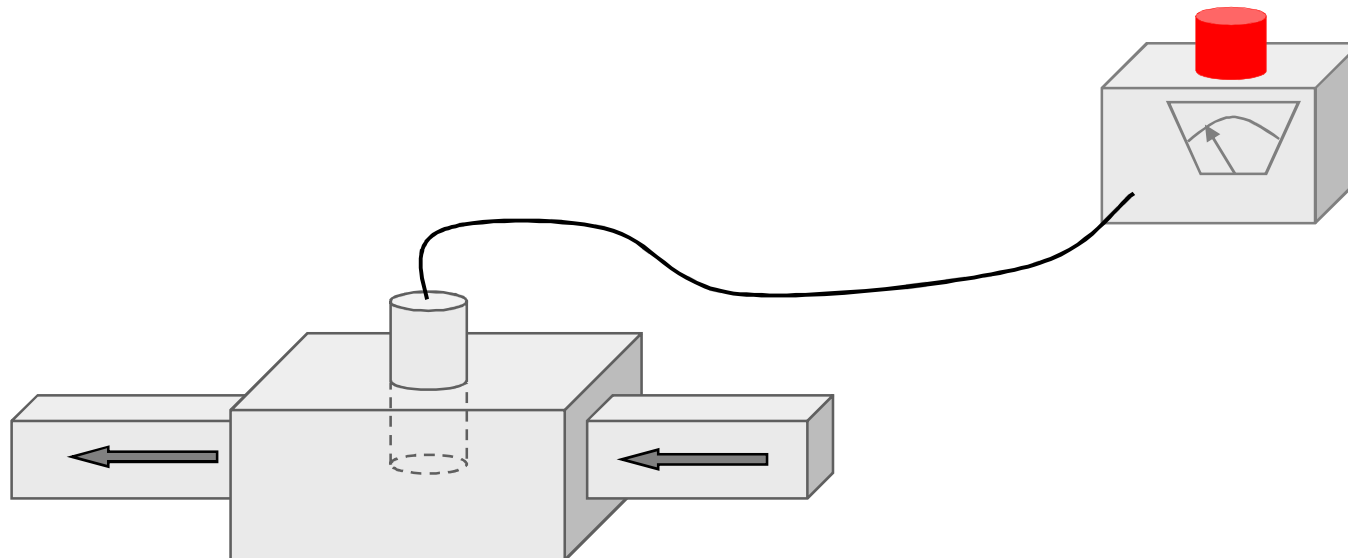




EFFECTIVE CONTAMINATION CONTROL PROGRAM



- **CONSTANT MONITORING**
 - Process Monitoring Systems
 - Alert operators of abnormal conditions





External Personnel Contamination Surveys



- Personnel Monitors
 - sensitive hand held detectors (e.g., “friskers”)

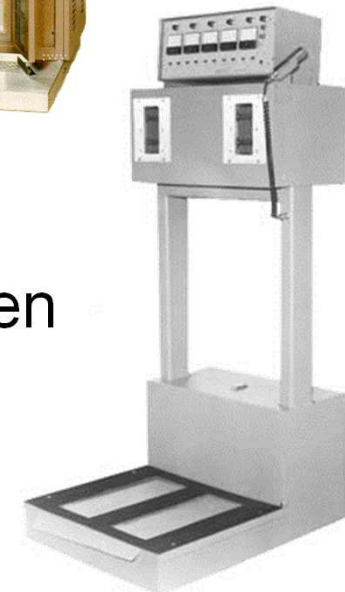




EFFECTIVE CONTAMINATION CONTROL PROGRAM



- EXTERNAL PERSONNEL SURVEYS
 - Personnel Contamination Monitors
 - Whole body monitoring systems
- EXTERNAL PERSONNEL SURVEYS
 - Hand & Foot Monitors -
 - Provides simultaneous check of hands & feet
 - Effective for exiting transitional areas between radiologically contaminated areas and “clean” areas





EFFECTIVE CONTAMINATION CONTROL PROGRAM



- EXTERNAL PERSONNEL SURVEYS
 - Portal Monitors -
 - Provides final monitoring point to ensure contamination is not spread
- EXTERNAL PERSONNEL SURVEYS
 - Upon detecting personnel contamination
 - area and/or equipment surveys may be necessary





EFFECTIVE CONTAMINATION CONTROL PROGRAM



- PERSONNEL INTERNAL DOSIMETRY
 - Breathing Zone -
 - Primary method to monitor internal dose
 - Work activities in:
 - » High Contamination Area
 - » Airborne Radioactivity Area





EFFECTIVE CONTAMINATION CONTROL PROGRAM



- PERSONNEL INTERNAL DOSIMETRY

- In Vivo Bioassay -

- Whole Body Counting

- Individual placed inside array of Sensitive detectors

- measures activity and energies of gamma emissions from inside body



- In-Vitro Bioassays

- Collection of urine or fecal samples from individual to determine type/activity of nuclides present in bodily waste



BASIC GOAL OF CONTAMINATION CONTROL



- Actions Contributing to Success
 - Good Housekeeping
 - Confine spread of radioactive materials to smallest possible area
 - Preventive maintenance programs can eliminate radioactive material releases



BASIC GOAL OF CONTAMINATION CONTROL



- Decontamination not always possible:
 - Economical Conditions
 - Radiological Conditions
 - Operating Conditions
- Other means of control must be initiated
 - Allow time for natural decay of short lived isotopes
 - Engineered controls
 - Administrative controls
 - Procedures
 - Radiological Posting
 - Personal Protective Equipment (PPE)



BASIC GOAL OF CONTAMINATION CONTROL



- Actions Contributing to Success
 - Controlling material taken into and out of Contamination Areas
 - Routine surveys in and around Contamination Areas
 - Be alert for potential violations to basic contamination control
 - Improper contamination control methods
 - Bad work practices
 - Procedure violations
 - Radioactive material releases or dry/liquid spills





CONTAMINATION CONTROL MEASURES



- Access/Admin Control
 - Boundary to controlled areas clearly marked with radiological postings/signs and rope
 - Items labeled with radiological tags
 - Step Off Pads create a sharp line of distinction between a contaminated area and “clean” areas





CONTAMINATION CONTROL MEASURES



- Preventive Methods
 - When conducting pre-job briefs
 - discuss measures that will help reduce or prevent contamination spread
 - Change gloves or protective clothing as necessary to prevent cross-contamination
 - Cover piping/equipment below work area to prevent spreading contamination into less contaminated areas.



CONTAMINATION CONTROL MEASURES



- Preventive Methods
 - Cover/tape tools or equipment to minimize decontamination efforts after the job.
 - Follow good work practices
 - **GOOD HOUSEKEEPING**
 - Cleaning up after the jobs
 - Control and minimize all material taken into/out of contaminated areas.



CONTAMINATION CONTROL MEASURES



- Engineered Controls - Ventilation
 - Permanent or temporary
 - Air flow
 - from Clean to Controlled Areas
 - Low or moderate contamination to higher contamination
 - Exhaust system filtered





Protective Clothing Considerations



- Factors to consider:
 - type & form of contamination
 - liquid
 - dust
 - surface vs. airborne
 - vapor/gas
 - level of contamination
 - nature of the work being performed





Protective Clothing (Cont.)



- Additional factors to consider:
 - potential for increase in contamination levels
 - body part(s) at risk for contamination
 - competing hazards
 - Heat stress
 - Asbestos
 - Chemicals
 - Fire hazards, etc.



Source:
http://www.weiku.com/products/12099728/Nuclear_radiation_Lakeland_protective_clothing.html



BASIC FACTORS for Consideration of Personnel Decontamination



- Three factors which determine the actions taken in decontamination of personnel.
 1. Physical condition of the individual
 2. Location of the radioactive contamination
 3. How much contamination is present



BASIC FACTORS



- Physical condition of the individual
 - Is the individual suffering from a life threatening illness or injury?
 - If YES → **MEDICAL TREATMENT TAKES PRIORITY**
 - If no, identify conditions
 - any open or puncture wounds
 - sprains
 - bruises
 - strains
 - simple fractures or multiple fractures?



BASIC FACTORS



- Location of contamination
 - Once physical (non-life threatening) condition of individual has been identified, location of contamination must be determined, is contamination
 - localized on general skin surface?
 - located at a body orifice or is a body orifice in close proximity?
 - located in or around a break in skin?



BASIC FACTORS



- Determine how much radioactive contamination is present:
 - Beta-gamma emitters
 - Alpha emitters
- Save a sample if possible for lab analysis



Radiological Incident Response Considerations



- Safety & Health Concerns (theirs and yours)
 - Health vs. Contamination
 - Is it safe to enter the area?
 - Fire
 - Toxic chemicals
 - High voltage
 - High pressure gases
 - Explosives
 - Debris, etc.



Performing Personnel Survey



- Establish a contaminated area at person's location
- Use floor coverings or decontamination pool
- Restrict access
- Take actions to prevent cross-contamination of other areas of body and surfaces
- Contain and collect ALL decontamination materials



Radiological Incident Response Considerations



- Performing Survey
 - Perform detailed survey of exposed surfaces.
 - Start at head and proceeding to feet
 - Nose, mouth, head
 - Hands, elbows and arms
 - Knees, legs, and feet
 - pay particular attention to
 - skin folds
 - injured area/open wounds if possible

**HOW LONG DOES IT TAKE TO
PERFORM AN ADEQUATE SURVEY?**



Radiological Incident Response Considerations



- Performing Survey (cont.)
 - 1 cm from surface being surveyed for beta contamination, approximately 0.5 cm from surface being surveyed for alpha contamination
 - Move probe slowly over surface
 - 2 – 5 cm/s
 - If count rate increases
 - pause for 5 - 10 seconds over area to verify presence of contamination



Response to Contaminated Personnel Clothing



- Carefully remove any clothing, coverings, etc., necessary to expose contaminated skin/hair
- Bag and identify owner of contaminated clothing (as available) for further analysis
- When clothing has been removed, perform an additional whole body survey to determine contamination has spread to the skin.



Decontamination of Personnel



- Avoid abrading or breaking skin by not brushing or rubbing affected areas
- Ensure that all personnel involved don appropriate PPE before starting.
 - Wipe from clean areas towards contaminated areas
 - If contamination is located near an open wound or body orifice – Wipe *AWAY* from wound or orifice



Decontamination of Personnel



- Perform cursory decontamination of skin and/or hair:
 - Ensure that all water, wipes, and other decontamination materials are collected and analyzed if necessary;
 - Use only lukewarm (body temperature) water and mild soap to clean/decontaminate affected areas.
 - Alternative - alcohol-free wipes may be used or tape presses may be used



Decontamination of Personnel



- Perform cursory decontamination of skin and/or hair:
 - Stop decon process if skin becomes irritated
 - Gently pat dry affected area(s) and resurvey for residual contamination.



Decontamination of Personnel



- Repeat previous steps, as necessary.
 - If contamination levels do not continue to decrease with repeated cleanings, or affected areas become irritated, stop;
- Cover and identify (as appropriate) any contaminated skin/hair;
- Address modesty concerns as necessary; and



Contaminated Personnel



- If decon successful or not successful
 - recommend individual report to their supervision/medical personnel for additional evaluation and/or paperwork
- Recommend contacting REAC/TS for assistance at 001-202-581-8100



Discrete “Hot Particle” Concerns



- Decontaminate - Discrete “hot particles” not directly associated with injuries should be removed immediately using tape or similar non-abrasive methods. Ensure “hot particles” are retained for analysis. **DO NOT** attempt to decontaminate the area around any wound.



Post Incident Surveys



- At conclusion of response/treatment/decontamination activities, perform contamination surveys of all individuals who were directly involved, as well as any vehicles, stretchers, blankets, etc., used in transporting injured individual to medical facilities.



Post Incident Surveys



- Perform contamination surveys of any room(s), equipment, and supplies (e.g., gauze bandages, towels, PPE) used during treatment and/or decontamination of individual

NOTE: Handle biological/radioactive contaminated waste with caution.

- Assist in any additional personnel, equipment, and facility decontamination activities, as needed or required.



Post Incident Surveys



- Ensure that all contaminated items, articles, etc., are removed, collected, bagged, labeled, and segregated for later inspection, analysis and disposition.



PERSONNEL DECONTAMINATION SUMMARY



- Personnel Decontamination
 - Rule of Thumb
 - 90% of contamination is removed by proper removal of protective clothing
 - Another 7% of contamination is removed with the first shower using lukewarm water and a mild soap
 - Avoid using a decontamination method that will harm the skin
 - Pay attention to skin folds, body openings and under the finger nails
 - Control the waste water to prevent the spread of contamination



DECONTAMINATION



- Area/Equipment Decontamination
 - Vacuuming
 - Strippable Paint
 - Tape/Sticky Rollers
 - Water and Cleanser
 - Abrasive Techniques



Considerations for First Aid



- First Aid is applied **PRIOR** to contamination control whenever it is considered to have life-saving value, or for the relief of pain or prevention of disability.





Considerations for First Aid



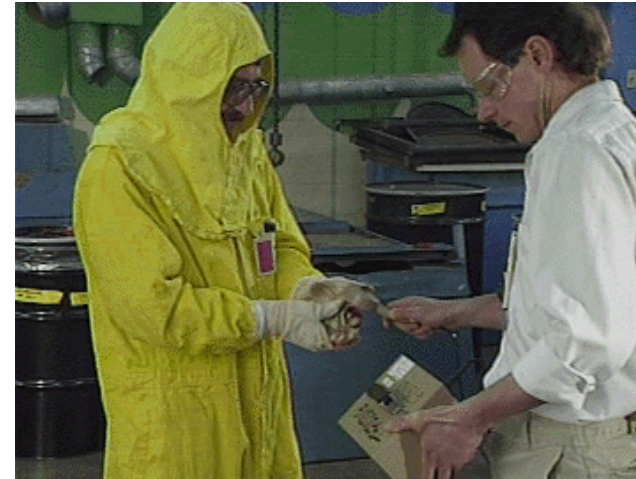
- The first individual to access the scene should
 - **STOP WORK** immediately,
 - **EVALUATE** the condition of incident site and the condition of the personnel involved,
 - **CHECK FOR HAZARDS** in the area and
 - **CALL FOR ASSISTANCE**



Considerations for First Aid



- Survey for contamination (clothing, skin, and wounds). If possible, without interfering with First Aid treatment, determine whether wounds are contaminated.
- Record the injured person's name, and the location and level of contamination.
- Inform Medical personnel about location and extent of contamination.





Transport of Contaminated Personnel



- Provide radiological control support as needed or requested.
- Follow instructions of medical professionals.
- Take precautions to prevent spread of contamination during transport and movement of individual, as applicable.



Considerations for First Aid



- Upon arrival at the medical facility:
 - Inform the medical personnel about radiological issues.
 - Assist the medical personnel to control the spread of contamination.
 - Assist the medical personnel regarding the collection of bioassay samples.
 - Survey all clothing, equipment, and instruments used in the transport vehicle, and recommend decontamination or disposal of items.



Considerations for First Aid



- **WHAT WOULD YOU DO?**

A person has a piece of metal sticking out of their arm in a contaminated area. The bleeding has been slowed so that it does not appear to be life threatening. The piece of metal has contact radiation levels of 0.10 Sv/hr beta and 0.05 Sv/hr gamma. Medical personnel arriving at the scene ask you, “Should we remove the piece of metal prior to transporting the patient?”

What would you tell them?



Considerations for First Aid



- **WHAT WOULD YOU DO?**

A person has fallen off of a ladder and is unconscious. There are no other outward signs of serious injury. The entire area is a posted contamination area, with approximately 6,000,000 Bq/cm², also the immediate area has a neutron radiation level of 0.15 Sv/hr and 1 Sv/hr gamma. Upon learning of the radiation and contamination levels in the area, the rescue personnel asks if it is safe to extract victim.

How would you respond?



Questions?

