A Practical Workshop on Radiological Emergency Response

SAND2007-0657P

CMC
COOPERATIVE MONITORING CENTER

Lesson 4 - Radiological Survey Instruments and Dosimetry Devices

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

National Nuclear Security Administration

Sandia National Laboratories

Module Objectives

- Identify two categories of radiological survey instruments.
- State the proper application and limitation of contamination survey instruments.
- State the proper application and limitation of radiation exposure survey instruments.
- Identify commonly used dosimetry devices.

Sandia National Laboratories

Radiological Surveys

- Use of instrumentation at scene is optional
- Radiation cannot be detected by our senses
- Survey instruments can:
  - Easily and accurately measure radiation and contamination
  - Help evaluate radiological hazards

Sandia National Laboratories

Radiological Surveys

- Two categories of instruments available:
  - Those that measure radiation
  - Those that measure contamination
- Some survey instruments are designed to do both

Basic Theory

- Ionizing radiation interacts with detector material and produces a meter reading
- In some instruments, the detector is connected to the meter by a cable
- In other instruments, the detector and meter are housed in one unit

Contamination Survey Instruments

- Typically read in counts per minute (CPM)
- Not designed for measuring radiation exposure

Application of Contamination Survey Instruments

- Locating contamination on personnel and equipment
- Determining the effectiveness of decontamination
- Verifying contamination control boundaries
- Determining the extent and magnitude of a contaminated area

Application of Contamination Survey Instruments

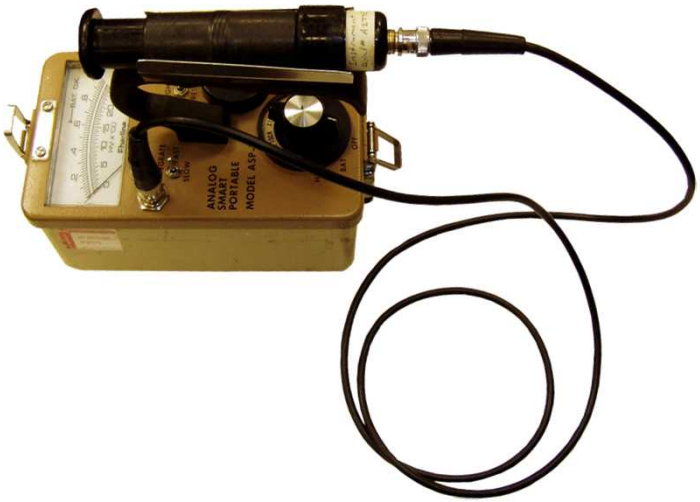
- Follow procedures for pre-operational check of instrument
- Verify instrument is on and set to the lowest/most sensitive scale
- Check for audio and visual response

Application of Contamination Survey Instruments

- Verify background radiation level
- Hold probe ½ inch (1 cm) from surface
- Move probe slowly, 1 – 2 inches (2.5 – 5 cm) per second
- Pause if count rate increases

Radiation Exposure Survey Instruments

- Typically read in
  - milliroentgen/hour (mR/hr)
  - roentgen/hour (R/hr)
  - microsievert (μSv/hr)
  - millisievert/hour (mSv/hr)
  - sievert/hour (Sv/hr)
- Best suited for use when entering a field of radiation



Sandia National Laboratories

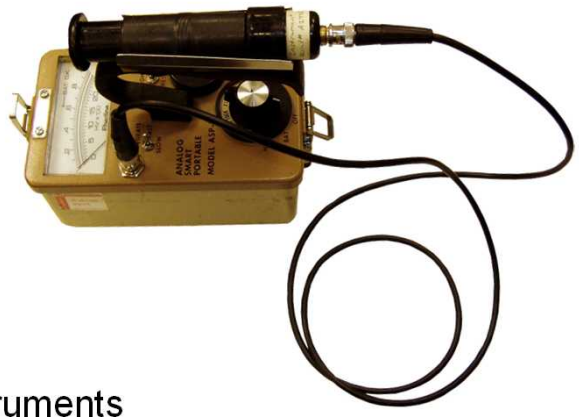
Application of Radiation Exposure Survey Instruments

- Establishing control zone boundaries
- Controlling personnel exposure
- Assessing package integrity
- Locating sources of radiation

Sandia National Laboratories

Application of Radiation Exposure Survey Instruments

- Start with low-range survey instrument
- Follow procedures for pre-operational check of instrument
- Verify instrument is on and set to the lowest/most sensitive scale
- Check for audio and visual response



Sandia National Laboratories

Application of Radiation Exposure Survey Instruments

- Many instruments employ a movable beta shield to differentiate beta and gamma radiation
- With shield open, beta and gamma admitted
- With shield closed, gamma only admitted
- Open window reading minus closed window reading = beta contribution

Sandia National Laboratories

Application of Radiation Exposure Survey Instruments

- Many survey instrument have meter faces that reads in both CPM and mR/hr
- When using a side window GM probe, readings should be recorded in mR/hr when the probe window is closed and in CPM when the probe window is open

Survey Instruments

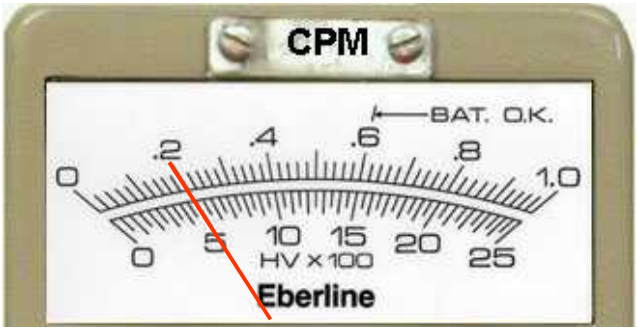
Sandia National Laboratories

Application of Radiation Exposure Survey Instruments

- Start with instrument on lowest scale
- Monitor with detector in front of you at waist level
- Periodically monitor above and below this level and in a 360º circle to ensure that you have not walked by a source of radiation

Reading the Meter Face

- Analog instruments can be more difficult to read than newer digital instruments
- Often require that user multiply displayed reading by a multiplier, based on which scale instrument is set to



.2 CPM X 10K

= 2,000 CPM

Dosimetry Devices

- **Self reading dosimeter (SRD):**
  - **Measures accumulated dose**
  - **Hold to light, look through eyepiece to read**
  - **Check frequently while in area**

Sandia National Laboratories

Dosimetry Devices

- **Electronic dosimeter:**
  - **Measures accumulated dose**
  - **Utilizes digital readout**
  - **Many options available**
  - **Audible response - chirp rate varies with radiation dose rate**

Sandia National Laboratories

Dosimetry Devices

- **Thermoluminescent dosimeter (TLD):**
  - **Measures accumulated dose**
  - **Does not provide on-the-spot indication of dose**
  - **Specialized equipment required to "read" TLD**
  - **Worn by specialized hazmat teams**

Sandia National Laboratories

Air Sampling Equipment

- Air sampling equipment is used to collect radioactive material has been dispersed into the air
- Qualitative field counting is possible but may result in erroneous decisions due to
  - Radon interference
  - High background
- Sampling media is sent to a laboratory to determine the type and amount of radioactive material

Air Sampling Equipment