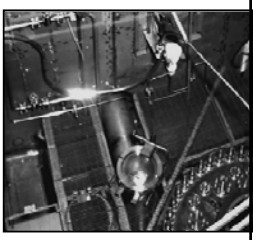
Basic Radiation Instrumentation



Steve Sugarman, MS, CHP
HP Project Manager
REAC/TS
www.orise.orau.gov/reacts

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Objectives

- Describe the use of basic radiation and contamination detection instrumentation.
- Describe techniques for contamination surveys, dose rate measurements, and radionuclide identification.

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What Are We Trying to Determine?

- Radioactive contamination levels
- Radiation dose rates in an area
- Accumulated dose to individuals in the area
- Identity of the radioactive materials

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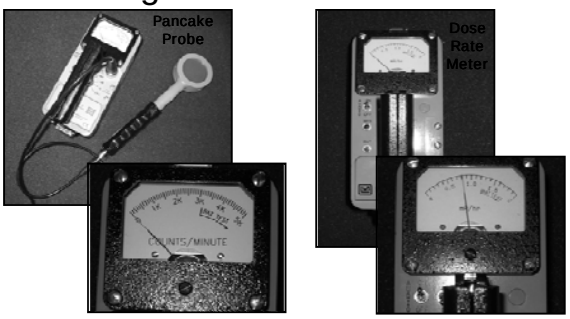
“Tools”: Handheld Instruments
Geiger Mueller Detectors



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Irradiation: Measuring Radiation Dose Rates

- Measure the penetrating radiation rate (dose per time) in the area
- Dose Rate Meter
- Used to assess risks to the responders and victims from radiation levels present
- Usual units are mR/hr (mSv/hr)

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Use of Dose Rate Instruments

- Check that the instrument is in calibration, has good batteries, and responds to a check source.
- Start on the highest scale and work your way down.
- Monitor slowly and carefully.
- Maintain awareness of instrument limitations.

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Contamination: Surveying for Radioactive Material

- Usually performed with a GM probe, pancake.
- Is contamination present, and if so, at what levels.
- Commonly report contamination levels as counts per minute (cpm)
- Survey Patient, Personnel, Area, etc…

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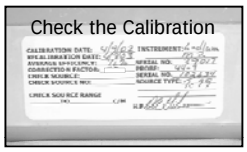
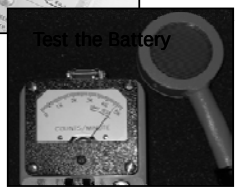
Use of Pancake GM: Check the Instrument





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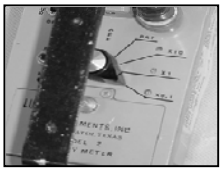
Use of Pancake GM: Background and Scale

Note background radiation level away from patient, look for levels of 2-3 times this value or greater on the patient



Start with the Most Sensitive Scale for Contamination Surveys (adjust as needed)

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Use of Pancake GM to Detect Contamination

- If alpha contamination is suspected, leave the probe uncovered
- If only beta-gamma contamination is suspected, the probe may be covered with a surgeon's glove to prevent contamination

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Patient Contamination Surveys

- Measurements can be made during patient treatment.
- Special attention should be given to wounds and face to indicate possible intake of materials.
- Repeated measurements in the same area determine the success of contamination removal techniques.

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Patient Contamination Surveys (cont.)

- Survey all areas of the patient (sides, back, etc.)
- Survey SLOWLY and carefully
- Can use headsets if noise will be distracting to patients or staff / or simply turn off the audio

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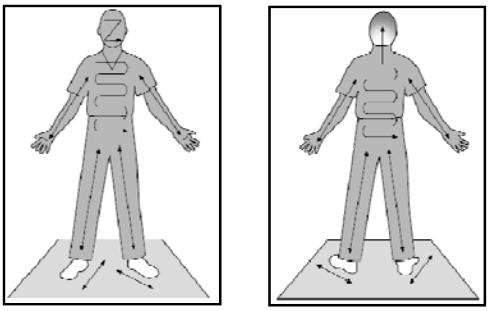
Personnel Contamination Surveys



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Area Surveys

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Use of Pancake GM: Limitations

- It will not detect very low energy betas such as those from tritium
- It may miss alpha contamination if <u>any</u> type of shielding is present, such as gauze, a thin layer of blood or even more than 2-3 inches of air

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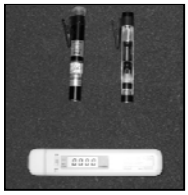
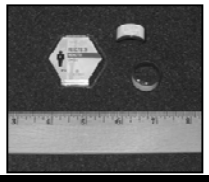
Instruments to Measure Accumulated Dose (Dosimeters)

- Two types are normally used:
  - direct readout devices (pocket dosimeters)
  - OSLDs, TLDs or film badges





- Finger ring dosimeters or similar extremity monitors may also be worn

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Identify the Radioactive Materials

- Typically done by relatively sophisticated lab equipment, e.g. gamma spectroscopy and alpha spectroscopy (analyze a spectrum for specific energies unique to a radionuclide)
- Samples collected from the patient or their clothing often used for this analysis.
- This information along with other information from the accident scene is used for possible treatment of internal contamination.

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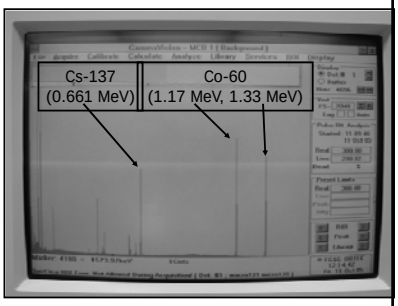
Gamma Spectroscopy



- Highly Accurate
- But Portable?

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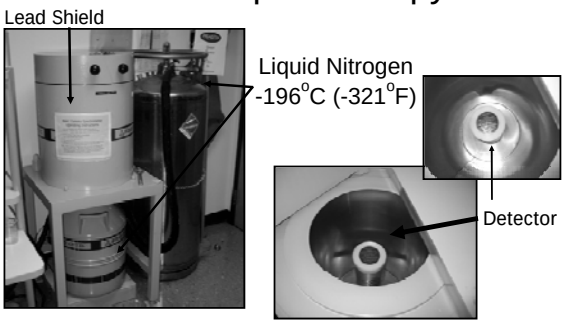
Gamma Spectroscopy



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Gamma Spectroscopy

- Exploranium Detector
- Highly Portable
- Less Sensitive

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Portal Monitors

- Advantages:
  - Quick
  - Large area
  - Alarmed
- Disadvantages
  - May miss low level contamination
  - Alpha contamination
  - Some assembly required
  - More expensive that handhelds
- Various Detectors
  - Plastic scintillators, GM tubes, etc.

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Reading the Scale (cont.)

- Use the lowest multiplier value consistent with detection of contamination levels present. Adjust this as needed when contamination is located.
- Be careful to apply the correct multiplier value when reporting contamination levels

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Examples of Reading the Scales (basic handheld instruments)

The following slides show examples of survey meters and their scales and will give you a chance to practice correctly reading the scales.

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Scale Reading (cpm)	Range Multiplier	True Reading (cpm)
700	1	700

700 cpm x 1 = 700 cpm

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Scale Reading (cpm)	Range Multiplier	True Reading (cpm)
700	1	700

700 cpm x 1 = 700 cpm

Assume 10% efficiency

700 cpm/10% = 7,000 dpm

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Scale Reading (mR/hr)	Range Multiplier	True Reading (mR/hr)
0.4	10	4

0.4 mR/hr x 10 = 4 mR/hr

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Questions

Presentation created by Steve Sugarman, MS, CHP

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