Radiation Safety and Equipment Considerations

Bonnie Meilner
Regional Sales Manager
LAURUS Systems Inc.
bonnie.meilner@laurussystems.com

Why do you need Radiation Detectors

If you have radiation detectors, are they the best solution for your needs ???

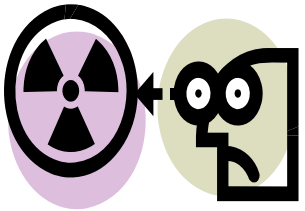
If you have radiation detectors, is it time to upgrade/replace them ???

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Scope of the problem

Worldwide, there have been over 40 deaths and 266 serious injuries as the result of uncontrolled radioactive sources

Aside from radiation exposure to workers and the public, this unwanted radioactive scrap material causes environmental and facility contamination with cleanup costs that average $12–15 million per incident.



It is estimated that through 2001, scrap yards and steel mills in North America have experienced over 10,000 detections of radioactivity in recycled scrap metal

Source: USEPA Poster by Deborah Kopsick, U.S. Environmental Protection Agency, et al
EPA Science Forum 2005

What can you do to help?

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Recycled Radiation: WMAR in Baltimore reports on recycled radiation

http://youtu.be/wgQANvdglgo

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Lets review the basics

Types of radiation

Radiation Measurement Units

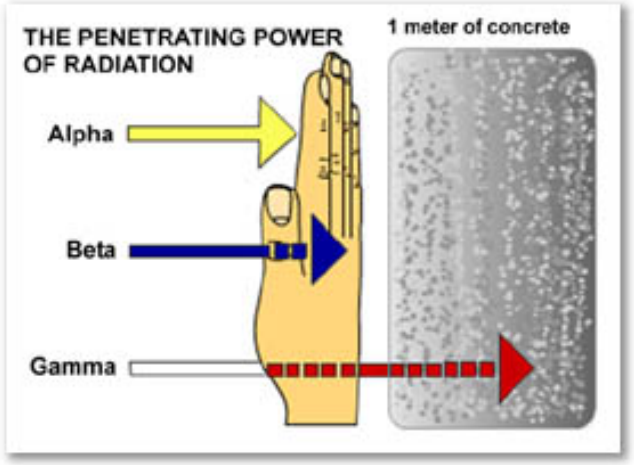
Radiation Protection

Some Examples

Radiation Types In Review

Radiation types

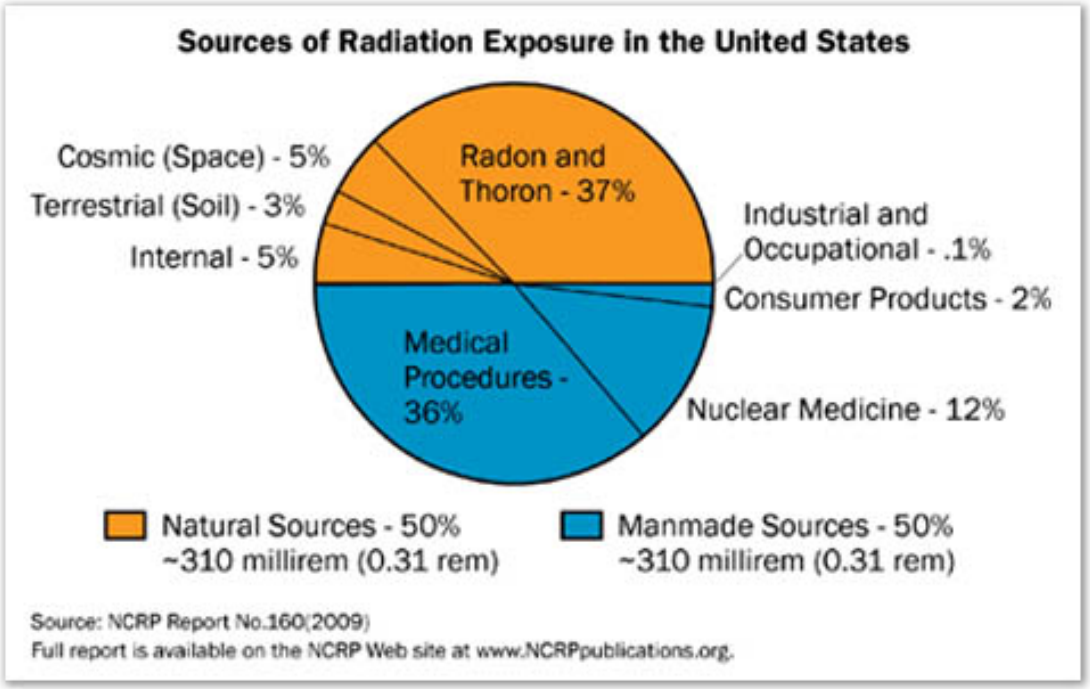
- Alphas – 1 cm in air, cannot penetrate the top layer of your skin
- Betas – about a meter in air, cannot penetrate beyond the top layer of the skin
- Gammas or Photons – several meters in air, can penetrate the body
- Neutrons – several meters in air, can penetrate the body



Radiation Measurement Units

- Counts per Second (cps)
- Roentgen (R, mR, uR)
  - ✓ Exposure or Energy produced by gamma radiation in a cubic centimeter of air. (R, mR, uR)
- Rad (rad, mrad, urad)
  - ✓ Radiation Absorbed Dose
    - ➢ Amount of energy transferred or absorbed by some mass of material.
- rem (rem, mrem, urem)
  - ✓ Roentgen Equivalent Man
    - ➢ Relates Dose of any radiation to the biological effect of that dose.
    - ➢ A quality factor is multiplied.
    - ➢ Examples: Deep, Shallow, Lens of Eye
- Sievert
  - ✓ International unit of measure for dose
  - ✓ 1/100 of rem (2 uSv = 200 urem)

Average Annual Dose Received by Individuals in US



Average Annual Dose Received by Individual in the U.S.

Source	*mrem/year*
Natural Background From body tissues, terrestrial and cosmic	~ 310 mrem/yr
Man-made Sources From products, medical and fallout	~ 310 mrem/yr

Medical radiation totals about 300 mrem/year --largest contributor is CT Scans (increased 10-11% annually in the past two decades) and nuclear medicine

Total	***~ 620 mrem/yr***

Note: statistics taken from NCRP Report #160 (published 2009)

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Radiation Protection

- Radiation Safety programs should have two principle objectives:

  1) to prevent acute exposure

  2) to limit chronic exposure to "acceptable" levels

- **ALARA**

  Stands for As Low As Reasonably Achievable

Radiation Dose Limits

Above background levels of radiation exposure, the NRC requires that its licensees limit maximum radiation exposure to individual members of the public to 100 mrem per year, and limit occupational radiation exposure to adults working with radioactive material to 5,000 mrem per year.

NRC website:
http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bio-effects-radiation.html

Radiation Safety, Three basic ways of controlling exposure

- **Time**
  - Less time = less radiation received
    - Total Dose = Dose Rate x Time
- **Distance**
  - Greater distance = less radiation received
  - Radiation exposure/dose follows inverse square law
    - Example:
      - If exposure/dose rate is 4 at a distance of D,
      - then, the exposure/dose rate at a distance of 2D is 1.
- **Shielding**
  - More shielding = less radiation received
    - The thicker the shielding, the greater percentage reduction of dose.

Same principals affect or limit detection

- **Time**
  Less time in front of detector= less radiation received at detector

- **Distance**
  Greater distance from detector = less radiation received at detector

- **Shielding**
  More shielding between source and detector = less radiation received at detector

Where does the radiation come from in the scrap yard?

Two classifications of radioactive material

NORM (Naturally Occurring Radioactive Material)

- Has been around since Day 1. It's in the ground as minerals, in bananas, in the basement (concrete block and Radon)
- Most of what is considered "Background Radiation" is made up of NORM.
- Background radiation levels can vary from location to location.
- Concentrated NORM can lead to radiation levels above background…mineral scale built up in pipes

Some Examples of NORM Found In Scrap

Sands
Fertilizers
Ceramics
Pipes containing scale
Welding rods
Grinding wheels
Road “salt”

Two classifications of radioactive material

Man Made (Artificial)

We can take non-radioactive material – and make it radioactive. We do this for:

- Medical applications (Iodine, Gallium, Technicium)
- Industrial non-destructive testing (Cobalt 60 radiography cameras for checking welds)
- Industrial measurement applications (Cesium 137 for thickness or density gaging)
- Weapons (processed Uranium and Plutonium)

Some examples found in industrial scrap

Gauge with saddle clamp

Gauge

Gauge with oxidation

Radiography camera

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Gauge found in industrial scrap

Source type noted;
IR 192
(Iridium 192)

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Some examples found in medical scrap

Medical seeds

Transport box/ammo case

And don't forget about military and aviation scrap!

Some instruments have the text "Radium" written behind the glass Meaning that dials and numbers Were painted with radioactive material

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

So what detector is right for me?

- Handheld
- Handheld Extended Wand
- Handheld Isotope Identifier
- Non Ferrous Scale Monitor
- Vehicle System
- Rail System
- Grapple or Magnet System
- Conveyor or “Charge Bucket” System
- Steel “Lollypop” sample analyzer

Traditional GM Detector

Where is my Geiger Counter?

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Handheld Scintillator

Traditional Handheld Meter

Analog vs. Digital

"Personal" Radiation Detector

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Handheld Extended Wand

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Handheld Isotope Identifier

MSpec

SYCLONE

identiFINDER2

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Non-Ferrous Scale Monitor

Handheld

Fixed position radiation detectors

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Vehicle System

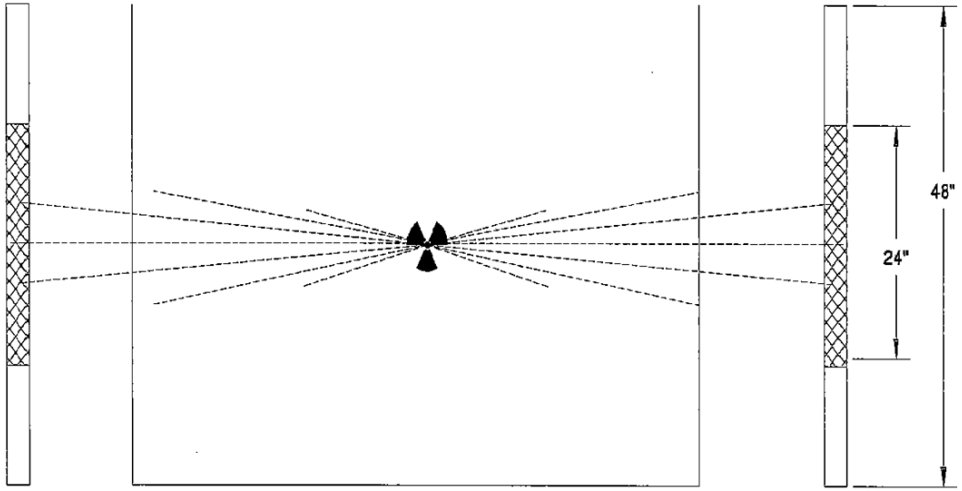
Dwell Time

Vertical Resolution

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Where is the source hidden in all that scrap?

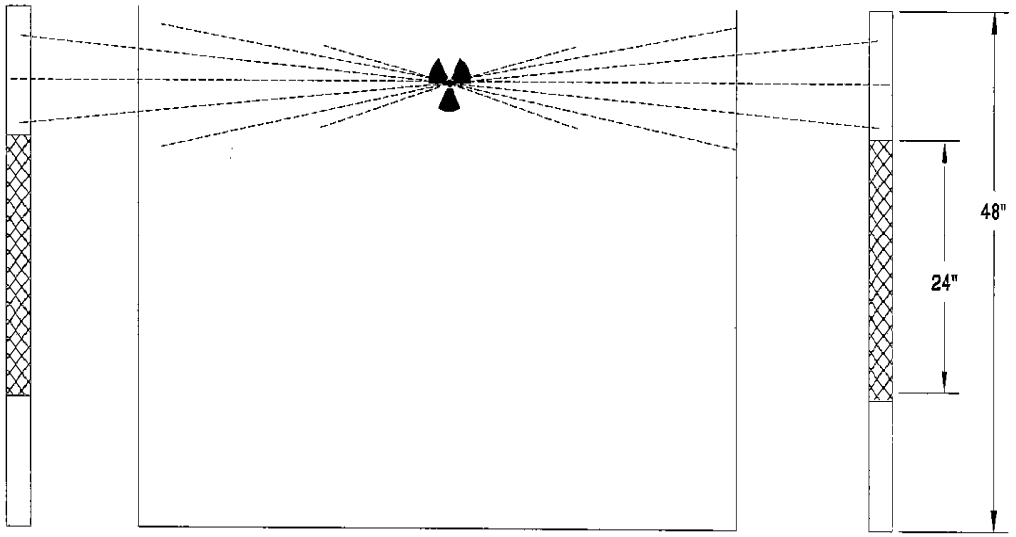
Buried Source – Center of truck



LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Where is the source hidden in all that scrap?

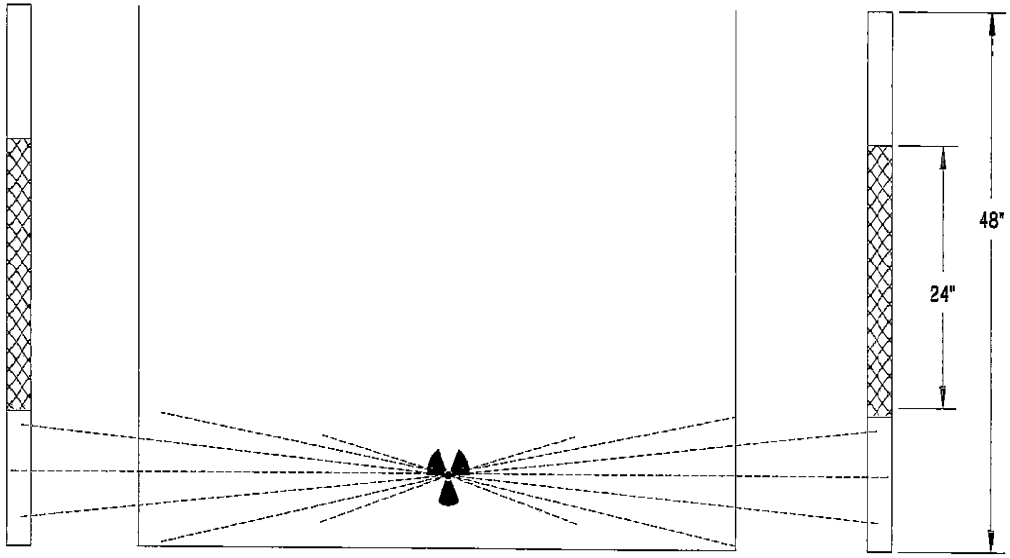
Buried Source – Top of truck



LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Where is the source hidden in all that scrap?

Buried Source – Bottom of truck



LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Rail System

“Low boy” and “High boy” gondola cars

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Grapple System

Maximum measurement time

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Magnet In-Core Radiation Detection System

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Conveyor Systems

Infeed conveyor with relay control

Downstream conveyor with relay control

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

Charge Bucket Monitors

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

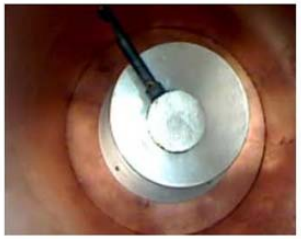
Steel “lollypop” sample analyzer

Specimen Analysis Report

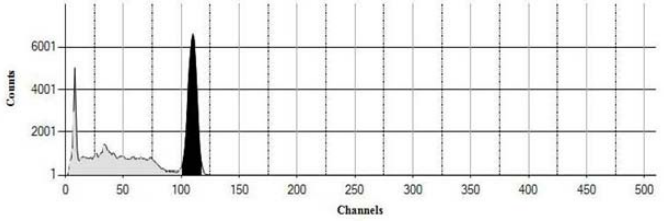
Page : 1

Report Summary :-

Date	: 16/11/2010
Time	: 4:29 PM
Operator Name	: John Smith
Specimen ID	: 1
Heat ID	: 1
Acquisition Time	: 60 Seconds
Specimen Type	: Steel
Specimen Weight	: 3.2 Grams
Specimen Thikness	: 1 cm
Specific Activity	**: 5832.088 ± 26.39 Bq/g**



Report Details



Detected Isotops

Isotop	: Cesium 137
Signal to Noise Ratio	: 220.96
Specific Activity	: 5832.088 ± 26.39 Bq/g
Activity Level	: Above Warning Level

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

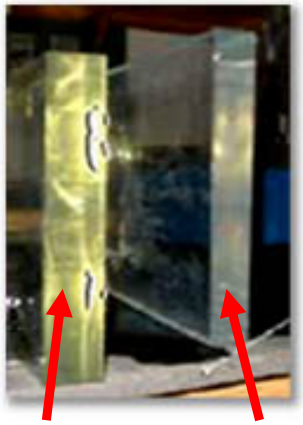
Maintenance

- Most manufacturer's recommend an annual calibration…when was your system last calibrated?
- If you have a check source, when was the last time you used it?
  - ✓ Do you know where it is?
- Systems that are exposed to the elements:
  - ✓ Have you checked the exterior cabinets for light leaks?
  - ✓ Electrical connections – exposed wires?
  - ✓ How many times has a vehicle run in to them?
- Software upgrades, have they been done? – more advanced algorithms for better sensitivity

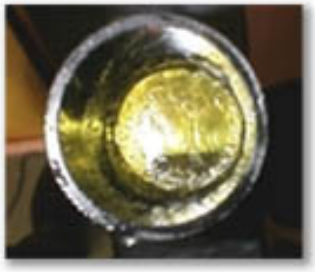
Is it time to upgrade or replace your system?

- Has your volume increased?
- Are you taking in a new kind of scrap and need a more sensitive or larger system?
  - ✓ Example: new contract for military scrap
- Have some loads been returned because you missed radioactive material?
- Can you still get parts for your system?
- Will the system still calibrate to manufacturer's standards?

Old Aging PVT Scintillation Material



Aged - PVT - New

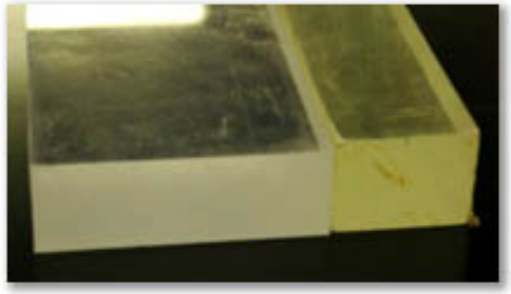


+8 year old detection systems aging becomes very noticeable

✓ Aging, yellowing PVT scintillators

" St. Gobain estimates the performance degradation of plastic scintillators (PVT) to be in the order of 3% per year…"

✓ Up to 10% degradation per year for energies below 100KeV



Aging = Yellowing

LAURUS Systems | Ph: (410) 465-5558 | Fax: (410) 465-5257

There are many factors that affect the ability to detect a radiation source!

Why do you need radiation detectors ???

If you have radiation detectors, are they the best solution for your needs ???

If you have radiation detectors, is it time to upgrade/replace them ???

Contact

Bonnie Meilner
Regional Sales Manager
LAURUS Systems Inc.
3460 Ellicott Center Drive
Suite 101
Ellicott city, MD 21043
(410) 465-5558
bonnie.meilner@laurussystems.com

LAURUS SYSTEMS
Protecting People, Places and Property