Radioactive Materials

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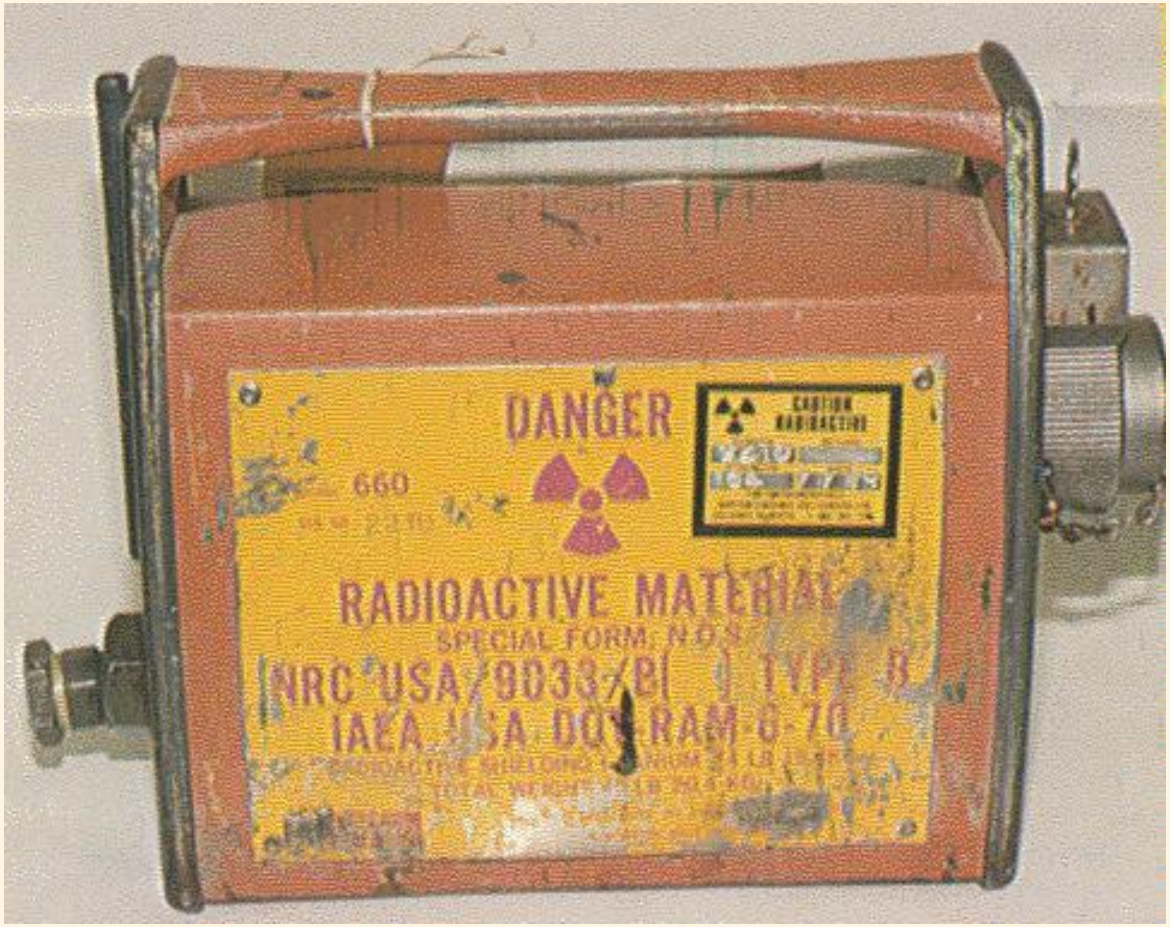
Radioactive Materials

- *Radioactive materials found in scrap and waste include:*
  - *Licensed Sources*
  - *Contaminated Biomedical Wastes*
  - *Consumer/Industrial Products*
  - *Historic Wastes*
  - *NORM Contaminated Materials*
  - *Radioactive Ores*

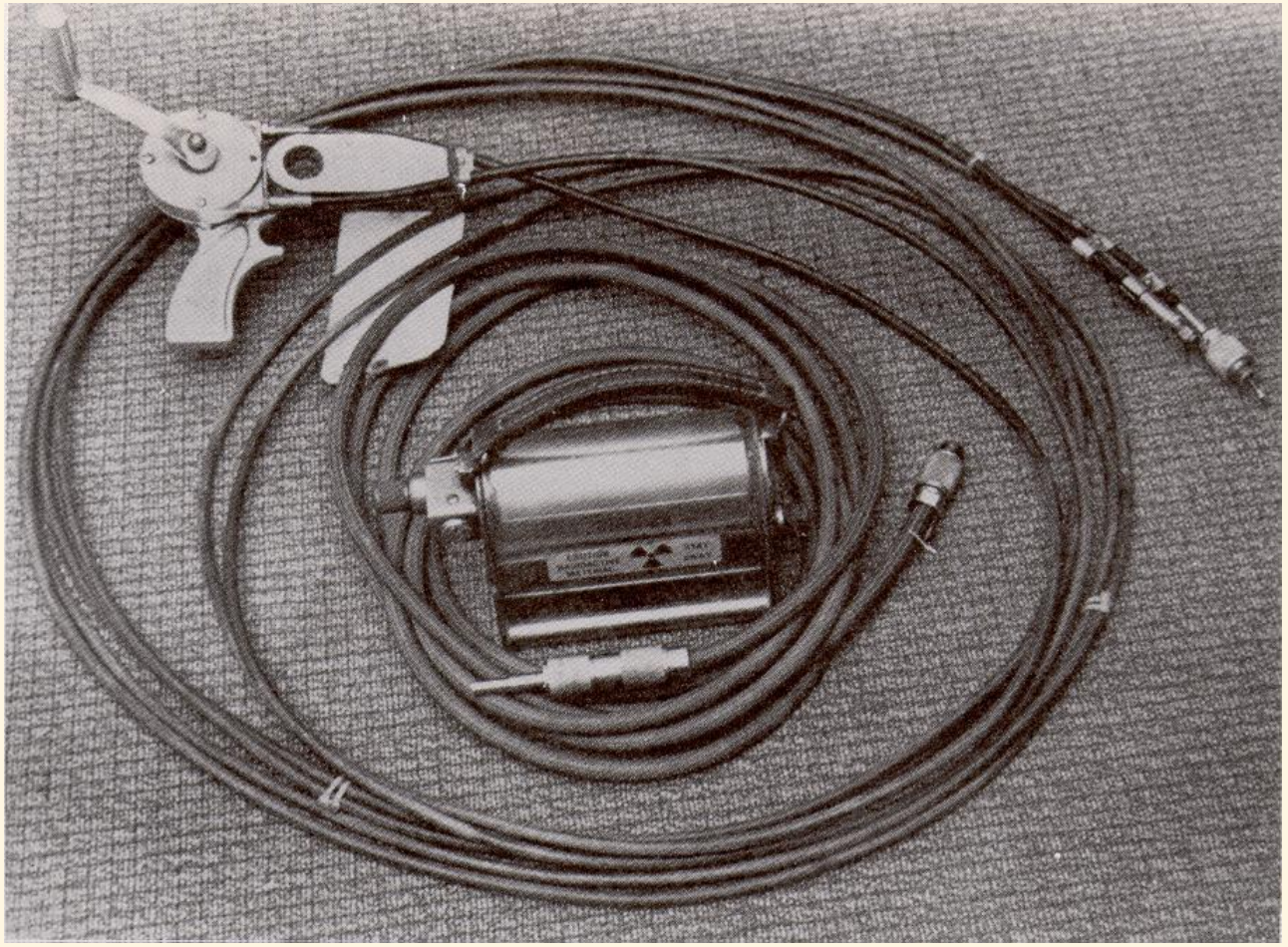
Licensed Sources

- *Licensed sources are occasionally discarded in waste or scrap - rare but potentially dangerous.*
- *Serious accidents that resulted in death have occurred in other countries (mostly third world).*
- *Most radiation accidents involve radiography cameras*

Radiography Cameras



Radiography Cameras



Industrial Gauges

Industrial Gauges

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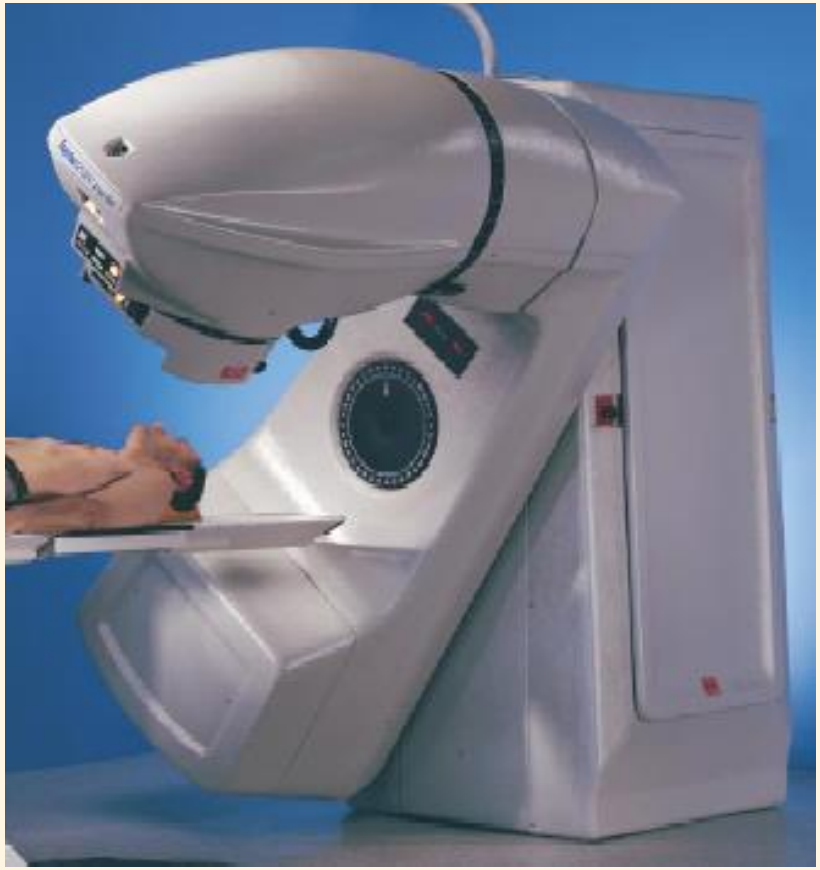
Medical Sources



Medical Sources

- *Cobalt-60 from radiotherapy machines is contained in a stainless steel capsule 3.7 cm high and 2.3 cm in diameter.*
- *Other medical sources include needles, spheres & discs - usually high specific activity gamma emitters (e.g.: Au-198, Ra-226) but sometimes Sr-90.*

Contaminated Biomedical Wastes

- *Radioactive materials are widely used in both diagnosis and treatment.*
- *Medical isotopes are generally short-lived beta/gamma emitters.*
- *Treatment generally involves much larger activities than diagnosis.*

Contaminated Biomedical Wastes

- *Radioactive material excreted from the body in urine, feces or perspiration can contaminate anything it contacts.*
- *Excrement from, or materials contaminated by persons undergoing treatment can contain a significant activity of radioactive material.*

Contaminated Biomedical Wastes

- *Common isotopes:*
  - *Technetium-99m (γ only, 6 hours)*
  - *Indium-111 ($\beta\gamma$, 2.8 days)*
  - *Thallium-201 ($\beta\gamma$, 3.0 days)*
  - *Gallium-67 ($\beta\gamma$, 3.3 days)*
  - *Iodine-131 ($\beta\gamma$, 8.0 days)*
    - *large activities are used in the treatment of Grave's Disease & other thyroid conditions*

Consumer/Industrial Products

- *Consumer & Industrial products that contain Naturally Occurring Radioactive Material include:*
  - *Refractory Materials*
  - *Smoke Detectors & Emergency Lights*
  - *Ceramic Glazes*
  - *Optical Lenses*
  - *Laboratory Reagents*

Consumer/Industrial Products

- *Refractory materials are heat-resistant materials (metals, brick, etc.)*
- *Usually contain thorium which has a very high melting point:*
  - *thoriated tungsten (welding rods, light bulbs)*
  - *thoriated magnesium (jet engines)*
  - *thoriated brick (steel mills, pottery kilns)*
  - *thoria or thorium oxide (gas lantern mantles)*

Consumer/Industrial Products

Consumer/Industrial Products

- *Smoke detectors sold in North America in recent decades contain Am-241 (European smoke detectors contain plutonium).*
- *Older model industrial smoke detectors contain Ra-226.*

Consumer/Industrial Products

Consumer/Industrial Products

- *Self-powered emergency lights contain tritium.*
- *Uranium glazes were used on ceramics from Roman-era to 1960/70s.*
- *Thorium fluoride is used in anti-reflective coatings on optical lenses.*
- *Uranium & thorium compounds are used in chemical laboratories (e.g.: uranyl nitrate, uranyl acetate, thorium nitrate).*

Historic Radioactive Materials

- *Historic wastes are materials used for their radioactive properties - they were not licensable when they were used but they would be licensable now.*
- *Radium-luminous dials (clocks, aircraft cockpit instruments) are the most common historic waste.*

Historic Wastes

NORM-Contaminated Metals

- *NORM is Naturally Occurring Radioactive Material.*
- *Usually alpha emitters like uranium, thorium or radium.*
- *NORM contamination occurs in many industries (oil & gas wells; natural gas pipelines; pulp & paper mills; petrochemical, fertilizer & phosphate plants).*

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Radioactive Ores

- *Rock, sand or soil containing radioactive ores may be found in waste but they are uncommon.*
- *One instance involved a bulk container that had been used to transport monazite sand - used to manufacture refractory brick.*

Questions