



# ***Benefits of Radiation in Every Day Life***



# *Beneficial Uses of Radiation*

- Medical Diagnoses and Treatment
- Research Applications
- Industrial/Manufacturing Applications
- Food Irradiation
- Consumer Products/Safety and Security
- Spacecraft Power Supply
- Electric Power Generation



# *Medical Uses*

## ■ Diagnostic

- Generally low doses
- Short-time exposures

## ■ Therapeutic

- Generally high doses
- Short to long time exposures



# *Diagnostic Uses*

- X-radiation
  - Radiographs
  - Fluoroscopy
  - CT scan
- Nuclear Medicine



# *X-Radiation: Radiographs*

- Short time exposures (much less than a second)
- Low doses
  - Dental: 0.08 - 0.10 mSv (8 - 10 mrem)
  - Chest: 0.06 - 0.10 mSv (6 - 10 mrem)
  - Mammogram: 0.3 - 0.5 mSv  
(30 - 50 mrem)
  - Hip: 0.4-0.8 mSv (40-80 mrem)



# *X-Radiation: Fluoroscopy*

- Long time exposures  
(minute or longer)
- Higher doses
  - Barium Enema: 6 - 9 mSv (600 - 900 mrem)
  - Upper GI: 3.5 - 5.5 mSv (350 - 550 mrem)



# *X-Radiation: CT-Scan*

- Series of short exposures at different angles
- Computer analysis and display
- Gives cross-section view of anatomy
- Medium doses:
  - Head: 2 - 3 mSv (200 - 300 mrem)
  - Body: 3 - 4 mSv (300 - 400 mrem)

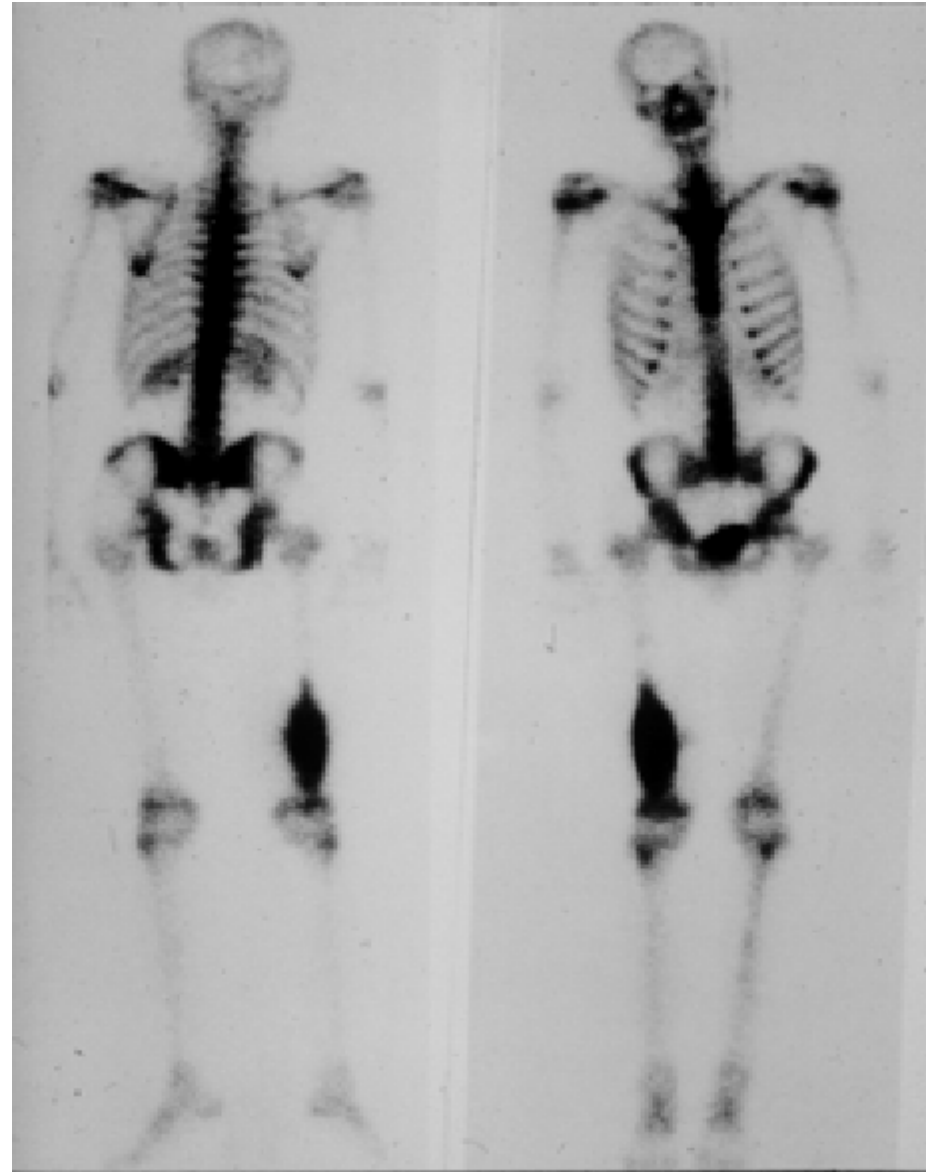


# *Nuclear Medicine*

- Radioactive material injected into the patient
- Gamma radiation detected to give image - computer analysis
- Used to:
  - Locate tumors
  - Determine organ function



# Skeletal Scan of Person After a Tc-99m nuclear Medicine Injection





# *Therapeutic Uses*

- Radiotherapy (Direct radiation beam)
  - Gamma rays
  - Electron beams
  - X-radiation
- Brachytherapy (Radiation from internally deposited radioactivity)
  - Removable seeds (long half-life)
  - Permanent seeds (short half-life)



# *Therapeutic Uses (Continued)*

- Internal Unsealed Sources
  - Biological uptake (Iodine)
  - Direct injection
- Very High Local Doses for Therapeutic Uses
  - 50 to several hundred Sieverts, depending on the type, location, and size of the tumor



Therapy  
Machine  
used for  
Targeting  
Cancerous  
Tissue





# *Characteristics of Ideal Brachytherapy Radionuclides*

- Half life should not cause extended stay in hospital
- Radioisotope should emit alpha or beta radiation
- Radioisotope should also emit gamma rays to ensure targeted area is treated



# *Characteristics of Ideal Therapeutic Radionuclides*

- Half life should not cause extended stay in hospital
- Radioisotope should emit alpha or beta radiation
- Radioisotope should also emit gamma rays to ensure targeted area is treated



# *Research Use*

- Biological and Genetic research
- Agricultural research
- Space research
- Pharmaceutical research



# *Manufacturing Testing and Measurements*

- Monitor thickness of materials during production
  - Sheet metal, aluminum foil
  - Newspaper
- Measure wear on cutting/drilling tools
- Other measurements
  - Amount of glue on postage stamp
  - Level of liquid in canned beverages



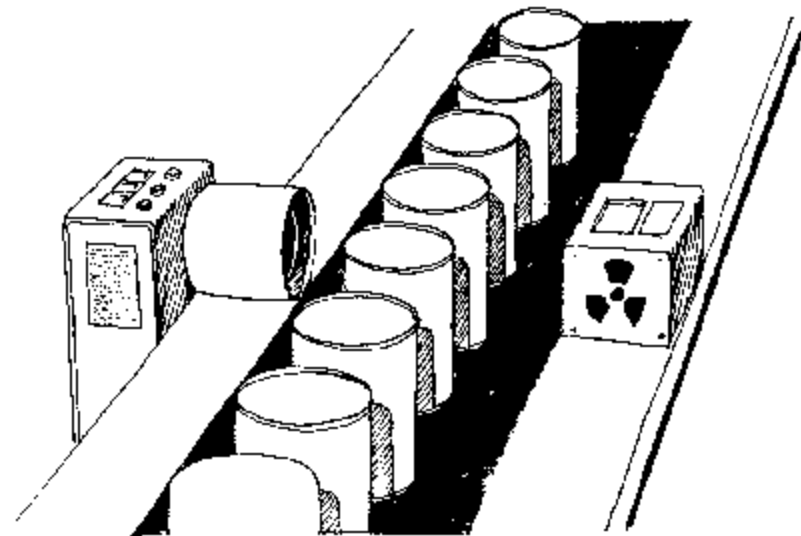
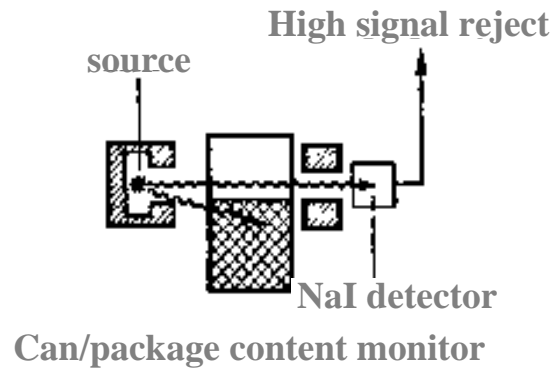
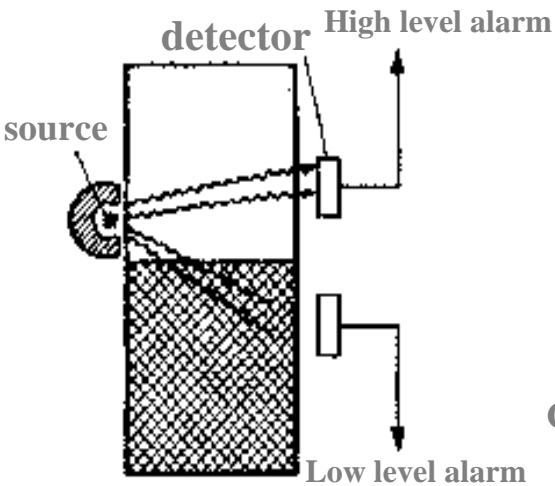
# *Industrial Use*

- Well logging
- Moisture/density gauges
- Radiography
- Sterilization
  - Medical instruments
  - Cosmetics
  - Food/Spices



# Level Gauge

## Gamma Switching Technique

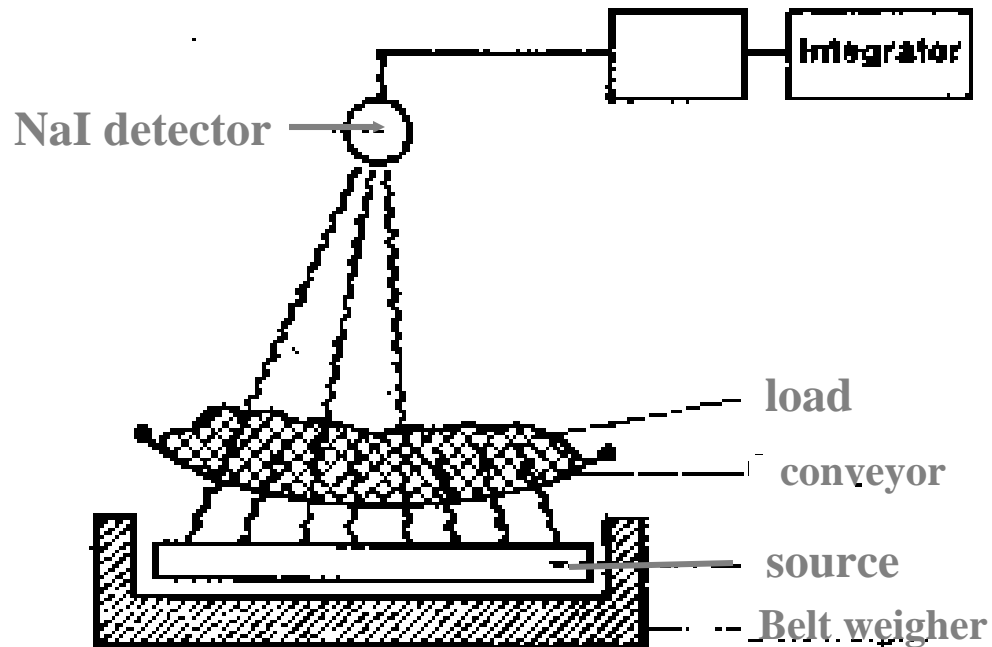


Storage hopper level control



# Thickness Gauge

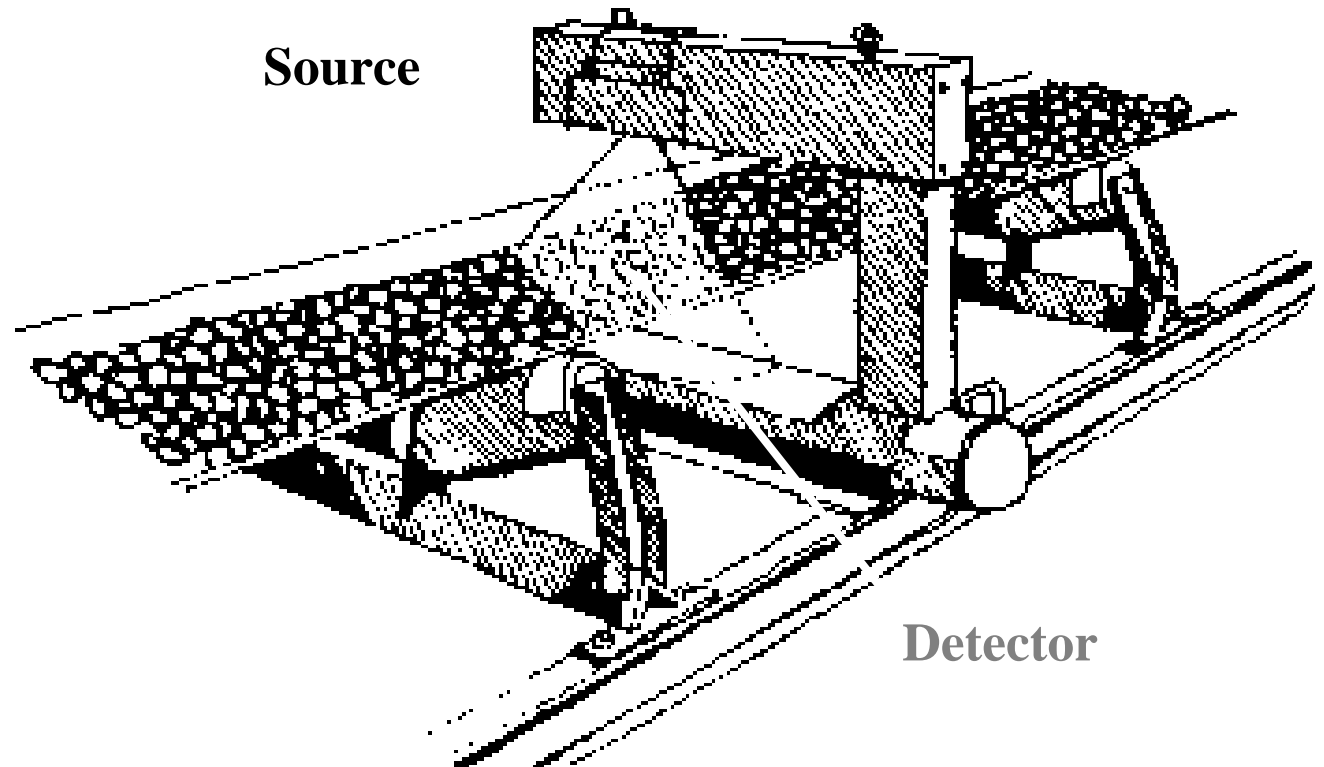
## Transmission Thickness Technique





# Thickness Gauge

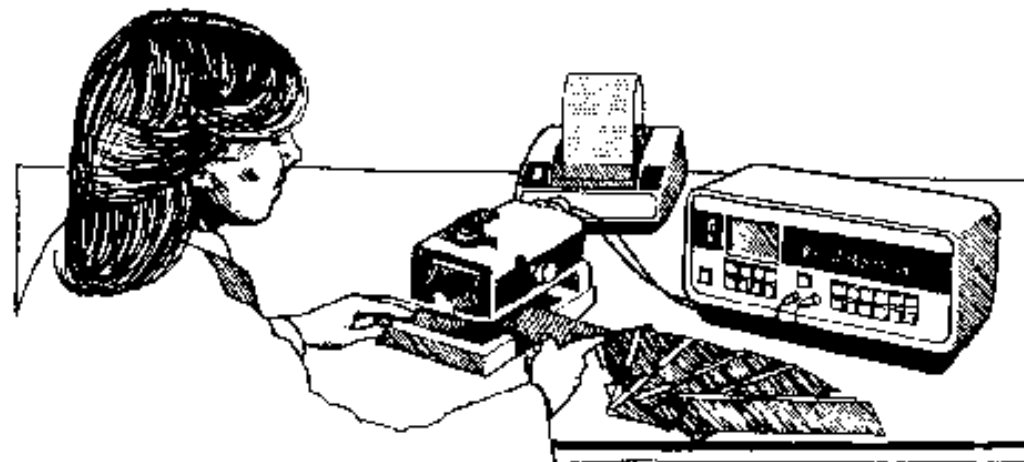
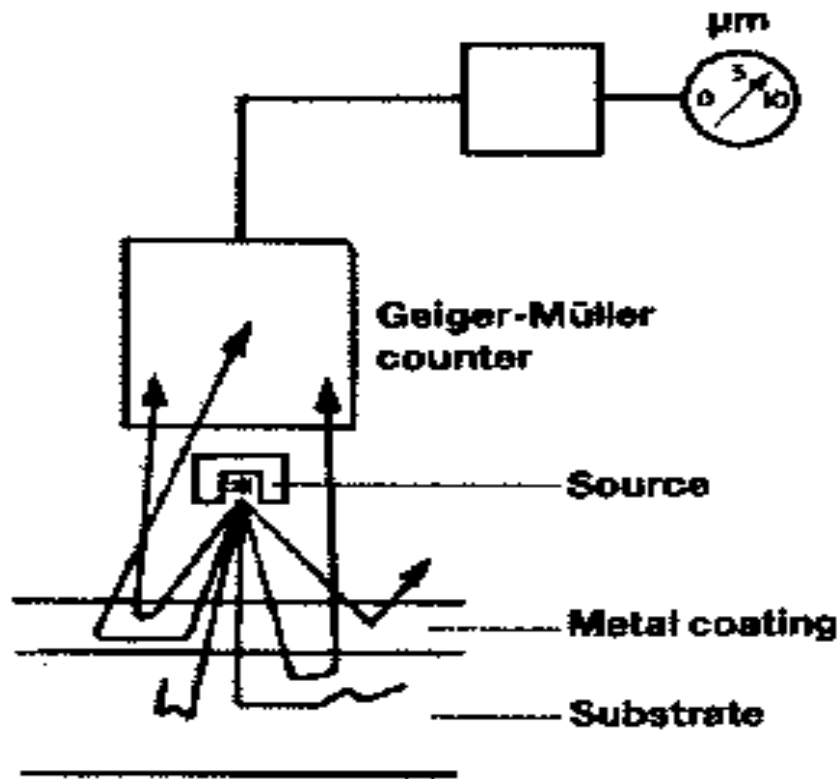
*Non-contact measurement and control of liquids, solids or slurry pipelines. Specific source size is selected for each application. This is also referred to as gamma gauging or belt weighing.*





# Thickness Gauge

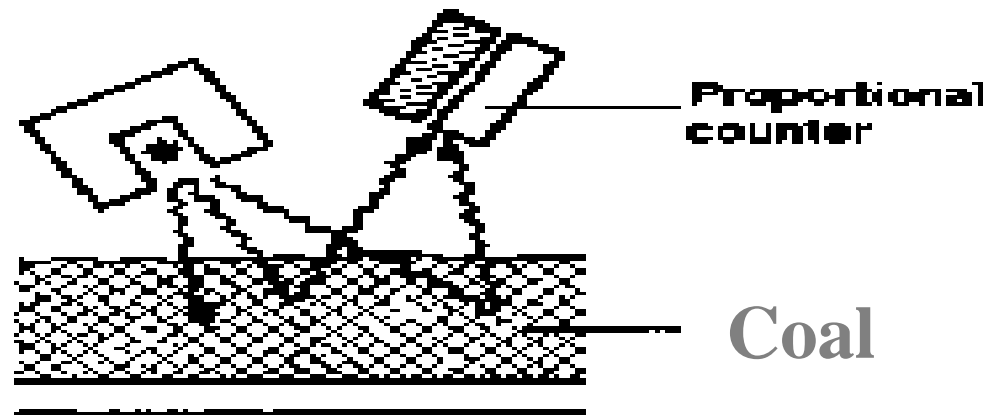
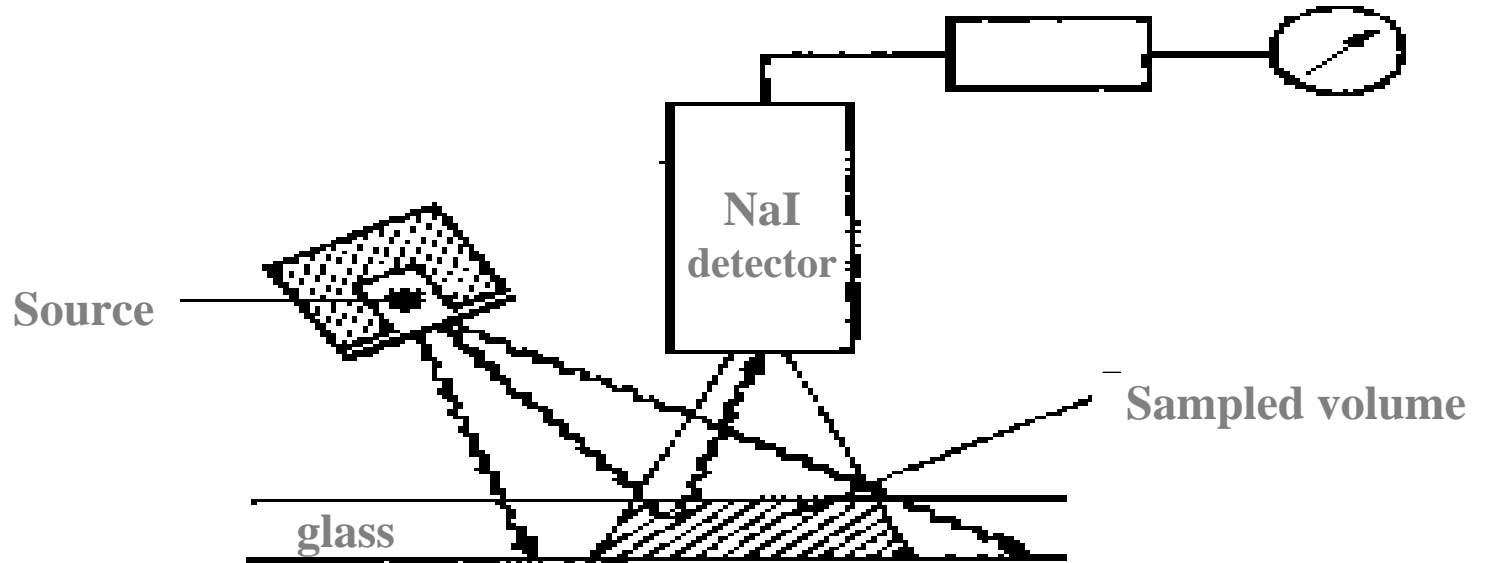
## Beta backscattering technique





# Thickness Gauge

## Gamma Backscattering Technique





# *Food Irradiation*

- Food treatment comparable to pasteurization
  - Kills pests/microorganisms without food degradation
  - Controls sprouting
- Does not make the food radioactive
- FDA Approved
- Must be labeled





# *Consumer Products Safety and Security*

- Smoke Detection Equipment
- Self-powered Lighting in Exit Signs
- Lighted Aircraft Instrumentation
- Pharmaceutical Detection
- Bomb/Weapons Detection
- Scanning and Surveillance Equipment
- Theft Deterrent Systems



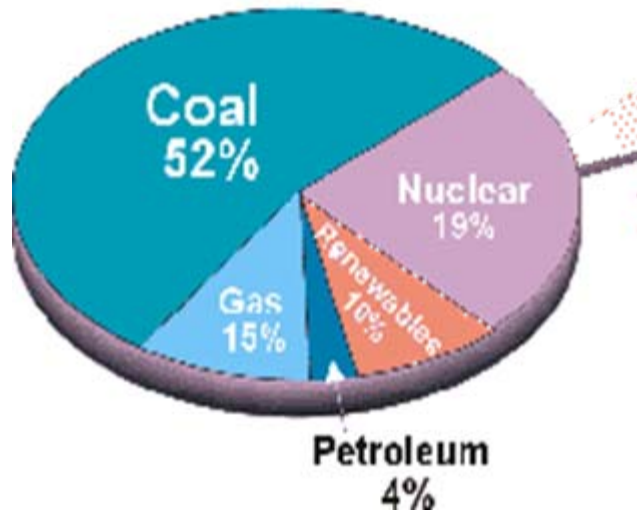
# *Spacecraft Power Supplies*

- Small radioactive sources have provided heat and electrical power for space probes for decades
- Radioactive power supplies have allowed space craft to explore the outer solar system, too far from the sun for solar panels to be effective



# *Electric Power Generation*

**1998**  
3,618 Billion Kilowatthours



- Nuclear Power supplies about 20% of the country's electric power
- Unlike fossil fuels, nuclear power does not release greenhouse gasses