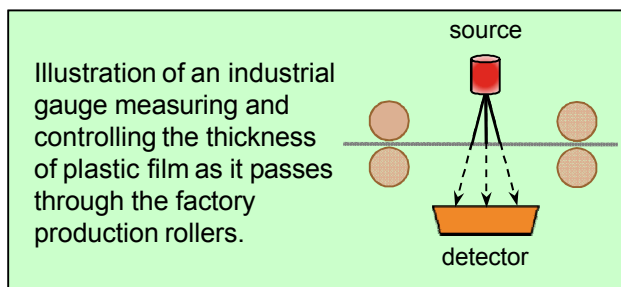


## Typical Industrial Uses

- Gamma **radiography** for examining various structures ( $^{60}\text{Co}$ ,  $^{192}\text{Ir}$ ,  $^{75}\text{Se}$ )
- Diagnosis, imaging, and treatment of **medical conditions** ( $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{67}\text{Cu}$ ,  $^{67}\text{Ga}$ ,  $^{123}\text{I}$ ,  $^{125}\text{I}$ ,  $^{131}\text{I}$ ,  $^{90}\text{Sr}$ ,  $^{99\text{m}}\text{Tc}$ ,  $^{201}\text{Tl}$ ,  $^{133}\text{Xe}$ )
- Gamma **sterilization** of medical supplies and food ( $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ )
- Characterizing the potential of underground **gas and oil wells** ( $^{241}\text{Am/Be}$ ,  $^{137}\text{Cs}$ ,  $^{244}\text{Cm}$ ,  $^{24}\text{Na}$ )
- Production of **nuclear power** ( $^{235}\text{U}$ )
- **Gauging** of plastic film, paper, and sheet metal thickness ( $^{241}\text{Am}$ ,  $^{85}\text{Kr}$ ,  $^{147}\text{Pm}$ ,  $^{90}\text{Sr}$ ,  $^{204}\text{Tl}$ )
- Measuring **depth, flow, density and leakage** of wet and dry materials ( $^{241}\text{Am}$ ,  $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{24}\text{Na}$ )
- **Moisture/density** measurement in roads and other construction ( $^{241}\text{Am/Be}$ ,  $^{252}\text{Cf}$ ,  $^{137}\text{Cs}$ )
- Monitoring the **location, flow, and dispersion** of hazardous waste, sewage, and water ( $^{198}\text{Au}$ ,  $^3\text{H}$ ,  $^{99\text{m}}\text{Tc}$ )
- Measuring **flow, erosion, and deposition** in rivers and oceans ( $^{137}\text{Cs}$ ,  $^{57}\text{Cr}$ ,  $^{198}\text{Au}$ ,  $^{99\text{m}}\text{Tc}$ )

## Industrial Gauging

Radioactivity can be reduced or blocked by various materials. This property is very useful for making measurements. A radioactive gauge can measure quantity in a silo or flow through a pipe. Gauges are able to accurately measure the thickness of paper, sheet metal, or plastic film during production. Density gauges measure compaction and density of road base and asphalt construction.



First fold out here.

Next fold out here.

## Trace Monitoring

Many natural and industrial processes are monitored by detecting very small amounts of tracer radioactive material. Injected into a flowing source, a tracer can identify pollution dispersion in the ocean, flow rate of a river, or deposition patterns for sediment. Tracers can show the extent of equipment wear, or the location of a tiny leak in a pipeline. The tracer is chosen with a half-life sufficient for the test, but short enough to leave no lasting impact.

## A Guide to Industrial Isotopes

SAND2011-2266P

Developed by the  
DHS Secondary Reachback Program  
March 2011

From the gas in our cars, to the bridges we cross, the food in our kitchen and the newspaper we read; our lives are influenced by radioactive isotopes used in industry.



Common household smoke detectors, using a small quantity of  $^{241}\text{Am}$ , constitute the largest number of radioactive devices worldwide.

Transparently to most people, radioisotopes increase our safety, health, efficiency, and prosperity.

Joint Analysis Center (JAC)  
24-hour Technical Assistance HOTLINE: 877-363-6522  
Email : [dndo.jac@hq.dhs.gov](mailto:dndo.jac@hq.dhs.gov)

## Industrial Irradiation

Medical devices such as syringes, instruments, and gloves are irradiated to ensure sterility. The medical industry accounts for half of all industrial irradiation. These irradiators are typically large, non-portable systems.



For more than 50 years,  $^{60}\text{Co}$  has been used to irradiate food to kill bacteria and parasites, thus enhancing safety and inhibiting spoilage. Candidates include fresh fruit, spices, grains, vegetables, meat, poultry, and shellfish.

Other uses include sterilization of cosmetics and pharmaceuticals, tire fabrication, and plastics processing to increase durability. Pest insect infestations can be eradicated or reduced by releasing radiation-sterilized males into the environment, to mate without producing offspring.

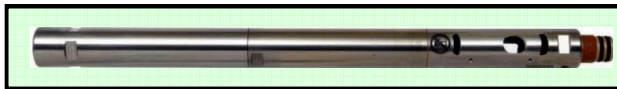
### Nuclear Medicine

Isotopes used in medical diagnosis, imaging, and treatment are described in a separate pamphlet entitled **"A Guide to Nuclear Medicine."**

## Industrial Logging



Well logging is a common and crucial practice in the oil and gas drilling industry. Gauges use radioactive isotopes (frequently  $^{241}\text{Am}$  or  $^{137}\text{Cs}$ ) to measure key underground properties such as rock type, water and hydrocarbon content, density, and porosity. These measurements are taken during drilling operations, or by lowering the measuring device into an existing well casing.



A fluid density gauge (approximately 2 feet long) that uses gamma rays from an  $^{241}\text{Am}$  source to measure fluids while logging. These portable gauges are common in oil producing areas.

Courtesy of Sondex

### Nuclear Waste

The classification, storage, transportation, and hazards of radioactive waste are described in a separate pamphlet entitled **"A Guide to Nuclear Waste."**

## Industrial Radiography

Radiographs (similar to dental x-rays for people) use gamma rays to show defects in welds, materials, and structures that might otherwise be difficult or impossible to detect. Pipelines, bridges, and steel reinforced structures are among the many beneficiaries.



A remotely controlled pipeline crawler. The device drives through the pipe to the proper position, retracts the shielding material to expose film outside the pipe, then moves on to the next weld.

Courtesy of MDS Nordion

$^{192}\text{Ir}$  and  $^{60}\text{Co}$  are the isotopes most frequently found in radiography equipment. Both fixed and portable systems are commonly used to perform radiographic inspections.

### Nuclear Power

The isotopes and operations of the nuclear power industry are described in a pamphlet entitled **"A Guide to Nuclear Power."**