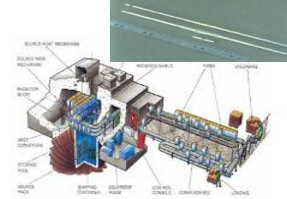


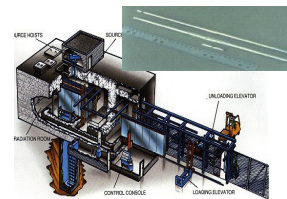
CATEGORY 1 QUANTITIES - COMMON APPLICATIONS



Gamma Irradiation: Sterilizes medical supplies/equipment to prevent the spread of disease. Medical product is irradiated in its final container, assuring product is sterile until opened. Typically 24/7 operations. FDA and NRC approved.
Co-60 – typical facility has 500-600 pencils - 7,000-11,000 Ci each



Food Irradiation: Food, spices, and drink containers are sterilized to improve food safety; prevent illnesses, outbreaks, recalls; extend shelf life; kill insects. Leaves no chemical residues on product. FDA and NRC approved.
Co-60 – typically facility has 500-600 pencils - 7,000-11,000 Ci each



Cancer Treatment: External Beam Radiation Therapy or Stereotactic Radiosurgery (e.g., GammaKnife®), radioactive material used to kill cancerous tissue and reduce tumor size. Reaches inoperable areas of the brain and spine. FDA and NRC approved.
Co-60 – typically 201 sources per device – 30 Ci each



Agriculture: Sterile insect technique, used in agricultural applications to control insect populations that threaten livestock, fruit, vegetables and fiber crops. Sterile insects do not breed. USDA and NRC approved.
Co-60 or Cs-137 – depends on facility size – multiple sources up to 50,000 Ci total



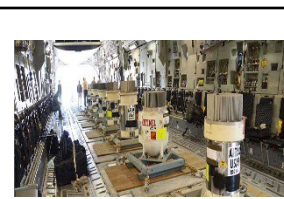
Blood Supply: Blood irradiators, irradiate blood for immunocompetent or immunocompromised patients to prevent Graft-Versus-Host Disease, which is fatal. FDA and NRC approved.
Cs-137 – devices can range from 600 – 3,000 Ci (depends on facility throughput needs)



Research: Research irradiators, used to expose biologic and non-biologic materials to radiation to evaluate the response of the target materials. Also used to evaluate electronic and satellite components. Typically used at educational and medical institutions. NRC approved.
Co-60 or Cs-137 – devices can range from 400 – 3,000 Ci



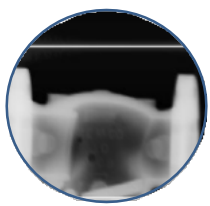
Power Source: Radioisotope Thermoelectric Generator (RTG), used as a power source for unmanned remote arctic facilities, and in space applications. In the U.S., RTGs using Sr-90 are only used by the DOD, those using Pu-238 are used by NASA.
Sr-90 – RTGs range from 50,000 Ci to 200,000 Ci



Cancer Treatments: Globally, teletherapy devices are used to deliver an external source of radiation to treat deep seated cancerous tumors. Teletherapy (human) has been replaced by linear accelerator (LINAC) devices in the U.S. A few units exist in the U.S., typically used for veterinary applications.
Co-60 or Cs-137 – devices can contain up to 10,000 Ci



CATEGORY 2 QUANTITIES - COMMON APPLICATIONS



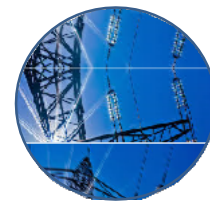
Fixed Radiography: Nondestructive testing method for inspecting materials for hidden flaws. Similar to how X-ray technology is used to check for broken bones. On portable specimens, radiography is conducted within a shielded vault at a fixed facility.

Ir-192 ~ 100-150 Ci per device, Co-60 ~ 100-300 Ci per device



Portable Radiography: Nondestructive testing method for inspecting materials for hidden flaws. Portable radiography devices are used to verify structural integrity in a wide variety of field conditions, e.g. pipelines, buildings, tanks, oil platforms, etc.

*Ir-192 ~ 100 -150 Ci per device, Co-60 ~ 100-300 Ci per device
Se-75 ~ 150 Ci per device, Yb-169 up to 81 Ci (category 3)*



Calibrator: This device uses radiation sources of a known intensity for calibration of radiation monitoring equipment and dosimeters.

*Co-60 – up to 200 Ci per device
Cs-137 – up to 20 Ci per device*



CATEGORY 3 QUANTITIES – COMMON APPLICATIONS



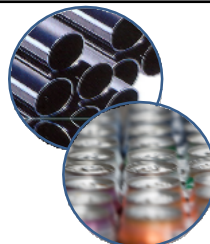
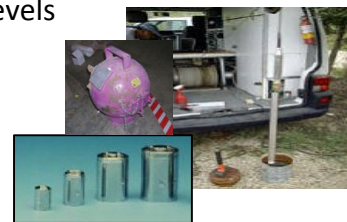
Cancer Treatments: High-dose rate brachytherapy is a type of internal radiation therapy that delivers radiation from implants placed close to or inside the tumors in the body through a catheter. At the end of the treatment cycle, the sources are retracted back into the device or remain in the patient.

Ir- 192 – multiple sources up to 14 Ci total



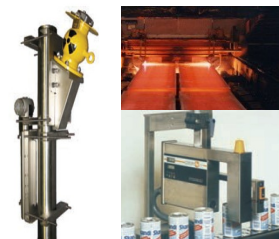
Petroleum Industry: A well-logging source, measures hydrogen levels in rock strata around the bore hole of an oil well by backscatter measurement. This measurement, combined with others, give an indication of the presence of hydrocarbons.

Am/Be – typically ~15.8 Ci



Production Lines: A radioactive measuring system to determine: the level or transmission in a tank or line; the backscatter of a beam of radiation passing through a thickness; or the amount of water in a material passing through a system.

Cs-137 ~ 10 Ci, Co-60 ~1 Ci, Am/Be ~3 Ci



Pacemaker: Around 1979, pacemakers were designed with a Pu based battery. These pacemakers were soon obsolete and replaced by the development of lithium battery based pacemakers. A very small population of patients with this pacemaker are still alive. Upon death, the pacemaker is removed from the patient and disposed.

Pu – pacemaker typically contained 3 Ci



Radionuclide	Category 1, 2, and 3 Thresholds					
	NRC - 10 CFR Part 37 and Parts 20, 30-36, and 39, as appropriate				NRC - 10 CFR Part 20 and Parts 30-36, 39 as appropriate	
	Cat 1		Cat 2		Cat 3 (and lower)	
	TBq	Ci	TBq	Ci	TBq	Ci
Am-241 (Be)	60	1,620	0.6	16.2	0.0006	1.6
Cf-252	20	540	0.2	5.40	0.0002	0.5
Cm-244	50	1,350	0.5	13.5	0.0005	1.4
Co-60	30	810	0.3	8.10	0.0003	0.8
Cs-137	100	2,700	1	27.0	0.001	2.7
Gd-153	1,000	27,000	10	270	1.00	27
Ir-192	80	2,160	0.8	21.6	0.08	2.2
Pm-147	40,000	1,080,000	400	10,800	40.00	1,080
Pu-238	60	1,600	0.6	16.2	0.06	1.6
Pu-239 (Be)	60	1,600	0.6	16.2	0.06	1.6
Ra-226	40	1,080	0.4	10.8	0.04	1.1
Se-75	200	5,400	2	54.0	0.20	5.4
Sr-90 (Y-90)	1000	27,000	10	270	1.0	27
Tm-170	20,000	540,000	200	5,400	20.00	540
Yb-169	300	8,100	3	81.0	0.30	8.1
						All other radioactive materials