Health Physics Society
Public Education Committee
Fact Sheet

MEASURING RADIOACTIVITY

Because ionizing radiation cannot be detected with our human senses, we use various types of instruments and radiation detectors to measure the amount of radiation present. We usually measure both the amount of radioactivity in a radioisotope source, and the ionizing radiation field density being emitted by the source.

We define radioactivity as the number of atoms which decay (disintegrate) in a radioisotope sample in a given period of time. The base unit is the Becquerel (Bq) or one disintegration per second (dps). This number is very small and therefore, not very useful. For this reason we use the Curie (Ci) which is 37 billion Bq. Because we often use very large or very small numbers when discussing radioactivity, we use a series o f prefixes which express multiples of 1000. The following table shows some of these prefixes:

milli (m) = 1/1,000	kilo (k) = times 1,000
micro (u) = 1/1,000,000	mega (M) = times 1,000,000
nano (n) 1/1,000,000,000	giga (G) times 1,000,000,000
Pico (P) 1/1,000,000,000,000	tera (T) times 1,000,000,000,000

Using the table, a mCi = 1/1000 of a Curie and a GBq
1,000,000,000 Becquerels. To put this in perspective, a normal home smoke detector contains a small sealed source of about 10 uCi (370,000 Bq) of radioactivity.

Ionizing radiation fields are expressed in units of Roentgens (R) which is equivalent to the number of atoms of a gas which are ionized. Radiation fields are usually expressed as R/hour or R/minute, called an exposure rate. To obtain an exposure you multiply the exposure rate by the time of exposure. For example, if you have an exposure rate of 50 mR/hr and are exposed for 3 hours, your exposure would be 150 mR.

When ionizing radiation penetrates a substance, whether it is living or non-living matter, it deposits energy in that matter. We use the rad (roentgen absorbed dose) or the Gray (Gy) to express this absorbed dose (1 Gy = 100 rads). For most types of radiation, the rad is equivalent to the Roentgen.

When a dose of radiation is absorbed in human tissue, a biological effect may be produced. The size of this effect depends on the type and energy of the ionizing radiation which is absorbed. Health Physicists use a "quality factor" to weight the radiation's ability to do biological damage. Multiplying the absorbed dose by the quality factor gives the dose equivalent which is the

biological damage done by the radiation. The unit of dose equivalent is the rem (roentgen equivalent man) or the Sievert (Sv) (1 Sv = 100 rem).

The average background radiation dose equivalent for persons living in the United States is about 360 mrem from natural radioisotopes and medical applications. The allowed radiation dose equivalent for occupational exposed persons in the United States is 5000 mrem to their whole body.