

Ionizing Radiation

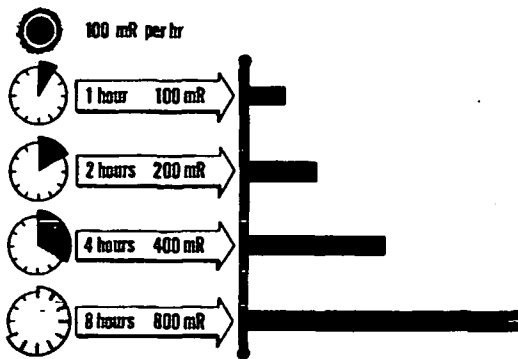


FIG 44-17 — The effect of time on radiation exposure is easy to understand. If we are in an area when the radiation level from penetrating external radiation is 100 mR/hr, then in 1 hr we would get 100 mr (millirems). If we stayed 2 hr, we would get 200 mr, and so on.

From U.S. Atomic Energy Commission,
"Living With Radiation, Part I—Fundamentals"

Functions of a Radiation Safety Staff

A radiation safety program must be concerned with establishing safe working distances, detecting and measuring radiation, making surveys, decontamination, laboratory and other special services, and record-keeping.

Establishing safe distance and times

Work involving external sources of radiation is often done where permanent barriers and shielding protect personnel from harmful exposure. But it is possible that certain operations may occasion some exposure of employees. In these cases, all unnecessary subjection to radiation should be avoided, even to the extent of barring personnel, including technicians, from active areas during exposure time, such as during use of X-ray equipment (see Fig 44-20).

Maintaining a safe distance is especially critical for employees who must work near portable sources of radiation or inadequately shielded nonportable sources. (See Fig 44-21.) In such cases, a radiation survey should be made with an appropriate survey meter by a qualified health physicist or technician in order to provide information to establish minimum safe distances that per-

sonnel must abide by.

A safe distance is the distance nonoperating personnel must maintain from the radiation source in order to receive no more exposure than that specified in the Radiation Protection Guides even if personnel were to remain *at that distance* continually (see previous discussion under "Regulation and Controls"). The distances specified for a given job may not necessarily remain constant if the radiation in use is modified.

Hazardous areas indicated by the protection survey must be barricaded or roped off to form a restricted section which must not be entered by nonoperating personnel or bystanders. Large signs bearing the standard radiation symbol, and worded in accordance with 10-CFR-20, should be posted.

Shielding*

The radiation level from a source is reduced by a factor of 1 divided by the square of the distance placed between a worker and the source.

If the radiation level is 10 roentgen per hour (R/hr) at a distance of 1 foot from a source and you move 2 feet away, the radiation level will drop by a factor of $\frac{1}{2}^2$ or $\frac{1}{4}$ (0.25 R/hr). If you move 3 ft away the level will be reduced by a factor of $\frac{1}{3}^2$ or $\frac{1}{9}$.

Thus, by simply putting 3 ft of space between a worker and the source, the radiation level has reduced a factor of almost ten.

Shielding is commonly used to protect against radiation from radioactive sources. The more mass placed between a source and a person, the less radiation the person will receive. If the mass is concentrated, as in lead, the barrier thickness required for the same degree of protection will be less than it would be for a less dense material such as packed earth.

This introduces another important term—half value layers (HVL). Tables of HVL are given in radiation handbooks and typical values for two radioactive materials, cobalt-60 and cesium-137, are given in this table.

	Cobalt-60	Cesium-137
Lead	0.49 in	0.25 in
Copper	0.83	0.65
Iron	0.87	0.68
Zinc	1.05	0.81
Concrete	2.6	2.1