Five basic safety factors

Ionizing radiation can be a complex subject At the risk of over-simplifying some basic physical principles and ignoring others, the purpose of this chapter is to present enough information so the safety professional will realize the problems involved and know when to call upon radiation safety experts for help

There are at least five basic factors that must be considered in such an approach to radiation safety

- Radioactive materials emit energy which can damage living tissue

- There are five different kinds of radioactivity and there must be an understanding of their characteristics in order to recognize safety problems The types of ionizing radiation with which we will be concerned are alpha, beta, X radiation (X ray), gamma, and neutrons

- Radioactive materials can be hazardous in two different ways Certain types can be hazardous even when located some distance away from the body These are *external* hazards Other types are hazardous only when they get inside the body by virtue of breathing, eating, or through broken skin These are referred to as *internal* hazards

- Tools are available for evaluating possible radiation hazards Meters or other devices are used for measuring radiation levels and estimating doses

- Specific guides and reference books

Need for concern

The first factor makes it necessary for people to be concerned about ionizing radiation The fact that at the time of exposure to ionizing radiation an individual is unable to sense the absorption of energy, with its related tissue damage, seems to give the hazard a mysterious quality which is frightening to some people This is unfortunate because many radioactive materials are far less hazardous to handle and use than is, for example, the family automobile

Nevertheless, radioactive materials emit energy in the form of one or more of the five types of radiation noted previously This energy, when absorbed by living tissue, produces damage by a process called ionization

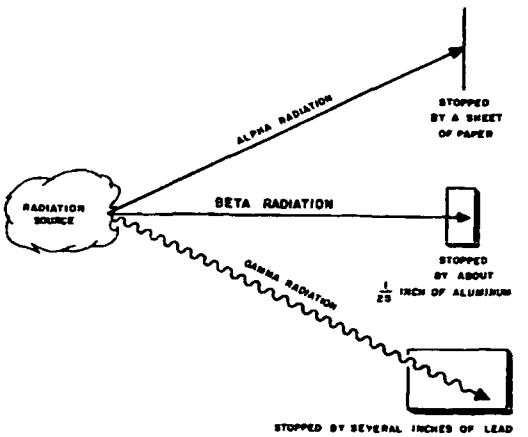

FIG 37–9 —The penetrating power of alpha, beta, and gamma radiation

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To understand a little about ionization it is necessary to recall that the body is made up of various chemical compounds which are in turn composed of atoms Each atom has a nucleus with its own outer system of electrons

When ionization occurs, some of the electrons surrounding the atoms are forcibly ejected from their orbits The greater the exposure to ionizing radiation, the more electrons displaced, and the more the physical damage to the cells containing the atoms that have lost electrons Incidentally, this is the reason why this type of radiation is referred to as "ionizing radiation"

Light from the sun is very similar to X ray and gamma radiation, differing only in wavelength and energy content (Fig 37–8) However, the sun's energy levels are too low to disturb orbital electrons and consequently light is not referred to as ionizing, even though it has enough energy to cause severe burns over a period of time

The exact mechanism of the manner in which ionization affects body cells and tissue is complex However, just as with a moving automobile, radioactive materials possess en-