10.1. Introduction

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WARNING. In this section, the main objectives of protection from ionizing radiation will be discussed and such information as may be necessary for the interpretation of legal documents relating to radiation protection will be given. The material contained herein is drawn from a wide variety of sources but principally from Vol. 26 of the International Commission on Radiological Protection (1977) (ICRP, 1977) and Part 4 (AS-2243/4) of the Standards Association of Australia (1979).

It must be stressed that the recommendations made here have no legal force, nor indeed do either ICRP-26 or AS-2243/4. The precise legal requirements will be stipulated in government legislation and by the regulations pertaining to the laboratory in which the researcher is working.

Notwithstanding the legal requirements, a moral requirement exists for the operator of a laboratory involved in research with ionizing radiation to be aware of the dangers involved, and to take such steps as are necessary to ensure that both he* and his workers are fully educated in the protective measures to be taken to preserve their own safety.

In Vol. III of *International Tables for X-ray Crystallography*, Cook & Oosterkamp (1968) restricted their discussions, in the main, to the effects of X-rays and neutrons. However, with the increasing use of Mössbauer and other γ-ray techniques in crystallography and the development of nuclear magnetic resonance techniques involving the orientation of (radioactive) nuclei (NMRON), the scope of this chapter will be necessarily more general than that of *IT* III (1968).

Finally, since this chapter can have only an advisory nature and the final arbiter is the legislation of the state and local authority concerned, a list of countries that are known to have legislation concerning radiation protection is given in Table 10.3.1. Also shown in the table is the law under which control is effected and the authority responsible under the act for the implementation of radiation safety procedures. This list results from the return of questionnaires sent to all countries and is believed to be correct as of 1 October 1997.

10.1.1. Definitions

10.1.1.1. *Ionizing radiation*

Ionizing radiation is defined as radiation that by its nature and energy has the capacity to interact with and remove electrons from (*i.e.* ionize) the atoms of substances through which the radiation passes. Sufficiently energetic radiations may cause permanent changes in the nuclei of the atoms of the substance. Radiation may be propagated in the form of electromagnetic radiation (X-rays and γ-rays) or particles (β and α particles, neutrons, protons, and other nuclear particles).

In the list of definitions that follows SI units will be used. The relation between these SI units and the earlier system of units is given in Table 10.1.1.

10.1.1.2. *Absorbed dose*

The energy per unit mass imparted to matter by ionizing radiation at the place of interest [SI unit = gray (Gy)].

Table 10.1.1. *The relationship between SI and the earlier system of units*

Quantity	SI	Earlier
Absorbed dose [gray (Gy = J kg^{-1})]	1 J kg^{-1} 0.01 J kg^{-1}	100 rad 1 rad
Activity [becquerel (Bq = s^{-1})]	1 Bq 3.7 $\times$ 10^{10} Bq	2.7 $\times$ 10^{11} Ci 1 Ci
Dose equivalent [sievert (Sv = J kg^{-1})]	1 Sv 0.01 Sv	100 rem 1 rem
Exposure	1 C kg^{-1} 2.58 $\times$ 10^{-4} C kg^{-1}	3876 R 1 R

10.1.1.3. *Activity*

The number of nuclear transformations per unit time occurring in a radionuclide.

10.1.1.4. *Adequate protection*

Protection against ionizing radiations such that the radiation doses received by an individual from internal or external sources, or both, are as low as reasonably achievable and do not exceed the maximum levels given in Table 10.1.2.

10.1.1.5. *Background (radiation)*

Ionizing radiation other than that to be measured, but which contributes to the quantity being measured.

10.1.1.6. *Becquerel (Bq)*

The SI unit of activity 1 Bq corresponds to one nuclear transformation per second. It replaces the curie (Ci).

10.1.1.7. *Designated radiation area*

An area where the occupational exposure of personnel to radiation or radioactive material is under the supervision of a designated radiation safety officer.

10.1.1.8. *Dose equivalent*

Product of absorbed dose and quality factor (Subsection 10.1.1.24). This enables the dose received by individuals to be expressed on a scale common to all ionizing radiations. Where the term 'dose' is used without qualification it is implied that 'dose equivalent' is meant.

10.1.1.9. *Exposure of X-ray or γ-radiation*

A measure of the radiation at a certain place based on its ability to produce ionization in air. [SI unit = coulomb kg^{-1}. It replaces the röntgen (R).]

10.1.1.10. *External radiation*

Ionizing radiation received by the body from sources outside the body.

*In what follows, 'he', 'his' and similar pronouns are to be interpreted in a non-gender-specific manner.

references