

Chapter 1 Introduction

Radiation is a fact of life. We live in a world in which radiation is naturally present everywhere. Light and heat from nuclear reactions in the Sun are essential to our existence. Radioactive materials occur naturally throughout the environment, and our bodies contain radioactive materials such as carbon-14, potassium-40 and polonium-210 quite naturally. All life on Earth has evolved in the presence of this radiation.

Since the discovery of X rays and radioactivity more than 100 years ago, we have found ways of producing radiation and radioactive materials artificially. The first use of X rays was in medical diagnosis, within six months of their discovery in 1895. So a benefit from the use of radiation was established very early on, but equally some of the potential dangers of radiation became apparent in the doctors and surgeons who unwittingly overexposed themselves to X rays in the early 1900s. Since then, many different applications of radiation and radioactive materials have been developed.

We can classify radiation according to the effects it produces on matter, into ionizing and non-ionizing radiation. *Ionizing radiation* includes cosmic rays, X rays and the radiation from radioactive materials. *Non-ionizing radiation* includes ultraviolet light, radiant heat, radio waves and microwaves.

This book deals with ionizing radiation, a term, which for simplicity, is often shortened to just radiation. It has been prepared by the International Atomic Energy Agency (IAEA) in co-operation with the National Radiological Protection Board (United Kingdom) as a broad overview of the subject of ionizing radiation, its effects and uses, as well as the measures in place to use it safely.

As the United Nations agency for nuclear science and its peaceful applications, the IAEA offers a broad spectrum of expertise and programmes to foster the safe use of radiation internationally. It has a statutory responsibility for the development of safety standards that are applicable to managing the wide variety of applications that use radiation. It provides assistance to its Member States on the application of those standards through technical co-operation projects such as training courses and advisory services. It also facilitates information exchange through conferences, and publications, such as this one.

Some uses of ionizing radiation

Medical diagnosis and treatment

Nuclear power

Industrial radiography

Sterilization of medical equipment

Food irradiation

Satellite batteries

Scientific and medical research

Benefits and risks

The benefits and risks of any practice involving radiation need to be established, so that an informed judgement can be made on their use, and any risks minimized. The discovery of ionizing radiation and radioactive materials has led to dramatic advances in medical diagnosis and treatment, and they are used for a wide range of procedures in industry, agriculture, and research. Nevertheless, they can be harmful to human beings, and people must be protected from unnecessary or excessive exposures. So in circumstances that we can control, we need to make a careful balance between the benefits and the risks of the procedures that expose people to radiation.

Public anxiety

The greatest concern about ionizing radiation stems from its potential to cause malignant diseases in people exposed to it and inherited defects in later generations. The likelihood of such effects depends on the amount of radiation that a person receives, whether from a natural or an artificial source. As the effects of ionizing radiation have become better understood during recent decades, a system of radiological protection has been developed to protect people from exposure to sources of radiation. But public anxiety remains.

Radiation is one cause, among many, of the ‘dread disease’ cancer. Our senses cannot detect radiation, making this invisible risk seem even more insidious. Our collective anxiety is strengthened by memories — and, in some cases, ongoing effects — of accidents at nuclear power plants and other facilities, and by the common tendency to associate any form of radiation with all things ‘nuclear’, including nuclear weapons.

Another contributory reason for general heightened sense of concern about radiation may be the lack of reliable and accessible information and the misunderstandings that arise. The aim of this book is to help by providing information for those who are not experts. In the following chapters, we describe the sources and effects of ionizing radiation of all types and explain the principles and practices of radiological protection.

