SAFETY SERIES

No. 9

Basic Safety Standards for Radiation Protection

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA 1962

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BASIC SAFETY STANDARDS FOR RADIATION PROTECTION

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THESE STANDARDS ARE ALSO PUBLISHED IN FRENCH, RUSSIAN AND SPANISH

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FOREWORD

Pursuant to the provisions of its Statute relevant to the adoption and application of safety standards for protection against radiation, the Agency convened a panel of experts which formulated the Basic Safety Standards set forth in this publication. The panel met under the chairmanship of Professor L. Bugnard, Director of the Franch *Institut National d'Hygiène*, and representatives of the United Nations and of several of its specialized agencies participated in its work.

The Basic Safety Standards thus represent the result of a most careful assessment of the variety of complex scientific and administrative problems involved. Nevertheless, of course, they will need to be revised from time to time in the light of advances in scientific knowledge, of comments received from Member States and of the work of other competent international organizations.

The Agency's Board of Governors in June 1962 approved the Standards as a first edition, subject to later revision as mentioned above, and authorized me, as Director General, to apply the Standards in Agency and Agency-assisted operations and to invite Governments of Member States to take them as a basis in formulating national regulations or recommendations on protection against the dangers arising from ionizing radiations.

It is mainly for this last purpose that the Basic Safety Standards are now being published in the Safety Series; but it is hoped that this publication will also interest a much wider circle of readers.

November 1962

SIGVARD EKLUND
Director General

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INTRODUCTION

1. Under Article III A. 6 of its Statute the Agency is authorized to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property (including such standards for labour conditions), and to provide for the application of these standards to its own operations as well as to the operations making use of materials, services equipment, facilities and information made available by the Agency or at its request or under its control or supervision; and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of atomic energy.

2. The document in which are set forth the Agency's Health and Safety Measures as approved by the Board of Governors on 31 March 1960*, states in part that Agency safety standards shall include:

(a) The Agency's basic safety standards—standards prescribing maximum permissible levels of exposure to radiation and fundamental operational principles; and

(b) The Agency's detailed operational standards.

3. This publication contains the Agency's Basic Safety Standards as defined above. They are based, to the extent possible, on the recommendations of the International Commission on Radiological Protection (ICRP) and are in accord, to the extent possible, with standards published by other international organizations.

4. In October 1958 the ICRP issued recommendations with respect to the maximum permissible accumulated dose for occupational radiation exposures and for exposures to the population. In 1959 the Commission released recommendations for the maximum permissible concentrations of radioactive materials in air and water. Both sets of recommendations were based upon the information available at that time concerning the biological effects of exposure to radiation from external sources and from concentrations of radioactive material in air and in water.

5. The Agency believes that the limits established in the following Basic Safety Standards, based on the recommendations of the ICRP, provide an appropriate regulatory basis for protection of the health and safety of employees and the public without imposing undue burdens

* IAEA General Conference Document INFCIRC/18

upon users of radioactive material. The recommended limits on exposure, based upon extensive scientific and technical investigation and upon years of experience with the practical problems of radiation protection, represent a consensus of opinion as to the measures generally considered desirable to provide appropriate degrees of safety in the situations to which these standards apply.

6. The Agency recognizes that the ICRP recommendations cannot be converted into regulations without loss of flexibility in their application to individual situations. It is, however, the policy of the Agency to minimize this loss of flexibility both in the formulation of its regulations and in their administration, to the greatest extent compatible with the nature of the problem and with good regulatory practice.

Other publications of the Agency in its Safety Series should be consulted for practical detailed guidance in implementing these Standards: for example, guidance on maximum permissible levels for surface contamination is to be found in Safety Series No. 1*.

When applied to the Agency's operations or to operations assisted by the Agency, this document is to be read in the light of the Agency's Health and Safety Measures**.

ACKNOWLEDGEMENTS

The Agency's thanks are due to the following members of a panel of experts convened by the Director General to discuss the original draft of the Basic Safety Standards prepared by the Secretariat:

Chairman:

Prof. L. Bugnard+
Institut National d'Hygiène
France

Members:

Dr. D. Beninson
Atomic Energy Commission
Argentina

Dr. H. T. Dunster++
United Kingdom Atomic Energy Authority
United Kingdom

Dr. A. Hedgran
Radiofysiska Institutionen
Sweden

* Safe Handling of Radioisotopes (First Edition with Revised Appendix I) Safety Series No. 1, IAEA, Vienna, 1962

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\+ Accompanied by Dr. H. Jammet of the Commissariat à l'Energie Atomique

++ Accompanied by Mr. A. H. K. Slater of the United Kingdom Atomic Energy Authority

Dr. G. C. Butler (1st session)
Mr. G. W. C. Tait (2nd session)
Atomic Energy of Canada Ltd.
Canada

Dr. L. L. Larsson (1st session)
Dr. W. Binks (2nd session)
International Commission on Radiological Protection

Prof. A. A. Letavet
Union of Soviet Socialist Republics

Dr. A. S. Rao
Atomic Energy Establishment
India

Prof. E. Kowalski
Polska Akademia Nauk, Instytut Badań Jądrowych
Poland

Dr. L. Taylor
National Bureau of Standards
United States of America

Dr. S. Watari
Atomic Energy Commission
Japan

Dr. A. R. W. Wilson
Australian Atomic Energy Commission
Australia

Representatives of the United Nations, the specialized agencies and other inter-governmental organizations:

Dr. Z. Ahmed
United Nations

Dr. R. L. Dobson
World Health Organization

Mr. E. Hellen
International Labour Organisation

Dr. P. Recht
European Atomic Energy Commission

Dr. E. Wallauschek
European Nuclear Energy Authority of the O.E.E.C.

Mr. G. Wortley
Food and Agriculture Organization of the United Nations

1. EXPLANATION OF TERMS USED

1.1. PHYSICAL AND RADIOLOGICAL TERMS

Ionizing radiation:

Electromagnetic radiation (X-ray or γ-ray photons) or corpuscular radiation capable of producing ionization in its passage through matter.

Source:

Apparatus capable of producing or substance producing ionizing radiation.

Nuclide:

A species of atom characterized by its mass number, atomic number, and when necessary nuclear energy state.

Radioactivity:

Spontaneous disintegration of a nuclide.

Activity:

Number of spontaneous disintegrations per unit time.

Specific activity:

The number of disintegrations per unit time per unit mass of material.

Radiotoxicity:

The toxicity attributable to the radiation emitted by a radioactive substance within the body.

External radiation:

Radiation reaching the body from external sources.

Internal radiation:

Radiation arising from radioactive substances within the body.

Natural radiation:

The various natural radiation sources include:

(a) External sources of extra-terrestrial origin (cosmic rays) and external sources of terrestrial origin, i.e. the radioactive isotopes naturally present in the crust of the earth and in air;

(b) Internal sources, i.e. the radioisotopes K^{40} and C^{14} which exist as a small percentage of these elements and are normal constituents of the body, and other isotopes such as Ra^{226} and Th^{232} and their decay products that are taken up from the natural environment.

Controlled area:

An area scheduled as such for the purpose of controlling individual exposure to personnel and which is under the supervision of a person who has the knowledge and responsibility to apply appropriate radiation protection regulations.

Qualified expert:

A person having the knowledge and training required to give advice on protective measures and operating procedures which will ensure effective protection of the health of any persons exposed to ionizing radiation.

Competent authority:

A governmental or international authority having jurisdiction with respect to the activities under consideration.

Emergency exposure:

A planned exceptional exposure in the case of compelling or overwhelming necessity.

Accidental exposure:

An unforeseen exposure resulting in a radiation dose or intake of radioactive material exceeding the maximum permissible values.

UNITS:

curie:

The unit of quantity of radioactive material evaluated according to its radioactivity. 1 c is the quantity of a radioactive nuclide for which the number of disintegrations/s is 3.700×10^{10}.

rad:

The unit of absorbed dose—1 rad is 100 erg/g.

rem:

The rem is the absorbed dose of any ionizing radiation which has the same biological effectiveness as one rad of X radiation. A dose in rem is equal to the dose in rad multipled by the appropriate factor as listed in Table I or Table IA in Annex I.

DOSES:

Absorbed dose:

Absorbed dose of any ionizing radiation is the energy imparted to matter by ionizing particles per unit mass of irradiated material at the place of interest.

Genetically significant dose:

The genetically significant dose to a population equals the average gonad dose weighted for the expected number of children.

2. SCOPE

2.1. These standards shall be applied to the production, processing, handling, use, storage and transport of natural and artificially produced sources and to the disposal of radioactive substances.

2.2. These standards shall not be applied to operations exempted from notification, registration or licensing under 5.1.1.4.

2.3. The aims of these standards are the protection of health and maintenance of safety. They apply to:

(a) Workers directly engaged in radiation work;

(b) Workers who are not directly engaged in radiation work, but who remain or pass where they may be exposed to ionizing radiation or radioactive substances;

(c) Individual members of the public; and

(d) The whole population as defined by the competent authority.

2.4. Doses referred to in these standards include the doses received from both internal and external radiation. They do not include:

(a) Doses to patients resulting from medical examinations or treatment;

(b) Doses resulting from natural radiation.

3. MAXIMUM PERMISSIBLE DOSES

3.1. WORKERS DIRECTLY ENGAGED IN RADIATION WORK

3.1.1. Except as provided in 3.1.3, 3.1.4, and subject to the procedures in 4.1.1.2, 4.1.1.3, 4.1.2.2 and 4.1.2.3, the total dose accumulated to the whole body, gonads, blood-forming organs and lenses of the eyes received by an individual shall not exceed the maximum permissible value derived from the basic formula

$$D = 5\,(N - 18)$$

where D is the maximum permissible dose in rem, and N is the individual's age in years. Age in years may, for administrative purposes, be reckoned as from any selected date of the year. Maximum permissible doses for single organs other than the blood-forming organs, gonads and lenses of the eyes are specified in 3.1.6.

3.1.2. Provided the accumulated dose does not exceed the maximum permissible value derived from the basic formula, referred to in 3.1.1, a worker may be permitted to receive in a quarter of a year a dose to the whole body, gonads, blood-forming organs and lenses of the eyes not exceeding 3 rem. 3 rem may be received as a single dose within a quarter of a year, but this should be avoided as far as practicable, especially in the case of women of reproductive age.

3.1.3. If the dose previously accumulated in radiation work by the worker over a given period is not known, it shall be assumed that the worker has received the maximum permissible dose as laid down in this document for that period. When the previous occupational exposure history of an individual is not known. it shall be assumed that he has already accumulated the maximum dose for his age as permitted by the formula.

3.1.4. Workers who were exposed in accordance with the former ICRP maximum permissible weekly dose of 0.3 rem and who have accumulated a dose higher than that permitted by the formula, should not be exposed at a rate higher than 5 rem in any one year, until the accumulated dose at a subsequent time is lower than that permitted by the formula.

3.1.5. If a worker begins to be directly engaged in radiation work at an age of less than 18 yr, provided the requirements of 3.1 are fulfilled, the dose to the whole body, gonads, blood-forming organs or lenses of the eyes shall not exceed 5 rem in any one year while the age is less than 18 yr, and the dose accumulated at the age of 30 shall not exceed 60 rem.

3.1.6. For organs other than the gonads, the blood-forming organs and the lenses of the eyes, a worker shall not receive in a quarter of a year a dose in excess of the values listed below:

Any single organ excluding the gonads, the blood-forming organs, bone, thyroid and skin	4 rem
Bone	8 rem
Thyroid	8 rem
Skin of the whole body	8 rem
Hands, forearms, feet and ankles	20 rem

3.2. WORKERS WHO ARE NOT DIRECTLY ENGAGED IN RADIATION WORK

A worker who is not directly engaged in radiation work but who remains or passes where he may be exposed to ionizing radiation or radioactive substances, shall not receive in any one year a dose in excess of the values listed below:

Whole body	1.5 rem
Gonads	1.5 rem
Blood-forming organs	1.5 rem
Lenses of the eyes	1.5 rem
Any single organ, excluding blood-forming organs and lenses of the eyes, gonads, bone, thyroid and skin	1.5 rem
Bone	3 rem
Thyroid	3 rem
Skin of the whole body	3 rem
Hands, forearms, feet and ankles	7.5 rem

3.3. INDIVIDUAL MEMBERS OF THE PUBLIC

An individual member of the public shall not receive in any one year a dose in excess of the values listed below: