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The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health problems of the countries it serves. The European Region has 32 active Member States,[a] and is unique in that a large proportion of them are industrialized countries with highly advanced medical services. The European programme therefore differs from those of other regions in concentrating on the problems associated with industrial society. In its strategy for attaining the goal of "health for all by the year 2000" the Regional Office is arranging its activities in three main areas: promotion of lifestyles conducive to health; reduction of preventable conditions; and provision of care that is adequate, accessible and acceptable to all.

The Region is also characterized by the large number of languages spoken by its peoples, and the resulting difficulties in disseminating information to all who may need it. The Regional Office publishes in four languages — English, French, German and Russian — and applications for rights of translation into other languages are most welcome.

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[a] Albania, Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, France, German Democratic Republic, Federal Republic of Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway Poland, Portugal, Romania, San Marino, Spain, Sweden, Switzerland, Turkey, USSR, United Kingdom and Yugoslavia.

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Nuclear power:

Accidental releases — practical guidance for public health action

Cover design: Michael J. Suess
Cover photo: Chernobyl nuclear reactor near Kiev, USSR after the accident on 26 April 1986.
Courtesy of POLFOTO, Copenhagen

World Health Organization
Regional Office for Europe
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Report on a WHO meeting
Mol, Belgium, 1–4 October 1985

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The views expressed in this publication are those of the participants in the meeting and do not necessarily represent the decisions or the stated policy of the World Health Organization.

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CONTENTS

NOTE

WHO policy in respect of terminology is to follow the official recommendations of authoritative international bodies, and this publication complies with such recommendations.

Nearly all international scientific bodies have now recommended the use of the SI units (*Système international d'unités*) developed by the Conférence générale des poids et mesures (CGPM),[a] and the use of these units was endorsed by the Thirtieth World Health Assembly in 1977. The following table shows three SI-derived units used frequently in this report, together with their symbols, the corresponding non-SI units and the conversion factors.

Quantity	SI unit and symbol	Non-SI unit	Conversion factor
Radioactivity	becquerel, Bq	curie, Ci	1 Ci = 3.7×10^{10} Bq (37 GBq)
Absorbed dose	gray, Gy	rad	1 rad = 0.01 Gy
Dose equivalent	sievert, Sv	rem	1 rem = 0.01 Sv

[a] An authoritative account of the SI system entitled *The SI for the health professions* has been prepared by the World Health Organization and is available through booksellers, from WHO sales agents, or direct from Distribution and Sales, World Health Organization, 1211 Geneva 27, Switzerland

Foreword

The WHO Regional Office for Europe has, over the years, developed a series of publications on public health aspects of nuclear power production and the disposal of radioactive waste. Following a report on the principles of public health action for accidental releases (1984), a working group was convened in Mol, Belgium in October 1985, to provide more detailed practical guidance in relation to such accidents.

The disaster at Chernobyl, USSR in April 1986 has dramatically highlighted the need for comprehensive contingency planning for — and emergency response to — such accidents. Such planning must be multisectoral and well coordinated, covering a wide range of governmental action at central, regional and local levels. Not least, the importance of clear guidance to the public must be recognized. There is also a need for close collaboration among neighbouring countries.

It must be accepted that there has been a major crisis of confidence in nuclear safety and, for its part, WHO is now embarking on an expanded programme related to public health aspects of radiation protection, to ensure that experience gained following the recent accident is fully evaluated and utilized.

Although the present volume was prepared before the Chernobyl accident, its conclusions are still considered as valid guidance to those concerned with the various aspects of emergency response.

It is appropriate that grateful thanks be recorded for the support provided by the Government of Belgium to this series of publications.

J.I. Waddington

Director, Environmental Health
WHO Regional Office for Europe

Introduction

In 1984 the WHO Regional Office for Europe published a report *(1)* on the principles of public health action in the event of the accidental release of radioactive materials into the environment, which is concerned largely with power reactors. Even though such reactors represent the major source of potential accidental release in many countries, they are by no means the only source, and emergency plans should also be developed for other types of nuclear installation. In addition, there may be unplanned releases from weapons accidents or terrorist activities which, by their very nature, defy the effective implementation of anything but the most general emergency plans. Nevertheless, the experience of planning to deal with accidental releases from nuclear installations will serve as a basis for the public health authority to deal with these other types of emergency.

In the previous report it was shown that accidents can be divided into three successive phases — early, intermediate and late — and that in each phase different decisions are required for action to protect members of the public. There is no single accident sequence that can be used for the preparation of emergency plans for different types of nuclear installation. However, the three phases appear to be common to all accidents and provide a framework within which radiological criteria can be established.

The previous report discussed the pathways of exposure relevant to each phase, and the potential consequences for health. In each phase the organs and tissues at risk were identified and both the stochastic and non-stochastic effects resulting from irradiation were considered and numerical risk values presented. In an accident that may lead to exposure of the public, the only means by which that exposure may be avoided or limited involve the introduction of countermeasures which interfere, to a greater or lesser extent, with normal living conditions. Countermeasures were identified that were applicable in each phase, and the risks and difficulties associated with introducing each countermeasure were discussed.

The principles evolved by WHO for protecting the public in accidents are consistent with the latest recommendations of the International Commission on Radiological Protection (ICRP) *(2)*. In the report of an ICRP task group *(3)* on the radiological criteria used for planning protection of the public in accidents, the principles established are as follows.

— Non-stochastic effects should be avoided by the introduction of countermeasures to keep individual doses below the thresholds for these effects.

— Individual risk from stochastic effects should be limited by introducing countermeasures that achieve a positive net benefit to the individuals involved. This can be accomplished by comparing the reduction in individual dose (and therefore risk) that would follow the introduction of a countermeasure with the increase in individual risk resulting from the introduction of that countermeasure.

— The incidence of stochastic effects should be limited by reducing the residual health detriment. This source-related assessment may be carried out by cost–benefit techniques and would be similar to a process of optimization, in that the cost of health detriment in the affected population is balanced against the cost of further countermeasures.

Following these principles, reference levels were proposed for the doses at which introduction of each countermeasure was warranted in each phase.

The present report is concerned with the implementation of the principles of the previous report. It is based on the collective knowledge and experience of the members of a Working Group, convened by the WHO Regional Office for Europe and WHO headquarters in collaboration with the Government of Belgium in Mol on 1–4 October 1985, to discuss practical guidance for public health action in the event of an accidental release of radioactive material. The Group included experts from 11 countries and representatives from international organizations such as the Commission of the European Communities (CEC), the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development, and the International Commission on Radiological Protection.

Dr N. Wald was elected Chairman, Dr R.H. Clarke and Dr. J.-C. Nénot were the Rapporteurs, and Dr M.J. Suess and Dr P.J. Waight acted as Scientific Secretaries. The composition of subgroups formed during the meeting and the list of participants are given in Annexes 1 and 2, respectively.

This report is addressed to those organizations and individuals responsible for public health in the event of a nuclear accident. It will also be of use to those medical practitioners who are not administratively responsible in an accident, but who may need to be aware of the consequences and of action to be taken in the aftermath of an accident. Other organizations with direct responsibilities in the event of an accident will also need to become aware of the role and responsibility of the public health administration.

The guidance will be applicable to all types of nuclear installation and to accidental releases to both the atmosphere and the hydrosphere. However, to assist public health authorities in defining the size and scope of the contribution that might be required from them in case of an emergency, some information is given on the typical probability and magnitude of accidental releases from large nuclear installations and on the associated

range of radiological consequences. The example given refers to a standard pressurized light water reactor of the type currently used for electricity generation. Many of the features will be common to other nuclear installations, such as other types of reactor or fuel reprocessing plants. Atmospheric releases of radioactive material are generally of more concern because the probability of occurrence is higher and the potential exists for higher doses to be received in the short term. Accidental releases to the aquatic environment are less likely to occur and, in general, are likely to involve lower exposure levels and some delay before exposure of the population occurs; therefore, it is expected that this type of accidental release will leave enough time to implement the appropriate protective measures. Nevertheless, the principles for protecting the public following accidental aquatic releases will be the same as for releases to the atmosphere.

This report first summarizes the range of accident sequences for which plans need to be prepared for protecting members of the public. The measures that can be taken are described and the levels of dose at which they should be considered are summarized. Guidance is given on routes of exposure and the monitoring procedures that are likely to be applied to assess levels of exposure. The report then considers the problems that will need to be considered by public health authorities and by medical practitioners who will become involved in the provision of clinical services. The administrative arrangements applicable are outlined and consideration is given to the information and training aspects of planning to which public health authorities should have an input.