

RADIATION PROTECTION

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Implications of Commission
Recommendations that Doses be kept as
Low as Readily Achievable

A Report by Committee 4 of the
International Commission on
Radiological Protection

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PREFACE

At its 1971 meeting, the International Commission on Radiological Protection asked Committee 4, the Committee on the Application of the Commission's Recommendations, to prepare a report clarifying the implications of paragraph 52 of *ICRP Publication 9*, which reads as follows:

“(52) As any exposure may involve some degree of risk, the Commission recommends that any unnecessary exposure be avoided, and that all doses be kept as low as is readily achievable, economic and social considerations being taken into account. It should be noted that the dose limits are intended for planning the design and operation of sources leading to foreseeable conditions of exposure; the setting of ‘action levels’ for exposures from uncontrolled sources depends on other considerations”

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INTRODUCTION

(1) For many years now, recommendations of the Commission and similar bodies have included requirements to keep all radiation exposures as far below the limiting values as can reasonably be achieved. The form of words has differed from time to time and from place to place, but the intention has been consistent. In practice, however, this qualitative requirement has given rise to some difficulties of interpretation and to requests for a more quantitative expression of the same objective. Initially, the Commission thought that this was a matter best left to professional judgement and that any attempt to introduce quantitative explanations would lead to an undesirable loss of flexibility. The Commission now feels, however, that a more detailed explanation of its intentions would be appropriate.

A. THE BASIS OF THE COMMISSION'S RECOMMENDATIONS

(2) The principles upon which the Commission's recommendations on radiation protection are based have evolved over a period of some 40 years. Radiation protection had its foundations within the medical profession in the early part of the twentieth century. Both acute effects and serious late effects were directly observed when man was exposed to sufficiently large doses of radiation from x rays and natural radionuclides. It was clear that acute effects were observed only above some level of dose that became known as a threshold dose. Erythema was an effect of this kind. On the other hand, serious late effects such as malignancy were more difficult to evaluate because they occurred with such low frequency that they were observed only after substantial exposure of large groups. Consequently it has never been possible to demonstrate that a threshold dose exists for these late effects. Over a substantial range of doses, from about 50 rads to many hundreds of rads, the level of risk appears to be related to the level of exposure in a manner such that the risk increases with increase in exposure. This consideration, in addition to the further adoption of the conservative hypothesis of a linear relationship between biological risks and the amount of dose down to the lowest dose levels, has determined the basic approach to radiation protection during the past 20 years.

(3) A group of paragraphs in *ICRP Publication 9*¹ sets forth the assumptions of risk that form the basis for the Commission's current recommendations. These paragraphs are quoted in Appendix I. They draw attention to the possibility that there may be no threshold for induction of deleterious effects following

exposure to radiation and, further, that the relationship between the probability of such deleterious effects and dose may be a linear one.

(4) As a result of these assumptions, no level of exposure to radiation can be considered to be without risk, and if one wishes to carry on activities resulting in exposures to radiation one must aim at conditions such that:

- (a) the detriment* resulting from exposures to radiation can be made less important than the benefits to individuals and to society from activities which result in the exposures; and
- (b) any further reductions in detriment become less important than the effort that would be required to accomplish such reductions.

(5) These principles are incorporated in the Commission's statement of policy in paragraph 47 of *ICRP Publication 9*, for the formulation of dose limitations applicable to exposures from controlled sources. In summary, this statement of policy is as follows (the sub-division into paragraphs is new, but the words are those of *ICRP Publication 9*):

- (a) The risks† associated with the dose limitations should be judged to be appropriately small in relation to the benefits resulting from the practice.
- (b) The limitation must be set at a sufficiently low level so that any further reduction in risk would not be considered to

*. See Explanation of Terms, paragraph 21 of this report.

† This use of "risk" in *ICRP Publication 9* is synonymous with the use of "detriment" in this report.

justify the effort required to accomplish it.

- (c) In the case of occupational exposure the hazards should not exceed those that are accepted in most other industrial or scientific occupations with a high standard of safety.
- (d) The risks to members of the public from man-made sources of radiation should be less than or equal to other risks regularly accepted in everyday life, and should be justifiable in terms of benefits that would not otherwise be received.

(6) In paragraphs 47–50 of *ICRP Publication 9* (see Appendix I), the Commission develops the policy underlying its recommended system of dose limitation. These paragraphs refer to the whole system of dose limitation, including the general and overriding recommendations of paragraph 52 to avoid unnecessary exposure and to keep all exposures as low as is readily achievable.

(7) It is important to note that the Commission's recommendations in paragraph 52 differ in wording from similar recommendations made in previous ICRP publications. The Commission's recommendations published in Supplement No. 6, *British Journal of Radiology* (1955)², include the following statement:

“Whilst the values proposed for maximum permissible doses are such as to involve a risk which is small compared to the other hazards of life, nevertheless,

in view of the incomplete evidence on which the values are based, coupled with the knowledge that certain radiation effects are irreversible and cumulative, it is strongly recommended that every effort be made to reduce exposure to all types of ionizing radiation to the lowest possible level.”

The comparable recommendation in *ICRP Publication 1* (1959)³ appears in paragraph 45 of that report. It reads:

“It is emphasized that the maximum permissible doses recommended in this section are *maximum* values; the Commission recommends that all doses be kept as low as practicable, and that any unnecessary exposure be avoided.”

There has been a progressive development in these recommendations leading up to paragraph 52 of *ICRP Publication 9*. The word “possible” has been successively replaced by “practicable” and “readily achievable”. The recommendation has also been expanded to identify two specific considerations that are to be taken into account in determining levels of exposure that may be considered “as low as is readily achievable”. These considerations are economic and social. Other considerations, such as ethical ones, are not excluded by this wording and may indeed be considered to be included by the adjective “social”.

BASIC PRINCIPLES OF DOSE LIMITATION

(8) Before attempting any explanation of paragraph 52 of *ICRP Publication 9*, it is advisable to look again at the basic principles which underlie the best modern practice of dose limitation. For many years, it has been clear that we cannot exclude the possibility that prolonged exposure at the Maximum Permissible Doses and Dose Limits may carry with it some risks of damage to the

health of individuals or the public. Nor, on the other hand, can we exclude the possibility that the risk of these small doses is zero. It follows that the Maximum Permissible Doses and Dose Limits must be regarded as part of a system of dose limitation aimed at keeping doses at levels that are justifiable in relation to the benefits accruing from the procedures giving rise to the doses and which are also