STATEMENT AND RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION FROM ITS 1980 MEETING

The International Commission on Radiological Protection (ICRP) held its annual meeting in Brighton, England from March 17–26, 1980, together with all four of its committees. In addition, representatives attended from the Commission of the European Communities, the International Atomic Energy Agency, the International Commission on Radiation Units and Measurements, the International Commission for Protection against Environmental Mutagens and Carcinogens, the International Electrotechnical Commission, the International Organization for Standardization, the International Radiation Protection Association, the OECD Nuclear Energy Agency, the United Nations Environment Programme, the United Nations Scientific Committee on the Effects of Atomic Radiation and the World Health Organization.

The Commission and its committees reviewed the extensive programme of work being performed within the ICRP, including reports on occupational exposure limits for radon, on the dose-equivalent limit for the lens of the eye, and a survey of the currently available information on estimates of radiation risk. The conclusions of these three points are included in this statement (*q.v.*).

The Commission authorised Committee 1 to establish a new task group to define non-stochastic effects and to advise on their bearing on ICRP recommendations. The Commission reviewed the committee's work proceeding on other topics, such as the effects of high LET radiation, the risks to the embryo and foetus from irradiation, and the combined carcinogenic effect of ionising radiation and chemicals.

Committee 2 is completing its report Limits for Intakes of Radionuclides by Workers (*ICRP Publication 30*). Part 1 of the report, containing ALIs for radioisotopes of twenty-one elements has already been published. Parts 2 and 3, to include ALIs for 30 and 44 further elements, will be published in 1980/81, along with supplements to each of the parts. The committee is also preparing a report on doses to patients from radiopharmaceuticals, and is planning to prepare a statement on the exposure of members of the public to radioactive material.

Committee 3 is currently preparing revised versions of the medical aspects of *ICRP Publication 15 and 21*—Protection Against Ionizing Radiation from External Sources—as well as of *ICRP Publication 16*—Protection of the Patient in X-ray Diagnosis; these are expected to be completed in 1981.

A task group of Committee 4 has submitted a draft of a report on the application of the Commission recommendation on the need for the optimisation of radiation protection. This is expected to be completed in 1981. Committee 4 is also preparing revised versions of *ICRP Publication 7*—Principles of Environmental Monitoring Related to the Handling of Radioactive Materials: *Publication 10*—Evaluation of Radiation Doses to Body Tissues from Internal Contamination due to Occupational Exposure: *Publication 10a*—The Assessment of Internal Contamination Resulting from Recurrent or Prolonged Uptakes: *Publication 12*—General Principles of Monitoring for Radiation Protection of Workers: *Publication 13*—Radiation Protection in Schools: and *Publication 24*—Radiation Protection in Uranium and Other Mines, which will then conform to the policies enunciated in the Commission's recommendations in *ICRP Publication 26*. Other topics being considered by the committee include practices that modify man's exposure to natural background, and the general principles for protection of the public in the event of radiation accidents.

As a result of its discussions at the Brighton meeting, the Commission decided to issue statements on the following points:

Lens of the eye

In *ICRP Publication 26* the Commission concluded that a dose equivalent in the lens of the eye accumulated over a working lifetime of 15 Sv would not produce opacities that would interfere with vision. The Commission's committee on radiation effects (Committee 1) has reviewed the available human information and has concluded that, at this level of accumulated dose equivalent, some opacities might be produced which, while not in themselves detrimental to vision, might develop without further exposure to the point of causing deterioration of vision.

Although the combined effects of the present dose-equivalent limit for skin and the effective dose-equivalent limit make it very unlikely that dose equivalents in the lens would reach 15 Sv in a working lifetime, the Commission has decided to reduce its recommended dose-equivalent limit for the lens of the eye from 0.3 Sv in a year to 0.15 Sv in a year.

In most practical situations, the limits on the deep and shallow dose-equivalent indices will achieve compliance with the revised limit for the lens. The Commission therefore continues to recommend the use of the deep and shallow indices for estimates of dose equivalent at corresponding depths.

Recent estimates of radiation risk

The Commission in its 1978 Statement* referred to information available to May 1978. The Commission has reviewed the very extensive epidemiological and radiobiological information that has become available up to March 1980. Apart from the change recommended for the lens of the eye, the Commission has concluded that the new information does not call for changes in the risk factors for stochastic effects or the dose-effect relationships for nonstochastic effects underlying the dose-equivalent limits recommended in *ICRP Publication 26*.

Annual limits for intakes of radionuclides

In *ICRP Publication 30* the Commission is now in process of recommending Annual Limits for Intakes (ALIs) of Radionuclides by Workers that replace its earlier recommendations in *ICRP Publication 2* (1960). The system of dose limitation now used by the Commission takes account of all body tissues that are irradiated following intake of the radioactive material instead of only the critical organs as previously. The system ensures that the total risk from irradiation of any combination of organs does not exceed that from irradiation of the whole body at the recommended dose-equivalent limit. This summation of risks from individual organs can now be made on the basis of the much better knowledge of the sensitivity of each organ to radiation damage than was available 20 years ago. These improvements have in themselves caused only small changes in the values of ALI for individual radionuclides, but might require a reduction in the limits for some mixtures of radionuclides.

Much larger changes, however, have resulted from improved knowledge of the uptake and retention of radionuclides in body tissues, and of the radioactive decay schemes of some radionuclides. As a result of this new information, a few values of ALI now recommended in Part 1 of *Publication 30* (1979) are substantially greater, and others substantially smaller, than those that can be derived from *ICRP Publication 2*.

*Reference: 1978 Statement. Annals of ICRP, Vol. 2, No. 1, 1978.

Occupational exposure to Radon-222 and its daughters

The Commission reached a conclusion about the appropriate limit for occupational exposure to radon and its daughter nuclides. It took as the basis for this limit the level of risk corresponding to the present limit on effective dose-equivalent of 50 mSv in a year. There are several ways of assessing the relationship between the inhaled amount of radon and its daughters and the level of risk. The dosimetric method used for most radioactive materials in *ICRP Publication 30* and a similar method, slightly modified because of the special problems of the short-lived daughters of radon, have both been used. Epidemiological studies have provided a third method. There is a reasonably close agreement between the results of these methods, and the Commission recommends a limit which is at the low end of the dosimetric results and which is consistent with the epidemiological conclusions. These conclusions are not specific to radon because they relate to the consequences of exposure to the whole mining environment which includes some potentially hazardous nonradioactive agents. A Commission report is being prepared for publication.

The recommended annual limit for intake by inhalation, the ALI, for radon-222 daughters, in terms of inhaled potential α-energy, is 0.02 J in a year. The corresponding derived air concentration (see *ICRP Publication 30*) expressed in the practical units previously widely used is then 0.4 working levels.

The system of dose limitation of the Commission requires the addition of exposures to external radiation and intakes of radioactive material. In the special case of exposure in uranium mines this additivity has the effect of requiring the inhalation of radon and its daughters to be kept below the recommended limit by an amount that depends on the exposure to external radiation and ore dust. A reduction of 20% is common.

These recommendations are intended for competent authorities for general application and they may not always be appropriate for application in particular cases. The Commission is aware that some mining conditions are such that it may not be possible to operate within the combined limits recommended by the Commission on a year to year basis. The national authorities will then have to take decisions on how best to deal with these few, but difficult, situations.

Assessment of total detriment

In *ICRP Publication 26*, the Commission introduced the effective dose equivalent as the sum of the dose equivalents in individual organs H_T, each weighted by an organ weighting factor w_T:

$$H_E = \sum_T w_T H_T.$$

The organ weighting factors were chosen by the Commission to reflect the relative risk of death from cancer or occurrence of severe hereditary effects in the first two generations after uniform whole body exposure. It was considered that, in assessing the risk for an individual, in contrast to that for the population as a whole, the hereditary effects of essential importance were those that might be expressed in the children or grandchildren of the exposed individual. If only one organ (T) were exposed, the risk would be $w_T H_T . r$, where r is the risk per unit dose equivalent in the case of uniform whole body exposure. As reported in *ICRP Publication 27*, the value of r was assumed to be $1.65 \cdot 10^{-2}$ Sv^{-1} ($1.25 \cdot 10^{-2}$ Sv^{-1} for fatal cancers and $0.4 \cdot 10^{-2}$ Sv^{-1} for the hereditary effects).

The effective dose equivalent was introduced as the quantity to be compared with the Commission's basic dose limits in the protection of individual workers or members of the public. It was recognised, and further illustrated in *ICRP Publication 27*, that the actual risk at a given effective dose equivalent would depend on sex and age, but the Commission regarded these

variations as sufficiently small to justify the use of average values to apply under most circumstances (paragraphs 38 and 106 of *ICRP Publication 26*).

The variation of the genetic risk with age was given special attention. The average risk of hereditary harm of a severe nature in the first two generations was assumed to be 10^{-2} Sv^{-1} in a population if based on the genetically significant dose. In a general population with normal age distribution, the risk would be expected to be 40% (the ratio of mean reproductive age to mean life expectancy) of this value. This gave the weighting factor $w_T = 0.4/1.65 = 0.25$ recommended for the gonads.

If a population of *workers* had uniform age distribution, the genetic risk (for the first two generations) may be assumed to be 25% (the ratio of 30–18 to 65–18) of the risk per unit of genetically significant dose, because of the shorter period of risk within the reproductive age. This difference, which would strictly have meant a total risk of $1.50 \cdot 10^{-2}$ Sv^{-1} and a gonad weighting factor $w_T = 0.25/1.50 = 0.17$ for workers, was not considered sufficiently large to justify the use of different weighting factors and reference risk values for workers and members of the public. The Commission has found no reason to change this policy: the accuracy of the risk and dose estimates would not justify any more accurate procedure in the application of the dose limits.

The weighting factors and the risk estimates did not include the genetic harm *after* the first two generations, because this was considered less relevant in the limitation of the risk to which individuals are exposed. Nor did they include non-lethal cancer. The justification of the latter—deliberate—omission was that the acceptability of the detriment in relation to the dose limit had been based on comparison with the risk of *lethal* effects in safe industries. In paragraph 97 of *ICRP Publication 26*, the Commission noted that this is likely to be a conservative comparison, since experience has shown that the non-lethal effects of radiation are much less frequent than the non-lethal effects encountered in other safe occupations.

Since the publication of *ICRP Publication 26*, there has been an increased use of the effective dose equivalent not only for comparison with the dose limits but also in assessments of collective dose in optimisation procedures. Questions have been raised whether it is then appropriate to use the effective dose equivalent without consideration of the total genetic harm and the non-lethal cancers.

The Commission has reviewed this matter and has reached the following conclusions with regard to the use of the effective dose equivalent in optimisation assessments. The addition of the future genetic harm in the case of uniform whole body exposure would add a further risk of $0.4 \cdot 10^{-2}$ Sv^{-1} in the case of the public, or rather less in the case of the average worker, to the total assumed risk of $1.65 \cdot 10^{-2}$ Sv^{-1}; i.e. it would increase the total detriment by at most 24%. In the less likely case that the gonads would receive the dominating dose, the genetic harm would be twice that implied by the effective dose equivalent alone.

The weight of the additional detriment attributed to nonlethal cancer would depend upon the weight to be attached to a given length of time lost from normal health (during illness prior to cure) relative to an equal period of life lost as a result of death from fatal cancer. If that relative weight (K) is taken to be 0.1 (as in *ICRP Publication 27*), the addition of the detriment due to nonlethal cancer and the induction of benign tumours would only increase the total non-genetic detriment by 2% in the case of uniform whole-body exposure. If organs such as thyroid and skin, for which cancers have a low fatality rate, are irradiated alone and K is taken to be as high as 0.5, the total detriment will approach about twice that implied by the use of the effective dose equivalent alone. In most cases of external exposure or exposure to mixtures of radionuclides, however, the use of the effective dose equivalent alone would not significantly underestimate the total detriment.

It may be added that, in the original use of the dose equivalent for the protection of the worker, the non-stochastic dose limit will limit the maximum risk after exposure of single organs to a greater extent than indicated by the organ weighting factors derived on the basis of the risk of stochastic effects.

In the case of selective irradiation of the thyroid, the non-stochastic limit of 0.5 Sv y^{-1} is more restrictive than the implied stochastic limit based on the induction of fatal thyroid cancers (1.7 Sv y^{-1}). It would remain more restrictive than the stochastic limit even if this were based on the induction of all thyroid cancers, whether fatal or not, and of benign tumours also. If all tumours were taken into account in this way, the implied stochastic limit would become 1.3 Sv y^{-1} if K were taken as 0.1, or 0.7 Sv y^{-1} for $K = 0.5$, as discussed above.

Future meetings

The Commission's committees will each meet again towards the end of 1980 to review the progress of their work and to complete reports that will be considered by the Commission when it meets in Tokyo in March 1981.

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