CRITICAL REMARKS ON THE EURATOM BASIC STANDARDS

M. Heinzelmann, R. Hille
Forschungszentrum Jülich GmbH
D-5170 Jülich, Bundesrepublik Deutschland

ABSTRACT

The data in the Annex to the EURATOM Basic Standards give rise to criticism in the following points:

- The classification of radionuclides does not correspond to that of the relative radiotoxicity for some nuclides.
- The derived limit of tritium concentration in air does not make allowance for elemental tritium autooxidation.
- The limits of annual intake are in some cases higher than permissible due to the chemical toxicity.

INTRODUCTION

The "Basic Safety Standards for the Health Protection of the General Public and Workers Against the Dangers of Ionizing Radiation" [1,2] of the Commission of the European Communities, which are presently being revised, are the essential basis for the health physics regulations in the countries of the European Community. A few data in the extensive Annexes to the Basic Standards give rise to these critical remarks which primarily concern the figures given in the Annexes. The points in question will be discussed in the following.

RADIONUCLIDES WITH AN ACTIVITY CONCENTRATION BELOW 100 $Bq \cdot g^{-1}$

The activity concentration of the long-lived radionuclides Cd-113, Te-123, Gd-152 and Ta-180 is lower than 100 $Bq \cdot g^{-1}$ even for pure isotopes. These radionuclides are grouped in a radiotoxicity class, so that an activity limit is stipulated for these nuclides. For activities above this limit an authorization is required for handling these nuclides. This is not consistent with Article 4 of the Directive [1] according to which the requirements for reporting and obtaining prior authorization are not applicable if radioactive substances with a concentration of less than 100 $Bq \cdot g^{-1}$ are involved.

CLASSIFICATION OF RADIONUCLIDES ACCORDING TO THEIR RELATIVE RADIOTOXICITY

The most important radionuclides are grouped in Annex I to the Directive according to their relative radiotoxicity [2]. A comparison of the nuclides in the different radiotoxicity groups with the limits of annual intake in Annex 3 to the Directive shows that the limits of annual intake do not correspond in each case with the radiotoxicity. Radiotoxicity is the toxicity of an incorporated nuclide and its daugther products due to ionizing radiation. The limits of annual intake should thus be a measure of radiotoxicity. Table 1a shows the isotopes of an element which have been incorrectly classified insofar as the isotope with the same or even higher limit of annual intake was allocated to a higher radiotoxicity group. Table 1b shows corresponding values for different elements.

DERIVED CONCENTRATION LIMITS FOR TRITIUM

Derived limits of concentration in the air inhaled are specified for elemental tritium and for tritiated water. The limit for elemental tritium ($2 \cdot 10^{10}$ Bq $\cdot$ m^{-3}) is higher than that for tritiated water ($8 \cdot 10^{5}$ Bq $\cdot$ m^{-3}) by a factor of $2.5 \cdot 10^{4}$. In determining the derived concentration limit for elemental tritium, the autooxidation of tritium in air has obviously not been taken into account. According to Casaletto [3] the oxidation rate of elemental tritium in air is 1.5 % per day. Tritiated water is formed relatively quickly from elemental tritium due to autooxidation. A concentration of tritiated water amounting to $1 \cdot 10^{-4}$ of the concentration of elemental tritium is already formed after 10 minutes. The concentration ratio of tritiated water to elemental tritium is practically always higher than the ratio of the derived concentration limits. Moreover, in radiation protection monitoring it is hardly possible to detect concentrations of tritiated water amounting to less than 1 % of the concentration of elemental tritium using normal air monitoring devices. The high concentration limit for elemental tritium is thus not conservative and should be changed so that it covers at least the 1 % concentration of tritiated water which is difficult to measure.

ALLOWANCE FOR THE CHEMICAL TOXICITY

The limits of annual intake due to inhalation do not make allowance for the chemical toxicity with one exception (uranium). For various long-lived nuclides the limits of annual intake due to inhalation are higher than the values which can be derived from the maximum permissible workplace concentrations (MAK values) of conventional safety regulations [4]. For the nuclides Cd-113, In-115, Te-123, Ta-180 and Re-187 the limit of annual intake is higher by more than a factor of 10^{3} than the corresponding value of conventional safety regulations. In such cases, the Euratom directives should make allowance - similar to uranium - to the chemical toxicity or at least refer to the values of conventional safety regulations.

LIMIT OF ANNUAL INTAKE THROUGH THE GASTRO-INTESTINAL TRACT FOR LONG-LIVED NUCLIDES

For certain long-lived isotopes (Cd-113; In-115; Te-123; Ta-180; Re-187) the limit of annual intake through the gastro-intestinal tract for individuals is so high that the amount corresponds to an average intake of 1 kg per day or more. A specification of these limits should be omitted since hardly 1 °/oo of these values is incorporated inadvertedly.

REFERENCES

1. Richtlinie des Rates vom 15. Juli 1980 zur Änderung der Richtlinien, mit denen die Grundnormen für den Gesundheitsschutz der Bevölkerung und der Arbeitskräfte gegen Gefahren ionisierender Strahlungen festgelegt wurden.
   Amtsblatt der Europäischen Gemeinschaften L246 vom 17. September 1980

2. Richtlinie des Rates vom 3. September 1984 zur Änderung der Richtlinie 80/836/Euratom hinsichtlich der Grundnormen für den Gesundheitsschutz der Bevölkerung und der Arbeitskräfte gegen die Gefahren ionisierender Strahlungen.
   Amtsblatt der Europäischen Gemeinschaften L265 vom 5. Oktober 1984

3. Casaletto, G.J.; Gevantman, L.H. and Nash, J.B.
   The Self-Radiation Oxidation of Tritium in Oxygen and Air
   Report USNRDL-TR-565(1962)

4. MAK-Werte-Liste 1989
   in: Betriebswacht 1990, Datenjahrbuch der gewerblichen Berufsgenossenschaften, Sankt Augustin, 149-187 (1989)

Table 1

Limits of annual intake for some nuclides from different radiotoxicity groups

a) Isotopes of one element

nuclide	radiotoxicity group	$I_{j,L}$ *) A *)	$I_{j,L}$ *) B *)
Tc-97m	III average	$2 \cdot 10^7$ $4 \cdot 10^6$	$2 \cdot 10^7$
Tc-99	IV low	$2 \cdot 10^7$ $2 \cdot 10^6$	$1 \cdot 10^7$
I-126	II high	$1 \cdot 10^5$	$8 \cdot 10^4$
I-129	IV low	$3 \cdot 10^4$	$2 \cdot 10^4$
U-233	I very high	$4 \cdot 10^3$ $3 \cdot 10^3$ $1 \cdot 10^2$	$4 \cdot 10^4$ $7 \cdot 10^5$
U-235	IV low	$5 \cdot 10^3$ $3 \cdot 10^3$ $2 \cdot 10^2$	$5 \cdot 10^4$ $7 \cdot 10^5$

*) $I_{j,L}$ = limit of annual intake
A = $I_{j,L}$ due to inhalation
B = $I_{j,L}$ through the gastro-intestinal tract

b) Isotopes of different elements

nuclide	radiotoxicity group	$I_{j,L}$ *) A *)	$I_{j,L}$ *) B*)
Ra-226	I very high	$2 \cdot 10^3$	$7 \cdot 10^3$
Ac-225		$1 \cdot 10^3$ $2 \cdot 10^3$	$2 \cdot 10^5$
Th-232	II high	$1 \cdot 10^1$ 4	$3 \cdot 10^3$
Be-10	II high	$6 \cdot 10^5$ $5 \cdot 10^4$	$4 \cdot 10^6$
Al-26		$2 \cdot 10^5$ $3 \cdot 10^5$	$1 \cdot 10^6$
Sm-151		$4 \cdot 10^5$	$5 \cdot 10^7$
Am-242		$3 \cdot 10^5$	$2 \cdot 10^7$
I-129	IV low	$3 \cdot 10^4$	$2 \cdot 10^4$
Gd-152		$4 \cdot 10^1$ $2 \cdot 10^2$	$6 \cdot 10^4$

If several limits are specified, these apply to chemically different compounds.