NEW SETTING-UP OF THE CRITERION OF ACCEPTABILITY OF RISK IN RADIOPROTECTION SECTOR

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ABSTRACT

The method presently used for choosing the values of "acceptability" of the risk of damage from i.r. is based on the comparison with other risks in human life, it divides the persons exposed to the risk into groups and establishes for each of them the values of doses considered "acceptable". Taking into account that the damage involves the single person, the risk-benefit relationis evaluated on him, putting aside the distinctionin groups and the general method of comparison.
The relation B-R>O where B=benefits and R=risks. Applied to the single person enables us to identify the "acceptable" doses for him, through an appropriate selection of B and R.

INTRODUCTION

As we know, ionising radiations (i.r.) can cause damages to the man who absorbes them. The probability of damage becomes lower whenever the absorbed dose of i.r. decreases; but it is not possible to establish a threshold under which this probability is zero. It is assumed as a working hypothesis in order to establish the fundamental criteria of radioprotection for those doses which produce "stochastic" effects. This hypothesis derives from the proportionality between the risk (probability) of damage and the absorbed dose, represented by a straight line which passes through the origin of the cartesian axis.
A large literature on this topic and mainly the ICRP itself, have examined and are examining the issue resulting from this lack of threshold; this involves the need to establish a value of "acceptability" of the risk which corresponds to a certain value of dose in order to make the use of i.r. possible. Therefore, it is necessary to choose and eventually indicate and recommend such value of "acceptability" based on appropriate methods or criteria to establish.
At this stage, this issue shifts obviously from the scientific field towards the moral, political and social ones.

DISCUSSION

The ICRP No.9 (sept.1965), but also others of its publications, states the principle "that all doses be kept as low as is readily achievable" but it also adds "economic and social consideration being taken into account", briefly indicated as ALARA. Apart from this, it is pointed out that this principle states the opportunity to keep doses as low as possible in order to expose people concerned to the minimum risk which is considered "acceptable", although the introduction in the second part: "economic.." makes its application more flexible.
The criteria and methods used by the ICRP to recommend the

values of "acceptability" are inspired by this principle and are based on the system of comparison with the risks the man runs during every-day life. Based on these criteria and on the above principle (ALARA), the ICRP has identified the maximum values for those doses which cause a risk considered "acceptable" by mankind. These values are divided into three groups of exposed people: 1) workers; 2) people exposed for medical reasons; and 3) population. Therefore they do not take into account the single person but they stick to general considerations. Moreover, they do not make a distinction between those people who are the object of the risks and those who get the benefits.
But the damages we are discussing have their effects on the single person exposed to i.r., causing considerable pain to the individual himself and to his relatives.
The proposed method for choosing the criteria of acceptability differs from the present method used, which has been explained earlier, as it examines the single individual exposed to i.r. developing a risk-benefit analysis which is personalized even though it utilizes, as we will see later, objective and general parameters. The above method consists of moving the risk-benefit analysis from a general interest for the society to the specific one for the single individual. The value of "acceptable" risk and, therefore, the maximum dose accepted for the stochastic damages is chosen on the basis of this individual analysis. According to the above, the objects of the risks and benefits respectively can be inserted automatically, being the individual the object of this relation, while the proposed three categories of the ICRP No.60 are no longer valid.
Let us indicate with "R" the risk of damage resulting from the absorption of i.r. and with "B" the benefits originated by the activity involving such risk; the "acceptable" dose for each single individual should be: $B-R>0$ (1).

The value of risk (probability) of damage to the single person, according to the absorbed dose, can be obtained from the straight line, used in the working hypothesis explained above, which indicates the proportionality between the dose and the risk. Therefore this value can easily be quantified for each person on the basis of the received dose, by using the above considerations; it will be possible to identify the value of maximum dose for each single person in order to make the risk-benefit relation more advantageous to him, hence to consider such value "acceptable".

The benefits deriving to man from the use of i.r. are numerous and of a different kind. They can, however, be summarized in two main benefits:
A) reduction, as a result of the use of i.r., of the risk of damage due to those activities differing from the ones which expose man to i.r. (B_d); if we know the type of activity exposing a person to i.r., we can evaluate this reduction (B_d), by considering those tables and statistics which are used for insurance purposes and are indicated by the competent national and international organizations. B) The improvement of welfare (living conditions) of the exposed person (B_m). The foundamental elements on which man physical welfare is based can be divided into the following two groups: $B_{m,1}$, those elements involving man directly; and $B_{m,2}$, those ele-

ments which act through the social organization. Hence we will have the relation: $B_m=B_{m,1}+B_{m,2}$. For the first elements ($B_{m,1}$) a further classification can be made into the following groups that are the fundamental elements for the human life: $B_{m,1,1}$: food; $B_{m,1,2}$: clothes; $B_{m,1,3}$: house; $B_{m,1,4}$: Health.
The quantitative choice of the varions $B_{m,1}$ dipends on the different individual and social situations and each country should establish these values giving them a "weight" on the basis of particular social and environmental circumstances. We will have: $B_{m,1}=B_{m,1,1}+B_{m,1,2}+B_{m,1,3}+B_{m,1,4}$.
For the second group ($B_{m,2}$:the social organization) to improve the conditions in the above sector, utilizes the elements which can be summarized as follows:
$B_{m,2,1}$: goods production; $B_{m,2,2}$: goods exchange; $B_{m,2,3}$: health.
The above sectors are a synthesis of varions activities. Like for $B_{m,1}$ also for $B_{m,2}$ we have to give a "weight" to each sector. Hence we will have: $B_{m,2}=B_{m,2,1}+B_{m,2,2}+B_{m,2,3}$.
Once $B_{m,1}$ and $B_{m,2}$ are evaluated in this particular situation, we will be able to calculate B_m keeping in mind that the "weights" to be given to $B_{m,1}$ and $B_{m,2}$ have a minimum value = 0 and a maximum value reflecting a particular environmental condition.
The choise of the above elements ($B_{m,1}$ and $B_{m,2}$) is only indicative; it can be substituted and extended. Our purpose is to present a working method necessary to introduce the proposed principle: "of the application of the risk-benefit relation to the single individual exposed to i.r.".

CONCLUSIONS

We have already shown how to evaluate B_d; with the above, we can evaluate B_m. Therefore we have $B=B_d+B_m$ (2) replacing on (1) we have $(B_d+B_m) - R>0$.
The evaluation of R can be easily made using the hypothesis of the straight line which shows the relationship be tween the absorbed dose and the probability of damage. This will give the possibility to choose the maximum value of dose of i.r. considered "acceptable" for the single individual exposed. Keeping unchanged the relation B-R>0 (1). However, if we take into account the ALARA principle, we will notice that the relation (1) indicates those values of R which are not to exceed but, if possible, they must be further reduced.

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