ECONOMICS OF RADIATION PROTECTION: EQUITY CONSIDERATIONS

ABSTRACT. In order to implement cost-benefit analysis of protective actions to reduce radiological exposures, one needs to attribute a monetary value to the avoided exposure. Recently, the International Commission on Radiological Protection has stressed the need to take into consideration not only the collective exposure to ionising radiation but also its dispersion in the population. In this paper, by using some well known and some recent results in the economics of uncertainty, we discuss how to integrate these recommendations in the valuation of the benefit of protection.

KEY WORDS: Radiation protection, equity, economics of uncertainty, optimisation

1. INTRODUCTION

Because of the uncertainty related to the existence of potential health effects induced by radiation exposure at low doses, the International Commission on Radiological Protection (ICRP) has adopted the reasonable assumption that there is some additional risk of cancer from any increment of dose. As a consequence, the proper attitude in radiological protection is to take any reasonable step to reduce all exposures as low as reasonably achievable, economic and social factors being taken into account. This attitude is known as the ALARA principle or optimisation of protection principle and constitutes (with the justification of practice and the limitation of individual doses) the basis of the system of radiological protection recommended by ICRP.

ICRP proposes guidelines to value investments in the field of radiological protection (see ICRP, 1973, 1983, 1985 and 1991). One of the purposes of any radiological protection investment is to reduce

the doses to which workers and the population are exposed. In order to evaluate these investments, one needs to compare their costs with the reduction in individual and collective doses they induce (see Stokell et al., 1991). To proceed to the computations, it is necessary to attach a monetary value to the detriment associated with each dose level.

The purpose of the present paper is to analyse the constraints imposed by the ICRP recommendations on the parameters of a widely used model of detriment valuation (the so-called value of the man-sievert) (see Berthet et al., 1992 and Lefaure et al., 1993). In the first section, we briefly present this model and its notation, as well as the three goals assigned by the ICRP recommendations to any investment in the field. In the following three sections, by using some results in the economics of uncertainty, we derive the implications of these goals in order to narrow the range of values admissible for one of the key parameters in the model.

2. THE MODEL AND THE ICRP RECOMMENDATIONS

In order to value the detriment associated with a dose level $x$, it is customary to define the average cost of this detriment ($\alpha_{\text{Ref}}(x)$) by a piecewise function:

$$\alpha_{\text{Ref}}(x) = \begin{cases} \alpha_{\text{base}} & \text{for } x \leq x_0 \\ \alpha_{\text{base}} \left( \frac{x}{x_0} \right)^a & \text{for } x \geq x_0 \end{cases}$$

This function implies, in accordance with economic intuition, that the average cost is constant (and equal to $\alpha_{\text{base}}$) below a dose level ($x_0$) and becomes a function of $x$ for values of the dose that exceed the level $x_0$.

The value of $\alpha_{\text{base}}$ reflects the basic monetary valuation of health effects associated with exposure and will not be discussed here. Similarly, the value $x_0$, which can vary according to categories of exposure (i.e. different categories of workers, or the public, as well as normal or accidental situations), will not receive our attention. Our main concern will be to determine some range of values for the exponent ‘$a$’ in accordance with the ICRP recommendations.