Combination of Utilitarian and Egalitarian Approaches in the Case of Radiation Accident

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I INTRODUCTION

The ICRP is developing new policy of radiation protection taking into consideration current social preferences. One of the important issues in the scope of new recommendations is emphasis on protection of individuals, including requirement to optimization. It means, that egalitarian ethics reflecting aspiration to equity of exposed individuals in radiological sense. Already 1990 Recommendations of the ICRP have introduced the constraint concept to limit the inequity of public exposure due to the certain practice. Also a model to determine a set of monetary values of a man-sievert according to the level of individual doses of occupational exposure is in consistence with egalitarian approach. However, optimization of protection in the case of nuclear accident continues to be based, implicitly, on the utilitarian ethics. This paper provides suggestions regarding the introduction of dose distribution information into the process of optimization of intervention following nuclear accident.

II THE PRESENT APPROACH

Clear examples of the utilitarian ethics application to problems of radiological protection of the public were given in the Publication 63 in the case of nuclear accident. For instance, optimized values of avertable dose rate for temporary relocation was defined as:

\[ E_a = \frac{c}{\alpha} \]  

where \( E_a \) is the average avertable dose per month, \( c \) is the ongoing costs of protective action per month, and \( \alpha \) is the value of avertable collective dose unit.

Taking into account the dependence of \( c \) and \( \alpha \) values versus national economic well-being, the relocation criteria have been estimated as much as 5 mSv/month \(^{-1}\) for rich developed countries and about 15 mSv/month \(^{-1}\) for developing countries (Table 1).

Consequences of utilitarian approach application are as follows:

1. monetary cost of radiological detriment varies up to 30 times for different countries;
2. inequity in acceptable level of radiation safety may be equals 3 times for different countries.

If international radiation standards for practice stimulate national regulatory authorities and legal persons to move to better safety levels reached in rich developed countries, then the proceeding from economic attribute is allowed for intervention inequity of public exposures. Two objectives may be defined for preventing of this confusion:

1. pragmatic global unification: the adoption of similar intervention criteria in different countries;
2. combination of utilitarian and egalitarian approaches: the application of both collective dose and individual dose distribution, when optimizing intervention levels.

III COMBINED UTILITARIAN-EGALITARIAN APPROACH

There are some models that allow to take into consideration the increasing monetary value of the collective dose unit, when the individual dose increases. The model of \( \alpha \) value linear growth is used here as follows:

\[ \alpha (E_a) = \alpha_0 + \beta E_a \]  

where \( E_a \) is the individual averted dose, mSv; \( \alpha_0 \) represents the monetary value of the health detriment associated with the unit of collective dose, USD (person\cdot mSv) \(^{-1}\); \( \beta \) is the value of collective dose unit assigned as a function of averted individual dose, USD (person\cdot mSv) \(^{-1}\).

Monetary value of protective action benefit, \( B \), (detti-
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Dose monitoring following the Chernobyl accident has demonstrated that distributions of external and internal doses within certain settlement may be approximated by log-normal distributions with geometric standard deviations of $\sim 1.5$ and $\sim 3$, respectively.

The external exposure was the main part of total dose in urban settlements (towns) and, alternatively, the internal exposure was the dominant component in rural settlements (villages without food restrictions).

Comparison of two approaches is given below for hypothetical cases of urban and rural settlements where $E_a = 100$ mSv, taking into account Russian economic situation, where

$$\alpha = 5 \text{ USD (person•mSv)}^{-1} \quad + \quad (1 \text{ USD (person•mSv)}^2)^{-1} \times E_a \text{ mSv}.$$  

According to utilitarian approach, $B_0 = 500$ N USD. According to combined approach, $B_1$ (urban) = 12,200 N (USD) and $B_2$ (rural) = 34,000 N (USD). If financial expenditure of relocation for one person is equal to 15,000

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<th>Table 1 Range of values of relocation and detriment costs for different countries$^a$.</th>
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<td>developing–rich developed</td>
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Monetary value of collective dose unit $\alpha$, USD (person•mSv)$^{-1}$

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IV DISCUSSION

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USD, then relocation is unjustified, according to utilitarian approach for both cases, but is justified for rural settlement, according to combined approach. Despite the conventionality of above-mentioned example the principal result is important: application of egalitarian ethics naturally takes into account requirement of radiation protection of critical group of population. Also, the combined approach has proposed the redistribution of financial resources in villages favor, if compared to towns in case of other equal conditions.

V CONCLUSION

High levels of public exposure in the case of a nuclear accident and wide distribution of individual doses should be taken into account in process of optimization.

Until now the egalitarian ethics was not considered for emergency and recovery actions. Both global unification of radiation standard and proposed utilitarian-egalitarian model for interventional criteria may be useful for these actions.

REFERENCES


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