METHODS AND PRINCIPLES FOR MAKING PRIORITIES IN RADIATION PROTECTION

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ABSTRACT

In making priorities one has to distinguish between the problems and the methods to solve them. They are both ranked on basis of aspects relevant for radiation protection and given different relative weight. The discussions in Sweden have concluded that the most important tasks in priority order are to prevent acute deaths, preclude stochastic effects in large populations, consider radiation problems related to high social and economical values and preclude stochastic effects in particularly exposed individuals. This leads to 8 areas of special concern.

INTRODUCTION

A first choice of priorities is found in the relative weight of questions on radiation protection as compared with other problems in the society. This choice is made on the political level on the basis of proposals presented by the competent authority. Factors involved are the available resources, the relative cost-effectiveness of activities in various areas of concern and the political significance of the problems in a more wide political framework.

A recent modifying factor in the choice of priorities is the increasing interest by politicians, authorities and scientists to get a better balance and similarities in the judgement and handling of risks from various kind of environmental pollutants. These may be e.g. radioactive and non-radioactive releases from industries and from waste disposal facilities. Two recent symposia discuss these problems (1,2).

In the area of radiation protection there is also an ambition to balance the efforts in reducing radiation doses in order to make the radiation protection optimized. That means that improvements in protection should be reasonable in comparison with other efforts made in society to reduce risks. This is achieved by using economical valuation of risks and relating these to protection costs.

PRINCIPAL METHOD FOR CHOICE OF PRIORITIES

At the authority level the decision on priorities is reflected in the budgetary process. This is made by choosing priorities of the marginal changes in the existing program i.e. using the so called incrementalistic approach in the decision making (3,4) or by using a more rigorous approach by questioning the whole programme on radiation protection and choosing priorities more thoroughly. Both methods have their benefits and drawbacks (5).

The first method is normally less cumbersome and therefore more often used. The second method is by definition more time consuming and needs more manpower. How it can be accomplished is described below on the basis of Swedish experience.

The activity of the authority is characterized by its programmes, working methods, organisation and resources. The choice of priorities is made on the problems to be solved i.e. the programmes, and on the working methods. The degree of priority of a problem decides its timetable and resources to be allocated. The degree of priority of various working methods decides inter alia the efficiency and profile of the authority. It is necessary before making priorities to structure the problems (and working methods) in a systematic way to make them comparable.

The various possible working methods are defined as e.g. international work, inspections, own measurements and control, check others' measurements, standardize, give lectures, give criteria, etc.

The basis for forming an estimate of the relative importance of the various problems (i) is a set of factors (aspects) (j), which are more or less important from the radiation point of view and for which we need to assess their relevance for each problem, (i).

Examples of these factors are political decisions, international decisions, requirements by the public, public concern, legal requirements, controllability, benefit of the practice where the problem occurs, cost-effectiveness of an action, collective doses, individual doses, risk of accidents, prognosis of development etc.

The importance of these factors (aspects) for each of the various problems gives a basis for choice of priorities. It can be found in three steps.

The first step means a ranking of the problems (i) with regard to the factors (j), one by one. This can be made by comparison of pairs of (i) in a matrix in such a way that the problems (i) will be ranked in order of importance for each factor (j). There is therefore one matrix for each (j). The ranking is made by answering the question: how important is factor (j) for a given problem (i) in the judgement of the overall importance of the problem, assuming that something can be made reasonably to solve/decreese/control the problem in respect to aspect (j). The ranking of problems in each matrix should reflect the relative importance of each aspect (j). In all matrices the condition of symmetry must be fullfilled i.e. if a>b and b>c then also a>c. This procedure yields a weighting factor w_{ij} for importance.

The second step means a ranking of the factors (j) irrespective of problem but just considering the overriding objectives of the authority and the general valuations in the society having in mind the actual state of conditions of the

radiation protection in the country. The ranking can also here be made in a matrix by a pair-ranking method, with condition of symmetry. The basis for judgements should in principle be made by interviews of various groups in the society. This yields a weighting factor q_j.

The two ranking procedures lead to a set of weighting factors of the problems (i) for each aspect (j). The third step is to multiply each factor w_{ij} with corresponding factor q_j and add all these products for each (i). The numerical value of the sum $\Sigma_j q_j w_{ij}$ indicates the relative priority of each programme. The reliability of the method is checked by a sensitivity analysis by having several people making the same analysis independently.

The choice of priorities for the working methods can in principle be made similarly. The factors (aspects) may be efficiency, cost, speed, competence, development, attracting and keeping personnel, good reliability, etc.

PRACTICAL RESULTS

In the discussions of priorities for the next 3-year radiation protection programme of the Swedish Radiation Protection Institute the presented methods and ideas were leading the thoughts even though we did not proceed along the mathematical formalism described above. It was concluded inter alia that the most important tasks of the Institute are in priority order the following

1. to prevent acute deaths and other serious damage caused by radiation
2. to preclude or decrease the stochastic effects of radiation in large populations
3. to pay attention to radiation protection problems related to conditions in society with high social and economical values
4. to further preclude or decrease the stochastic effects of radiation in particularly exposed individuals.

Using these bases of judgment in combination with some others, eight programmes (problems) were identified as those of highest priority. They are given below with special explanation in Fig.1 why they are justified. Their relative position is not in order of priority.

1. Radon in houses
2. Sun radiation
3. X-ray examinations of patients
4. Emergency preparedness for nuclear accidents in Sweden or abroad
5. Data screens
6. Strong sealed radioactive sources and large accelerators
7. Normal operation of nuclear power
8. Radioactive waste of nuclear power.

Fig. 1

Qualification/Programme	1	2	3	4	5	6	7	8
Number of cancer deaths per year prevented by protection effort	>100	>100	-	$>10^3$ 2)	-	-	-	-
Number of Swedes running a risk >1% to die in cancer caused by radiation	$>10^6$	$\sim10^6$	$>10^3$ 1)	-	-	-	$>10^3$	-
The protection efforts are cost-effective. Number of lives saveable for less than 0.2 M US dollars per life	>10	>100	>10	-	-	-	-	-
The radiation problems are connected to high social and economical values	yes	yes	-	yes	yes	-	yes	yes
There is a risk of acute deaths	-	-	-	yes	-	yes	-	-
The problem is increasing. A protection effort now is more efficient than later	-	yes	-	-	yes	-	-	yes
Need of good control	-	-	-	-	-	yes	yes	-

Notes. 1. Means unnecessary deaths
2. In total after a very serious accident

CONCLUSION

The discussion on priorities has been well received at the political level since it has been possible for board members and ministry officials to understand the main arguments behind the priorities suggested. In times of budget cuts it helps the politicians to get the best value for the money spent.

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