RISK ANALYSIS IN APPLICATION TO POST-ACCIDENT MANAGEMENT

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INTRODUCTION

As it follows from the experience in the assessment and analysis of the consequences of nuclear accidents or nuclear weapon tests as well as in the implementation of the protection and restoration measures, there are some reasons, on the one hand, to go beyond the scope of the radiation protection and to consider the non-radiation sources of risk as well. On the other hand, remaining in the framework of the radiation protection, it is not enough to base oneself only on the dose approach and using the current concept of the effective dose D_E, even though only the stochastic effects of exposure are under consideration (detailed discussion on these aspects see in (1)).

Values of risk determined by D_E do not involve the time and cannot make allowance for local and age features of population cohorts (or personnel) for which the aftereffects are estimated. The necessity of estimating non-radiation risks goes from the following:

- Some countermeasures being implemented can have negative side consequences of a non-radiological nature for a population; for example, the relocation, as follows from the experience available, may adversely affect the human health because of changing the social and other living conditions;
- Some possible trouble with the health of the population caused by local or national-wide social living conditions requires, in the context of the most efficient investitions in health protection, to assess by a unified way—through the risk analysis—the state of health as a whole and the background radiation and non-radiation risk causes;
- As it follows from the present-day methodology of estimating the radiological risk, the background values of carcinogenic risk must be known for the application of this methodology (models of relative risk).

All these points show that for assessment of consequences of nuclear accidents or tests and decision making on their mitigation health risk assessment from various radiation and non-radiation risk sources should be developed and used.

METHODOLOGY AND DATA BANK FOR RISK ASSESSMENT

To meet these needs a methodology and a bank of data for risk assessment and management are developed.

In the frame of the CIS state research programmes (Chernobyl and Altai case studies) and the international (EU–CIS) project JSP2 the research subproject "developing the methodology (MAR) and data bank (BARD) on risk analysis" started in 1994. The first version of MAR is published in (1). Main functions of BARD are:

- assessment of the radiological and non-radiological consequences of nuclear tests and accidents,
- assessment of the health of a population in terms of risk indices.
- analysis of effectiveness of radiation and social protection measures.

One version of BARD is developed as a module for the decision support computer system for a post-accident management.

BARD includes

1. Service and calculation codes realizing the methodology mentioned;
2. Health-demographic data (HDD: the age-cause-specific death rates and the age distribution density) which are neccessary for radiation and non-radiation risks assessment.

HDD have been prepared for population of many regions of Russia for different years, for some regions of CIS and some countries around the world.

Input data for BARD are: 1) values of absorbed or equivalent doses (short-term exposure) and dose rates (chronic exposure) of different human body organs due to radiation exposure from a source considered. These doses or (and) dose rates should be given in their dependence on age, time at exposure, countermeasures adopted etc.; 2) HDD from the internal BARD data base; 3) primary radiation or non-radiation risks models.

BARD to a certain extent analogous to the computer codes ASQRAD and SPIDER being developed by CEPN (France) and NRPB (UK). BARD differs from them by the large intrinsic HDD data base, the possibility of calculating non-radiological risks, areas of application etc.

BARD is constantly supported and developed in the two versions: local and distributed. The last one can be accessible through Internet (`http://144.206.130.230/`) at RRC "Kurchatov Institute" (Moscow, Russia).

RESULTS AND CONCLUSION

With these RAM and BARD estimations of health effects of the nuclear weapon tests on the Semipalatinsk test site and the Chernobyl accident respectively for population of the Altai region and Russia regions adjoined to the Chernobyl zone were made. The goal of the study is to obtain data on consequences of the tests and the Chernobyl accident for planning social protection measures. Two examples of these estimations for the rural population of the Bryansk region (for the most contaminated territory, the variant of exposure doses without countermeasures) are given (see Fig. 1 and 2).

Using risk assessment results can change notions about consequences of the nuclear tests or accidents and effectiveness of countermeasures.

A role of the approach based on the risk analysis in decision making on protection and restoration measures is discussed. One should note that in Russia the additional development of regulation documents for radioactively contaminated territories with using the risk assessment results has already began.

REFERENCES

1. V.F.Demin, Methodological recommendations on risk assessment in application to situations after nuclear weapon tests or accidents, in the Bulletin of the Federal Research Programme "Semipalatinsk Test Site / Altai Case Study", N 1, 1995, p. 36 – 55 (see also the improved and developed version of the recommendations in the 1995 report of the international (EU - CIS) project JSP2).

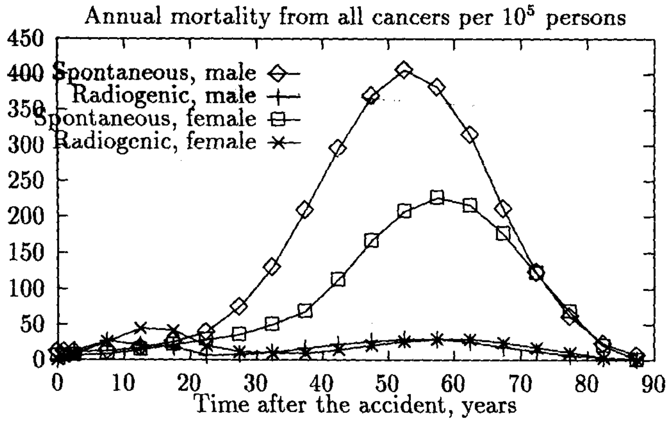

Figure 1: Annual mortality $\dot{M}(t)$ from spontaneous and radiogenic (due to the Chernobyl accident) cancers (per 100 000 persons with age 0 - 18 years at the accident), as a function of time t after the accident.

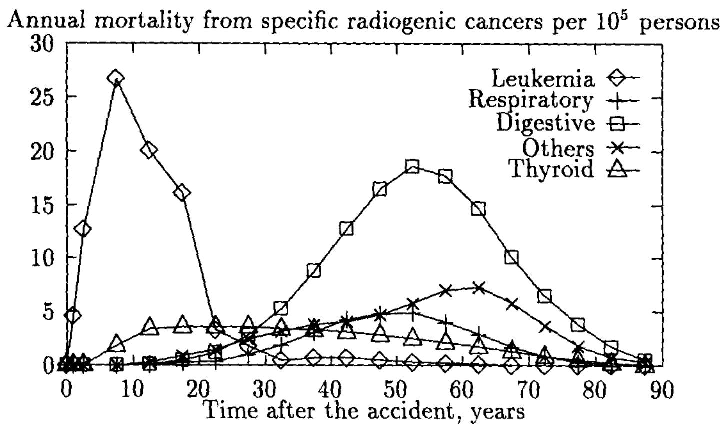

Figure 2: Annual excess mortality $\dot{M}(t)$ (morbidity for thyroid) from specific radiogenic cancers (per 100 000 persons with age 0 - 18 years at the accident, male), as a function of time t after the accident.