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solid cancer incidence among nuclear workers

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Preface to English Translation

Mankind has been exposed to radiation from time immemorial and has been exposed to man made radiation for over 100 years. Some adverse effects on health of man made X rays were found very quickly; high exposures received in a short period of time (acute exposures) destroyed tissue, and if over large parts of the body proved to be fatal. Smaller exposures over a longer period of time (chronic exposures) were later found to produce disease – primarily cancer. Starting in 1928, the International Commission on Radiological Protection (ICRP) made its landmark pronouncement that no one should be subjected to radiation without expectation of some benefit. The interpretation of this has occupied the Radiation Protection community, and the public, ever since.

Since the cancers produced by radiation are indistinguishable (to a pathologist) from naturally occurring (sporadic or spontaneous) cancers, it has been assumed (following Taylor’s theorem) that even small exposures produce an effect – increase in cancer rate – proportional to the dose. The most important data so far on the coefficients relating cancer rate to dose (as a function of age, sex, etc) are from the studies of cancer among 50,000 survivors of the atomic bombs dropped in Hiroshima and Nagasaki. These were single high, but sublethal, doses. They are modified by a Dose Rate Effectiveness Factor (DREF) believed to be about 2 based on experiments in animals.

Whereas in the 1920s and 1930s radiation protection concentrated on avoiding individual high doses – high meaning 10 times natural background – ICRP suggested that a «collective dose» criterion be used – the integral of the dose over the population. Using the assumption of linearity, a prediction can be made of the total number of cancers that are produced – even if they cannot be seen due to statistical fluctuations in the background. The Nuclear Regulatory Commission in the USA proposed that radiation doses be reduced if the cost is no more than $200,000 per person-Sv. (about $5,000,000 per calculated cancer). This concept is being extended in some situations by the US EPA who use a figure of $5,600,000 per statistical life.

ICRP is now modifying this policy to address individual risks to a greater extent than recently. These papers are starting a discussion of how this would apply for workers at Russian nuclear installations. This is an important discussion and all members of society must be involved. How much extra medical care should a worker receive when his calculated risk is 10% greater as a result of his radiation exposure? Simple arithmetic suggests that the nuclear installation should add 10% to the costs the worker or society would otherwise pay for cancer care. If a person with an attributable risk of 10% of the risk due to natural causes, dies of a cancer the risk becomes unity and we then discuss the Probability of Causation which becomes 10%. Is that enough for his family to receive compensation and if so how much? In the USA the rule in toxic tort cases is that it be «more likely than not» that the postulated cause (radiation) is the actual cause (Probability of Causation greater than 50%) and but there have been specific cases (such as persons downwind of atomic bomb tests) where the US Congress has been more generous. On another aspect, there have been many academic discourses, but no public agreement, suggesting that compensation be paid proportional to the Probability of Causation.

These issues are not unique to radiation, because cancer is not uniquely caused by radiation exposure and low dose linearity applies to many chemical exposures also. The issues are therefore far broader than ICRP and should be, and hopefully will be, widely discussed not only in the Radiation Protection Community (as in these papers) but also in the academic community, the legal community, the government community and the general public. Not only in Russia, but in the whole world. This set of papers is an important start.