**A Statement of the German Society for Radiation Protection against Current Attempts of the Nuclear Lobby to Deny Low-Dose Radiation Effects**

# The 100 Millisievert Threshold Lie

***Decades ago, the concept of "stochastic" radiation effect was developed by the International Commission on Radiological Protection (ICRP) for cancer and hereditary diseases. Makers and users of radiation technologies and several professional associations have fought the ICRP´s no-threshold thesis since, and after the Fukushima disaster interested bodies have promoted the assertain that no detrimental effects have ever been observed below a dose of 100 mSv.***

In contrast to this view, the international committees ICRP, UNSCEAR* and BEIR** have accepted meanwhile, that in fact stochastic effects must be expected following doses far below 100 mSv. This state of knowledge is derived from the following five fields of research:

1) Cancer induction after in utero exposure by ionizing radiation
The results of the Oxford Survey of Childhood Cancers have been reevaluated[1, 2]. Consequently the BEIR VII report of 2006 f.i. states in the summary of Chapter 7 (Medical Radiation Studies) on page 173: "Studies of prenatal exposure to diagnostic X-rays have, despite long-standing controversy, provided important information on the existence of a significantly increased risk of leukemia and childhood cancer following diagnostic doses of 10-20 mGy *in utero*."

2) Low dose effects in the A-bomb survivors
It is a common claim in lectures on radiation protection, that effects in the low dose range cannot be measured but must be extrapolated from findings at high doses. The investigators of the Japanese A-bomb survivors protested against this interpretation, because most survivors are in the low dose cohorts and the mean dose of the whole sample is only about 200 mSv[3]. Pierce and Preston studied the data for solid cancer in the dose range below 0.5 Sv separately and found:"There is a statistically significant effect in the range 0-0.1 Sv"[4].

3) Radon in homes and lung cancer
It was shown by analysis of 13 case-control studies in Europe[5] and 7 North American case-control studies[6] that there is a proportionate increase of lung cancer and the mean radon concentration for individuals in houses. Darby et al.[5] state that the effect is also significant in the dose range below 200 Bq/m$^3$, which corresponds to an effective dose of 3.2 mSv per year and a lung dose of 26.7 mSv per year. This was adopted by the World Health Organisation (WHO) in 2009, Fact sheet No. 291. In 2011, a prospective study surveying 820,000 Canadians[7] found an 15 % increase of lung cancer mortality per 100 Bq/m$^3$ increase in radon (Darby 16 %; Krewski 11 %; WHO 16 %).

4) Occupational exposures
Since the 1970ies, a great variety of studies on nuclear workers have been done. They showed a significant increase of effects with dose even within the legal limits. This was confirmed in 2007 by the IARC (International Agency for Research on Cancer), a foundation of the WHO. IARC organized the 15-Country Collaborative Study of Cancer Risk among Radiation Workers in the Nuclear Industry[8]. The Canadian National Dose

* United Nations Scientific Committee on the Effects of Atomic Radiations
** Biological Effects of Ionizing Radiations

Registry published similar findings and states that the cancer risks are higher than in the studies on atomic bomb survivors[9]. In the third analysis of the British National Registry for Radiation Workers the authors find that it strengthens the evidence for elevated risk from these exposures[10]. The mean exposure taken from personal dosemeters was 24.9 mSv.

5) The contaminated population at Techa river, South Ural
The speaker of the 15-Country Study Elisabeth Cardis came to the opinion that the effects of low dose-rate exposures are most reliably shown in that study and – besides Radon – in the Techa river population[11]. This region was contaminated between 1949 and 1956 by the effluents of a plutonium reprocessing facility (Mayak) for the Soviet nuclear weapons programme. The investigators found "strong evidence that such exposures lead to significant increases in risk that are rougly proportional to dose" (for solid cancer) and were not less effective than acute exposures[12]. The median stomach dose was estimated at 40 mGy.

Moreover, there are numerous findings about late effects after diagnostic X-rays, also in recent times. These should be noted and adopted by the scientific community. For example:

**Leukemia** after exposure of children and adults[13-17].
**Breast cancer** mortality in scoliosis patients of exposure age < 19 y., RR=1,63, mean breast dose 109 mGy[18].
**Brain tumors** by dental and other exposures, see Table 1.
**Prostate cancer** in the U.K.[24], the authors estimate that 20 % of cases in men < 60 y. are radiation-induced. The effect is confirmed by other low dose studies (nuclear workers, pilots, radon).
**Others**[19; 25-30].

Table 1. Brain tumors after diagnostic X-ray exposure.

| Investigation (Case-control studies) | | Study about | Results (relative risk) |
|---|---|---|---|
| **Dental exposures** | Los Angeles[19] 1972-1979<br>≥ 4 x Panorama | Meningiomas | 2.5 P=0.04 |
| | Missouri Cluster[20] 1973-1982 | Malign tumors | 10.7 (1.4-81) |
| | Uppsala[21] 1987-1990<br>≥ 1 x annually | Meningiomas<br>Gliomas<br>All tumors | 2.1 (1.0-4.3)<br>not elevated<br>not sign.elevated |
| | U.S.A.[22] 1995-2003<br>≥ 6 x Panorama | Meningiomas | 2.0 (1.0-4.2) |
| **X-ray Neck/Head** | 2 Swedish regions[23] 1994-1996 | Meningiomas<br>All tumors | 5.0 (1.6-15.8)<br>1.6 (1.0-2.6) |

**To insist on a "practical" threshold dose of 100 mSv in these days simply ignores the current state of knowledge. It is irresponsible and criminal with respect to the victims of environmental radioactive contaminations and other low dose exposures.**

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