# IONISING RADIATION & CANCER

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The weight of scientific opinion holds that there is no threshold below which ionising radiation poses no risk of inducing fatal cancers. Moreover, as scientific understanding of the effects of ionising radiation has advanced, permitted dose limits have been dramatically reduced. For workers, the permitted dose has decreased from 500 millisieverts (mSv) p.a. in 1934 to 20 mSv (averaged over five years) in 1991. In Australia, the maximum permitted dose is 1 mSv for members of the public (in addition to background radiation which is typically of the order of 2 mSv p.a.)

**Linear no-threshold risk model**

Radiation protection agencies around the world, including the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), all base regulations on the linear no-threshold model which assumes that there is no threshold below which radiation exposure is safe.

Uncertainties will always persist because of methodological difficulties. In circumstances where people are exposed to low-level radiation, epidemiological studies are unlikely to be able to demonstrate increased cancer rates because of the 'statistical noise' in the form of widespread cancer incidence from many causes, as well as other methodological difficulties. A report by the US Committee on the Biological Effects of Ionising Radiation (BEIR 2005) illustrates the point − it estimated that one out of 100 people exposed to 100 mSv of radiation over a lifetime would probably develop cancer as a result of that exposure, but that 42 cancers can be expected in the same group from causes other than radiation exposure.

The methodological difficulties are discussed by Dr Sue Wareham (www.energyscience.org.au):

*"Firstly, health effects such as cancer due to radiation exposure often take decades to develop. Secondly, cancers due to radiation exposure are indistinguishable from any other cancer. Thirdly, radioisotopes can travel great distances. Therefore epidemiological studies investigating the effects of a particular radiation exposure are necessarily very long, they may involve many countries if not continents, and they are extraordinarily complex.*

*"Add to this the fact that cancer is a common disease in any event, and the result is that a small percentage increase in cancer rates due to radiation exposure can readily be overlooked, even when the absolute number of cancers caused by radiation exposure may be very large.*

*"A further source of misleading research results is the mixing, inadvertently or knowingly, of data for populations exposed to quite different levels of radiation, for example after a nuclear accident. The results for heavily exposed populations may then be 'diluted' by results for much less exposed populations and the results overall will appear reassuringly low."*

**US National Academy of Sciences**

Notwithstanding the methodological problems, there is growing scientific confidence in the linear no-threshold model. An important study was the 2005 report of the Committee on the Biological Effects of Ionising Radiation of the US National Academy of Sciences. The BEIR report comprehensively reviewed available data and supports the linear no-threshold risk model. The BEIR Committee stated:

*"The Committee judges that the balance of evidence from epidemiologic, animal and mechanistic studies tend to favor a simple proportionate relationship at low doses between radiation dose and cancer risk."*

*"... the risk of cancer proceeds in a linear fashion at lower doses without a threshold and ... the smallest dose has the potential to cause a small increase in risk to humans."*

Other scientists and scientific bodies have reached similar conclusions. For example **a** 2010 report by the United Nations Scientific Committee on the Effects of Atomic Radiation states that "the current balance of available evidence tends to favour a non-threshold response for the mutational component of radiation-associated cancer induction at low doses and low dose rates."

**Misinformation from the nuclear industry**

The difficulty of demonstrating health impacts from low-level radiation exposure is used by nuclear proponents as the basis for disingenuous and scientifically-indefensible statements.

The industry-funded Uranium Information Centre (UIC) ignored predicted deaths from low-level radiation to claim that nuclear power is far safer than alternative energy sources including hydro. Yet the United Nations Scientific Committee on the Effects of Atomic Radiation estimated the collective effective dose to the world population over a 50-year period of operation of nuclear power reactors and associated nuclear facilities to be two million person-Sieverts (UNSCEAR, 1994, "Ionising Radiation: Sources and Biological Effects"). Applying standard risk estimates to that level of radiation exposure gives a total of 100,000 to 200,000 fatal cancers. Of course, applying risk estimates (with their uncertainties) to dose estimates (with their margin of error) is less than precise. But the nuclear industry's solution − to pretend that its emissions have no impact whatsoever − is dishonest.

To give one further example, the UIC states: "According to authoritative UN figures, the Chernobyl death toll is 56 (31 workers at the time, more since and 9 from thyroid cancer)." However, detailed UN reports in 2005-06 estimated 9,000 cancer deaths due to Chernobyl among the people who worked on the clean-up operations, evacuees and residents of the highly and lower-contaminated regions in Belarus, the Russian Federation and Ukraine. Other, credible scientific studies estimate 16,000 to 93,000 cancer deaths across Europe. (More information: www.nuclear.foe.org.au/power)

**Uranium mining and cancer**

Uranium mine workers are exposed to radiation from the ore itself and from the inhalation of radon gas.

The waste ore and tailings from uranium mining pose a public health hazard well into the future.

There is a well established link between uranium mining and lung cancer. The BEIR VI report reviewed eleven studies of 60,000 underground uranium miners. It reported 2,600 deaths from lung cancer, eight of which were uranium mines in Europe, North America, Asia and Australia. The report found an increasing frequency of lung cancer in miners. This was directly proportional to the cumulative amount of radon the miners had been exposed to.

In addition to exposure to radon gas, uranium miners are also exposed to gamma radiation directly from the radioactive ore. At the Olympic Dam underground uranium and copper mine, the total annual dose per miner is approximately 6 mSv, of which 2−4 mSv are due to radon gas (allowing for the new ICRP risk estimate for radon) and the balance due to gamma radiation. Workers at the smelter at the Olympic Dam mine receive annual doses that may exceed 12mSv.

In recent years the International Commission on Radiological Protection (ICRP) has upwardly revised its estimate of the carcinogenicity of radon. The latest ICRP evaluation of epidemiological studies of lung cancer risk from radon and radon progeny indicates that the risk is greater by approximately a factor of two than previously estimated. The ICRP's upwards revision of the hazards associated with radon exposure is clearly inconsistent with specious claims that the 'modern' view is that low-level radiation exposure is harmless.

ARPANSA has noted that the reassessment of the hazards associated with radon exposure "will have significant implications for the uranium industry worldwide, particularly for underground uranium mines." Previous dose estimates to miners from radon need to be approximately doubled to accurately reflect the lung cancer hazard.

**More information**

Dr Peter Karamoskos, 2010, 'Nuclear power & public health', http://evatt.org.au/papers/nuclear-power-public-health.html

Medical Association for Prevention of War: www.mapw.org.au/nuclear-chain/radiation

Friends of the Earth: nuclear.foe.org.au/radiation