

Statement on Tritium

On Nov. 19, 2020, SLF had radiation biologist, Ian Fairlie PhD, lectured to the safety of living near a nuclear power plant. Dr. Fairlie described some recent thinking about tritium, a radioactive isotope of hydrogen which is released in large quantities by nuclear facilities, even closed plants such as CA's San Onofre. The summary of his comments are followed by references to his reports.

Reassessment of Tritium's Dangers to Humans and the Environment

Tritium was first discovered almost a century ago by New Zealand scientist Ernest Rutherford and his colleagues. Rutherford was the first to split the atom and is often regarded as the father of nuclear physics. He was knighted by King George V and received a Nobel Prize for his pioneering work. Lord Rutherford, referred to by Albert Einstein as "a second Newton," was buried in Westminster Abbey just west of Sir Isaac Newton.

For the rest of the 19th century, tritium was often dismissed as a "weak" radionuclide which led many to underestimate its hazards. All this changed in the 21st century when scientists began to realize that tritium is much more dangerous than previously suspected. Although tritium is a low-range beta emitter, it can be very harmful as an internal emitter when it gets inside the body. It is more dangerous than most radionuclides partly because its beta particle free path is quite large, about the diameter of a chromosome in relative terms. It is also quite dangerous because it remains in the body for long periods.

The new concern about tritium is partly because all nuclear facilities emit very large amounts of tritium. In its elemental form, tritium diffuses through most containers, including those made of steel and concrete. Tritium is difficult to contain, and in its oxide form it is generally not detected by commonly used survey instruments. Because tritium is both an activation product and a tertiary fission product, large amounts are produced in nuclear reactors. It contaminates the concrete structures at nuclear power plants so that the older the station, the more the contamination. Large amounts of tritium continue to be released for decades after a nuclear power plant is closed.

We now know that tritium has an exceptionally high molecular exchange rate with stable hydrogen atoms thus making it extremely mobile in the environment. Emissions from nuclear facilities can rapidly contaminate all biota in adjacent areas. Tritium binds with organic matter to form organically bound tritium. Because of its long half-life, it resides in tissues and organs for extended periods. This can increase cancers and congenital malformations for those living near nuclear facilities.

Tritium is the only one of the three hydrogen isotopes that is radioactive. It is an essential component of every nuclear weapon. The gaseous form, tritium oxide (i.e., radioactive water or radioactive water vapour), enters the body by inhalation, ingestion, or absorption through the skin. Tritium in the body immediately mixes with body fluids and is dispersed widely because water is found everywhere in our bodies. Once inside the body, it becomes organically bound and can concentrate in cells and certain organs in our bodies.

Tritium decays via a beta particle emissions and can be more dangerous than most X-rays. It has a half-life of 12.3 years. While most of its atoms will have decayed in ten half-lives (123 years), many scientists believe it might take 20 half-lives (246 years) or more to reach safe levels. The safety of tritium after centuries depends partly on how much was emitted since a small fraction of a large amount can still be very hazardous. Studies reveal that tritium is one of the most common internal emitters found in humans. As an internal

emitter, tritium can alter cellular DNA and cause a variety of damaging health effects. One of the most significant effects is cancer which sometimes takes years to develop. Many epidemiology studies have reported increases in cancers and congenital malformations among people living near nuclear facilities.

References and further details regarding the reports of Dr. Ian Fairlie

The Hazards of Tritium, March 13, 2020: <https://www.ianfairlie.org/news/the-hazards-of-tritium/>

Continued Radioactive Emissions from Old Closed Nuclear Reactors, Oct. 12, 2019: <https://www.ianfairlie.org/news/continued-radioactive-emissions-from-old-closed-nuclear-reactors/>

Should TEPCO / Japanese Government Dump Tritium-Contaminated Water from Fukushima into the Sea? Sept. 18, 2019: <https://www.ianfairlie.org/news/should-tepco-japanese-government-dump-tritium-contaminated-water-from-fukushima-into-the-sea/>

A Hypothesis to Explain Childhood cancers near nuclear power plants, *Journal of Environmental Radioactivity*, Vol. 133, July 2014: <https://www.sciencedirect.com/science/article/pii/S0265931X13001811>

Review of epidemiology studies of childhood leukemia near nuclear facilities (with A.A. Körblein), *Radiation Protection and Dosimetry*, 138 (2), Feb., 2010

Report of the Committee Examining Radiation Risks of Internal Emitters (CERRIE), <https://webarchive.nationalarchives.gov.uk/20140108135440/http://www.cerrie.org/report/>, 2004

New Yorker <https://www.newyorker.com/tech/annals-of-technology/the-activists-who-embrace-nuclear-power>

LTE: *The Activists Who Embrace Nuclear Power*, Feb. 19

It's easy to dismiss anti-nuclear activists as fear mongers who confuse nuclear power with atomic bombs. The concern is legitimate. Cancer is the number one killer in the country and over 100 million live within 50 miles of a nuclear facility. Cancer effects are not immediate and may take many years to develop, especially in women and children who are much more vulnerable to radiation. Although the nuclear industry suppresses research on cancer streaks near nuclear power plants, there is enough scientific evidence to raise concern. Radiation biologist Ian Fairlie has reviewed 60 epidemiological studies. He reports most published research has discovered cancer effects.

Another serious worry is the inability to find any solution for the 100,000 tons of highly radioactive nuclear waste produced by nuclear power plants. This is the Achilles heel of the nuclear industry. Not discussed is the vulnerability of nuclear power plants to terrorism and earthquakes, nor mention of the real story at San Luis Obispo.

When the accidents happen, they can be trillion-dollar catastrophes. Nuclear power remains the most expensive, dangerous, unreliable, and environmental unfriendly form of energy production. Let's focus on clean energy.

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