nuclear watch new mexico

Selected Literature on the Potential Health Effects of Tritium

Summary: The Los Alamos National Laboratory's planned release of up to 100,000 curies of radioactive tritium from four "Flanged Tritium Waste Containers" could impact public health. Of particular concern could be human female reproductive capability. LANL has sat on its tritium containers since 2008 and has not made clear why venting before this winter is so urgent now. The Lab has also not stated what (if any) alternatives it has considered to open venting. Before proceeding with venting LANL must obtain "temporary authorization" from the New Mexico Environment Department. NMED should not grant that temporary authorization until LANL has supplied it with a comprehensive analysis of alternatives and documentation of little to no expected public health impacts, all subject to public review and comment.

Potential Health Effects of Tritium

The available literature on the potential health effects of tritium vary widely in their conclusions, sometimes in contradictory fashion. Tritium is a low-energy beta emitting radioactive isotope of hydrogen. Commercial nuclear power plants routinely produce and emit large amounts of tritium. In addition, tritium is used to "boost" the explosive power of nuclear weapons. Not surprisingly the nuclear energy and weapons industries pretty much dismiss any serious public health danger from tritium, for example noting that:

> "…its potential to be hazardous to human health is solely because it emits ionizing radiation (the beta particle). This radiation exposure may very slightly increase the probability that a person will develop cancer during his or her lifetime."[1]

On a more neutral note, a 2014 Scientific American article stated:

> "… unlike other radionuclides, tritium is usually part of water, so it ends up in all parts of the body and therefore can, in theory, promote any kind of cancer. But that also helps reduce the risk: any tritiated water is typically excreted in less than a month."
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> "Some evidence suggests the kind of radiation emitted by tritium—a so-called beta particle—is actually more effective at causing cancer than the high-energy radiation such as gamma rays, even though skin can block a beta particle. The theory is that the low-energy electron actually produces a greater impact because it doesn't have the energy to travel as far and spread its impact out. At the end of its atomic-scale trip it delivers most of its ionizing energy in one relatively confined track rather than shedding energy all along its path like a higher-energy particle. This is known as density of ionization, and has been shown with the similar form of radiation called an alpha particle."

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[1] *Tritium*, Health Physics Society Fact Sheet Adopted: March 2011 Revised: January 2020, https://hps.org/documents/tritium_fact_sheet.pdf

> "Ionization is what makes radiation dangerous for human health. Essentially, the radioactive particle smashes into the atom or molecule and pushes out an electron or other particle, leaving that atom or molecule in a charged or ionized state. These charged molecules can then cause other damage as they interact with other atoms and molecules. That includes damage to DNA, genes and other cellular mechanisms. Over time this DNA instability results in a higher chance of cancer. As a result, scientists work under the assumption that any amount of radiation poses a health risk." [2]

An independent scientist in the United Kingdom speaks more strongly against the potential health impacts of exposure to tritium:

> "Nuclear facilities emit very large amounts of tritium, ^{3}H, the radioactive isotope of hydrogen. Much evidence from cell/animal studies and radiation biology theory indicates that tritium is more hazardous than gamma rays and most X-rays. However the International Commission on Radiological Protection (ICRP) continues to underestimate tritium's hazard by recommending a radiation weighting factor (w_R) of unity for tritium's beta particle emissions. Tritium's exceptionally high molecular exchange rate with hydrogen atoms on adjacent molecules makes it extremely mobile in the environment. This plus the fact that the most common form of tritium is water, ie radioactive water, means that, when tritium is emitted from nuclear facilities, it rapidly contaminates all biota in adjacent areas. Tritium binds with organic matter to form organically bound tritium (OBT) with long residence times in tissues and organs making it more radiotoxic than tritiated water (HTO). Epidemiology studies indicate increases in cancers and congenital malformations near nuclear facilities. It is recommended that nuclear operators and scientists should be properly informed about tritium's hazards; that tritium's safety factors should be strengthened; and that a hazard scheme for common radionuclides be established." [3]

There is substantial concern over how tritium may impact fetuses since tritiated water can easily cross the placenta. There is also concern that tritium can be transferred from the mother to offspring through milk.

In 1980 the U.S. National Academy of Sciences noted that:

> "Because tritium (hydrogen-3) is a potential pollutant from nuclear-energy production, it's effect on development [of unborn babies] has been the subject of a number of studies… Tritiated water (HTO) is a common chemical state of tritium, and it has easy and rapid access to living cells, including those of the embryo or foetus… HTO administered in the drinking water to rats throughout pregnancy produced significant decreases in relative weights of brain, testes, and probably ovaries, and increases in norepinephrine concentration, at doses of 10 microcuries per

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[2] *Is Radioactive Hydrogen in Drinking Water a Cancer Threat?*, David Biello, February 7, 2014,https://www.scientificamerican.com/article/is-radioactive-hydrogen-in-drinking-water-a-cancer-threat/

[3] Summary, *The Hazards of Tritium*, Dr. Ian Farlie, March 13, 2020, https://www.ianfairlie.org/news/the-hazards-of-tritium/ This independent study is recommended for its comprehensiveness.

millilitre (estimated at 3 rads per day), and produced weight decreases in a number of [other] organs at higher doses. [4]

"Until an exposure has been clearly established below which even subtle damage does not occur, it seems prudent not to subject the abdominal area of women of child-bearing age to quantities of radiation appreciably above background, unless a clear health benefit to the mother or child from such an exposure can be demonstrated." [5]

Some relevant quotes from other sources are:

"There is now experimental evidence, both in terms of changes in the developmental effects on foetuses in utero in animals and also in studies of cancer induction, that tritium [is] four or five times more effective than would be predicted just on the basis of its energy alone." [6]

"Concerning the passage of tritium administered [in animal studies] under the form of tritiated water from the mother through the placenta and into the foetus ... several statistically significant effects were found at various HTO levels, in no apparent relationship with dose. These included microcephaly [shrunken heads, also observed at Hiroshima], sterility, stunting, reduction of the litter size, ..." [7]

There is also reported concern over how tritium could affect the reproductive capability of human females, as in the following:

Dr. Radford: First, with regard to the relative effectiveness of this very weak beta, there is now experimental evidence, both in terms of changes in the developmental effects on foetuses in utero in animals and also in studies of cancer induction, that suggest that tritium has somewhat more effect. How much more? Four or five times more effective than would be predicted just on the basis of its energy alone. It has what we call an RBE [a "relative biological effectiveness" factor] of about four or five. So that factor has to be borne in mind…

What if a woman is in the early stages of pregnancy and the child is a girl -- 50 per cent chance? That woman is going to be laying down her ova in the uterus at the time that slug of tritium comes in. Now the DNA of the ova will be labelled with the level of concentration of tritium that is appropriate at that time, within a day or two or three, rather than averaged over a longer time. As far as we know that tritium that is laid down in the DNA of the ova of that developing girl will remain for her whole reproductive lifespan. There is no exchange of that type of hydrogen. It is a very different kind of hydrogen as far as the body is concerned. Most of the hydrogen in our body exchanges readily with tritium…

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4 The U.S. National Academy of Sciences' BEIR-III Committee, (BEIR = Biological Effects of Ionizing Radiation), Excerpt from pp. 485-486: "Somatic Effects Other Than Cancer", http://www.ccnr.org/tritium_1.html#BEIR

5 Ibid., p. 493.

6 Dr. Edward Radford, testimony to the Select Committee on Ontario Hydro Affairs, July 10 1979.

7 *Sources and Effects of Ionizing Radiation,* United Nations Scientific Committee on the Effects of Atomic Radiation, Report to the UN General Assembly. 1977, p.695, http://www.ccnr.org/tritium_1.html#UNSCEAR

> They will have tritium in them as long as that girl is alive. After she is born the tritium is still there, it is hung on to. That hydrogen is held very tightly, in contrast to most hydrogen. Therefore, the probability is that that tritium will decay at some time during the reproductive period of that girl. Under those circumstances the concentration of tritium in that particular, very small compartment of the body of that woman is much higher than one would predict on the basis of the classical models.[8]

This compendium of literature on potential health impacts of tritium is available online at https://nukewatch.org/potential-health-effects-of-tritium/ October 15, 2020

[8] Testimony of Dr. Edward Radford to the Select Committee on Ontario Hydro Affairs, Hearings on The Safety of Ontario's Nuclear Reactors, July 10, 1979, http://www.ccnr.org/tritium_2.html