**Plymouth nuclear power plant testimony–re-proposed Holtec tritiated hydrogen release**

Good afternoon, and thank you to the Plymouth Board of Health for inviting me to speak here today.

I am Dr. Brita Lundberg, Chair of the Board at Greater Boston Physicians for Social Responsibility, Chair of the Environmental and Occupational Health Committee at the Massachusetts Medical Society; and an infectious disease doctor and internist.

Greater Boston Physicians for Social Responsibility is a physician-led group of health professionals and community members working to address the twin existential threats to human health: nuclear weapons development and climate change. Our members include nationally recognized experts in public health, cancer epidemiology, occupational medicine, environmental health, emergency medicine and disaster preparedness.

**A brief history**

One of GBPSR’s members is Dr. Dick Clapp, Professor Emeritus at the Boston University School of Public Health and former MA state cancer epidemiologist. Professor Clapp shared with me that the Massachusetts cancer registry was created in 1980 due to the excess number of cancer cases and excess mortality that arose in proximity to Pilgrim nuclear power plant; there was, he says, an increased signal for leukemia from the time the Plymouth reactor first went into operation: Clapp found fourfold excess leukemia cases among nuclear power plant workers–according to Clapp, the worst in the US nuclear industry in terms of over-exposure of workers to radiation at the time; and a case control study showed increased infant mortality, thyroid cancer; and leukemia was 75% more frequent in 1982-84 in that community, an effect that was attributable to the presence of the nuclear plant.

Now that the plant is decommissioned, the new operator, Holtec, wishes to dispose of over a million gallons of radioactive waste water from the holding pools into Cape Cod Bay. What are the health risks of this action? There are several.

1. Risks to marine life–one of the known radioactive contaminants in this water, tritium, can achieve concentrations in mussels and benthic fish 1000 times higher than the HTO concentration in the water;
2. Risks to humans–both from ingesting fish and molluscs, since the increased radioactivity will travel up the food chain; and via direct assimilation from swimming in and absorbing radioactive water.
3. Unknown but certain health risks due to cumulative effects with other pollutants, which will be magnified because this radioactive material will persist in the environment for more than a century;
4. Unknown effects of other radioactive isotopes that might be present in the waste water–below the limits of detection of tests used by Holtec

**Tritium–Background**

Tritium is the radioactive isotope of hydrogen. Because the tritium atom can exchange with hydrogen in organic molecules like water, it makes water radioactive. Tritium is unique in this. Since it makes water radioactive, that means that whatever living organisms absorb that water–plants, animals, essentially, our food –will likewise become radioactive–as will we, since that radioactivity will move right up the food chain into humans.

Tritium has a relatively short half life–12.5 years. Materials with very short half-lives, like iodine-131 (8 days), are intensely radioactive. For a given mass, for instance, tritium is about 150,000 times as radioactive, in terms of disintegrations per unit time, as plutonium-239. Tritium is **a persistent pollutant: it is estimated** to persist in the environment for up to 130 years. It is a potent pollutant: very little of it is required to contaminate water to the EPA limit: just one teaspoon of tritiated water (as HTO) would contaminate about 100 billion gallons of water to the U.S. drinking water limit.

Tritium is particularly problematic because, unlike most other radioactive contaminants, it cannot be filtered out of the water since it is incorporated into the water molecule.

**Health effects**

Thenegative health effects of radiation have long been recognized, but I think it is important to recognize how even a small amount of radiation exposure can have significant health consequences. Dr. Alice Stewart’s work in England In the 1960s made clear the harms of radiation exposure to the developing fetus: she showed that a single maternal x-ray in a pregnant woman (which used to be a standard practice until the 1980s to determine the position of a fetus) *doubled* the risk of subsequent childhood leukemia in the child.

One x-ray is equivalent to 2 millirem of radiation. The allowed level of radiation from tritium (MCL or maximum contamination level), according to EPA, is 4 millirem a year, or two chest x-rays a year.

Tritium is in a way a more insidious form of radiation than that from a chest x ray: it is a a so-called internal emitter–which means, *according to the Nuclear Regulatory Commission, that it has a greater ability to penetrate tissues*, because it is readily incorporated into the body. It is taken up *especially avidly by the respiratory passages, bone surfaces, and in bone marrow.* It crosses the placenta and concentrates in the fetus at higher levels than in the mother. According to Argonne National Laboratory:

Ingested tritium oxide is also almost completely absorbed, moving quickly

from the gastrointestinal tract to the bloodstream. Within

minutes it is found in varying concentrations in body fluids, organs, and other tissues.

There are few studies of the human health effects of tritium alone because in general it keeps company with many other potent radioactive isotopes. But the clinical studies that do exist have shown signals for increased leukemia, prostate and kidney cancer; and in vitro data in animal models show various biological effects known to trigger cancer including DNA strand breaks, cell death or apoptosis and chromosomal abnormalities. A recent study of tritiated water in human umbilical vein endothelial cells likewise showed significant cellular damage, with increased cell death; decreased cell adhesion (which is required for healthy blood vessels) and decreased ability to form new blood vessels.

**No safe level of radiation exposure**

Like other environmental pollutants like the air pollutant PM 2.5, and heavy metals like lead and the volatile organic compound benzene, there is no threshold for the negative health effects of radiation. The scientific consensus is that every additional exposure to radiation adds to the total risk for genetic damage and thus for cancers like leukemia; increased radiation necessarily implies increased incidence of these diseases in exposed populations. For solid cancers, the risk for cancer from radiation is linearly proportional to exposure.

No threshold or "safe dose" of tritium has been scientifically established for any of these effects.

**For all of these reasons,** UN experts opposed the Japanese decision to release radioactive waste water at Fukushima: in addition to tritium, they are concerned that the water may contain quantities of radioactive carbon-14, as well as other radioactive isotopes including strontium-90.

**Above all do no harm: time to ask to call for a universal Hippocratic Oath?**

In 1997, the Director of the EPA Office of Radiation and Indoor air, Ramona Trovato, declared: “To put it bluntly, radiation should not be treated as a privileged pollutant. You and I should not be exposed to higher risks from radiation sites than we should be from sites which … contained any other environmental pollutant. ” (April 12,1997)

What did she mean by that? She meant that –then, as now–the guidelines for radioactive pollution allow for 1 excess cancer for every hundred people exposed. That is 100-10,000 times the standard acceptable risk level for all other carcinogens.

To protect public health, we as a society have an obligation to “above all do no harm” by preventing exposure of our fellow humans to highly hazardous substances and to protect the marine environment to which human health and wellbeing is so closely tied.

It is clear that the radioactive isotopes in this water have the potential to move up the food chain and affect plant life, fish and humans. The radioactive hazards of tritium could pose risks to humans and the environment for over 100 years and those negative health effects will be magnified by other pollutants that have overlapping toxicities. As the former EPA director stated, treating radiation as a privileged pollutant is harmful to health. According to Professor Dick Clapp, “There is no safe level of radiation exposure, so no additional releases to the Plymouth harbor are warranted.”

There is no need to repeat history here. The lessons of the early years of this reactor are fresh enough–and should be paid heed. This community deserves better. Releasing this radioactive contaminated water is a risk to health and safety –and as Dr. Clapp has said–an unacceptable one.

**References**

Arjun Makhijani has written extensively on the under-appreciated risks from tritium, most recently: <https://ieer.org/wp/wp-content/uploads/2023/02/Exploring-Tritum-Dangers.pdf>

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EPA on tritium

Clapp, Richard et al

<https://www.researchgate.net/publication/255560779_Leukemia_and_other_health_outcomes_in_the_vicinity_of_the_Pilgrim_Nuclear_Power_Station_Plymouth_MA>