# Radiation as a result of nuclear power generation

**The following is part two of an eight part written debate regarding nuclear power generation**
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**The Debaters**

**Dr. Jeremy Whitlock** is the Manager of Non-Proliferation and Safeguards at Atomic Energy of Canada Limited (AECL), with responsibility for ensuring that reactor design at AECL meets international obligations on nuclear weapons non-proliferation. He is a second-generation employee of AECL Chalk River Laboratories, most of the time since the mid-90s as a reactor physicist working on research reactor development.
Dr. Whitlock received a B.Sc. (Physics) from the University of Waterloo in 1988, a M.Eng. (Engineering Physics – Nuclear) from McMaster University in 1991, and a PhD (Engineering Physics - Nuclear) from McMaster in 1995.

**Brenda Brochu** is a past president of the Peace River Environmental Society (PRES). Through PRES, she helped organized talks on nuclear power by several speakers, including Dr. Gordon Edwards, Dr. Jim Harding and Jack Century. She also helped organize the nuclear debate in Peace River in October, 2009 between Dr. Helen Caldicott and Dr. Duane Bratt.
A mother and grandmother, she works as executive director of the Peace River Regional Women's Shelter.

**Jeremy Whitlock opening statement**

One of the features distinguishing nuclear power from other forms of power generation is the creation of large amounts of radioactivity. The most important role of safety systems in reactors is to keep this radioactivity contained under all normal and credible abnormal conditions. The "containment building" itself is a reinforced concrete enclosure that ensures this is the case, even for unanticipated situations.

Well over 99% of the radioactivity is generated in the fuel itself, which is typically as far as it gets. Reactor fuel is designed to contain the radioactivity created within it while it is producing power. This radioactivity remains within the fuel when it is removed from the reactor, and is isolated from the environment thereafter through various protective barriers.

A smaller amount of radioactivity is found in the surrounding structural material and water systems of the reactor. Through routine processes some of this radioactivity is released to the containment building, and recovered with 99% efficiency. The approximately 1% that escapes to the environment is rigorously monitored, and contributes negligibly to our natural background radiation exposure. It is notable that these emissions are less than the radioactivity emitted from coal-fired power stations, which is not regulated due to its low danger.

More importantly, these radiation levels are millions of times less than what is known to cause harm, and are unnoticeable compared to the natural radioactivity of our own bodies. This includes radiation from tritium released from CANDU reactors, which has attracted some controversy due to a perceived high drinking water limit in Canada. This limit (7000 Bq/L) is actually in the middle of international limits, all of which would contribute a fraction of annual background exposure even if consumed year-long.

Radioactivity is likely the most rigorously regulated, best understood and most easily controlled by-product of human industry.

**Brenda Brochu opening statement**

Each stage of the nuclear power cycle creates large quantities of radioactive wastes which are so dangerous to human health and the environment that they must be monitored for thousands for years.

That is the carefully researched conclusion of the Pembina Institute in its report *Nuclear Power in Canada: An Examination of Risks, Impacts and Sustainability (December, 2006)*.

Uranium mining releases radioactive radon gas into the environment. Radon gas is second only to cigarette smoking as a cause of lung cancer. Such mining also produces dust containing radioactive particles. This dust settles wherever the wind blows.

The tailings from uranium mills, which are found near the mines, contain up to 85 per cent of the radioactive elements found in the ore. Such tailings have caused major contamination of surface and ground water in Canada.

The operation of nuclear power plants creates used fuel bundles which are thousands of times more radioactive than the original fuel. An unprotected person standing two meters away from such a bundle as it is removed from a reactor would be dead within an hour from radiation poisoning.

Canadian nuclear power plants also produce large quantities of tritium, which is radioactive hydrogen. Although it cannot penetrate the skin, it combines with oxygen to form radioactive water. This can be inhaled in water vapour or taken into the body by drinking or eating. Once in the body, it becomes part of the living cells, where it gives off radiation that can cause cancer and/or genetic damage.

Other radioactive substances which routinely enter the environment through nuclear power plants include carbon-14, iodine-131, noble gasses such as argon and radioactive particulates.

Once decommissioned, a nuclear power plant itself becomes a piece of radioactive waste. It has to be dismantled using robots and babysat in perpetuity.

**First rebuttal by Jeremy Whitlock**

We are in agreement that nuclear power produces large amounts of radioactivity. Logically, one next addresses the level of risk this imposes on society.

In this respect it isn't sufficient to know that a person standing unprotected next to a discharged fuel bundle would perish; that's like pointing out that a person standing next to a hydro dam spillway when it floods will drown, or that a person sitting atop the stack of an operating coal plant will asphyxiate.

Technology has risks, and one of the most important for nuclear power is radiation. That's why enormous effort has been spent since the early twentieth century understanding this risk and reducing it to a level that makes the nuclear industry one of the safest on the planet - and, as the record shows, the safest method of large-scale, baseload electricity production.

Responsibility for maintaining this level of safety lies with each nuclear worker, each manager, each plant owner, and each member of the Canadian Nuclear Safety Commission (CNSC) that regulates the industry. Nobody understands this risk more than those who work with radiation, who are typically those most at risk.

Uranium mining has improved significantly since its early days with respect to health protection and environmental stewardship - the same can be said for mining in general in Canada. Control of radon releases, safety of workers, isolation of tailings, and protection of surrounding waterways, populations, flora and fauna, are all rigorously regulated by the CNSC, which documents this activity on its website.

**First rebuttal by Brenda Brochu**

Reading Mr. Whitlock's opening statement, one would think the problem of safely disposing of used nuclear fuel bundles has been solved once and for all.

Yet no nation has established a permanent method of isolating these materials from the environment. Even the United States has all its used fuel bundles in temporary storage at reactor sites.

Mr. Whitlock acknowledges that some radioactivity escapes from nuclear power plants during normal operations. Yet he dismisses the radiation levels as "millions of times less than what is known to cause harm".

In fact, the National Academy of Sciences in the United States found in 2005 that there is no safe level of radiation. Numerous studies around the world have linked proximity to nuclear power plants with an increased incidence of childhood leukemia.

Mr. Whitlock would have us believe that we are protected by tough regulations and rigorous enforcement. But in Canada, our standards are based on exposure to external radiation only. We now know that radiation which gets inside the body can be far more harmful.

As for the Canadian Nuclear Safety Commission, its ability to function as an independent watchdog was severely compromised after Prime Minister Harper dismissed Linda Keen as its president two years ago. She was dismissed for trying to enforce safety regulations for the aging research reactor at Chalk River, which produces medical isotopes. Since her dismissal, the reactor has sprung several leaks, which has resulted in the discharge of a substantial amount of tritium into the Ottawa River.

**Second rebuttal by Jeremy Whitlock**

There are actually several demonstrated options for long-term management of used nuclear fuel; however, this is next week's topic so I'll defer to that discussion.

It is a fact that there has never been an effect seen for radiation exposures up to roughly 100 mSv, which is about forty times the annual natural background dose in Alberta. Nuclear power would be millions of times less. (Quite simply, you are more exposed to the natural radiation in milk than you would be from a nuclear plant.)

Despite this fact, health officials err on the safe side by assuming that any dose is dangerous, for the purpose of administering public and occupational safety. This assumption tends to be misunderstood by the public to mean a "real" effect, and unfortunately this misunderstanding is often exploited by those wishing to spread fear.

Most studies that have looked at cancer incidence near nuclear sites find no correlation; some have found a link with proximity, although this link has never been connected with radiation emissions. In Canada these studies also find nuclear workers to be in better average health than the public, and birth defects to occur less in the population around the Pickering and Darlington stations in Ontario. This is likewise probably not connected with radiation emissions. Welcome to the world of statistics.

It is absolutely not true that Canadian radiation regulations are based on external doses only. Internal doses have always been included, and in fact internal dosimetry is a long-standing area of Canadian expertise.

**Second rebuttal by Brenda Brochu**

The argument that radiation exposure from nuclear power facilities has no effect sounds a lot like the argument once made by the tobacco industry that smoking is harmless.

Canadian reactors produce large quantities of tritium, which is known to produce cancers, birth defects and genetic mutations. Canadian standards allow up to 7,000 becquerels per litre in drinking water, 70 times as much as the European Union.

Tritium is released into the air and water near all nuclear reactors in Canada as a part of normal operations. There have also been large accidental releases.

Used fuel bundles contain about 200 different radioactive substances, including plutonium, the deadliest substance on earth. Just one millionth of a gram is enough to produce lung cancer if inhaled.

Yet this substance is kept in cooling pools that are encased in buildings with much less structural integrity than a nuclear reactor. It is also kept in concrete silos meant to last 50 years. It takes 24,000 years for plutonium-239 to lose half its radioactivity.

According to the Health Canada website, Canadian standards for exposure to radiation are based on the recommendations of the International Commission on Radiological Protection (ICRP). These recommendations are based on studies of Hiroshima survivors, which looked at the effects of a single, large dose of external radiation.

Studies from across Europe and the United States show considerably higher levels of death and disease than those predicted by the ICRP model.

The destruction that could be caused by radiation during a major nuclear accident is almost beyond imagination.