

**Written Submission from
Prevent Cancer Now**

**Mémoire de
Prevent Cancer Now**

In the Matter of

À l'égard de

SRB Technologies (Canada) Inc.

SRB Technologies (Canada) Inc.

Application by SRB Technologies (Canada) Inc. to seek authorization to resume the processing and use of tritium at its Class IB Nuclear Substance Processing Facility in Pembroke, Ontario

Demande de SRB Technologies (Canada) Inc. pour obtenir l'autorisation de reprendre les activités de traitement et d'utilisation du tritium à son installation de traitement de substances nucléaires de catégorie IB à Pembroke, en Ontario

Public Hearing Day Two

Deuxième jour de l'audience publique

June 12, 2008

Le 12 juin 2008

Presentation on behalf of Prevent Cancer Now to the Canadian Nuclear Safety Commission (CNSC) on the dangers of Tritium with regard to the proposed two year licence renewal for SRB Technologies in Pembroke, Ontario.

Prevent Cancer Now is a Canadian organization dedicated to the elimination of preventable causes of cancer. It is governed by a Board of Directors and represents membership from across Canada.

The Canadian Nuclear Safety Commission (CNSC) recommendation of a license to permit resumption of manufacture and export of products containing tritium is disturbing and dangerous in PCN's opinion. It indicates a misappropriation of the CNSC's mandate to protect the environment and the health of persons from nuclear industry generated radiation hazards.

In light of the known detrimental health impacts of tritium, a known carcinogen, mutagen and teratogen (crosses the placenta to cause harm), PCN strongly recommends that the **SRB Technologies, Pembroke**, licence should not be renewed. In fact the plant should be permanently closed and decommissioned as soon as possible, with immediate cleanup of the affected areas by those responsible, under government supervision and control.

As Valence Young, of Pembroke has written, "All levels of government need to become involved in the work of decontamination. The use of groundwater flow analysis to map tritium plumes is essential. It is both ethical and prudent to plan and implement a tritium removal project. This project would include the extraction of tritium from contaminated groundwater and soils, and the disposal of contaminated building materials and industrial waste. There is community concern that some local citizens, in particular those with water wells near the SRB Technologies site, may manifest illnesses that could relate to their tritium exposure. These health concerns require serious consideration with careful long-term monitoring, reporting, research and care." (presentation to CNSC, 2008).

The CNSC website declares "the CNSC considers it crucial to preserve public confidence and trust in the fairness of the regulatory decision-making process". However, there is serious concern that a Class 1B Nuclear Substance Processing Facility should be allowed to operate so closely adjacent to a residential community. It should never allow releases into the environment and should be immediately and safely cleaned up as part of the decommissioning process. Revoking the current possession licence of SRB Technologies to protect the environment and health and safety of living systems on which we depend, has now become a necessity.

Thus, PCN believes that responsible action for the CNSC as a regulator would be to immediately ensure that manufacture and export of products containing gaseous tritium light sources be discontinued. More-effective, non-hazardous alternatives to tritium lights are readily available and should be encouraged rather than using this waste product from nuclear reactors.

Rationale for Concerns

Tritium has consistently been underestimated in its potency to cause harm to humans. “Health Risks of Tritium: The Case for Strengthened Standards”, Institute for Energy and Environmental Research (IEER), 2008 states: “With a relatively short half-life of 12.3 years, tritium is highly radioactive....For example, one gram (approx. the weight of a quarter of a teaspoon of salt) of tritium in irradiated water will contaminate almost 500 Billion gallons of water up to the current drinking water limit of 20,000 picocuries (740 Bq/l) per litre set by the U.S. Environmental Protection Agency (EPA).” “One ounce of tritiated water (HTO) would contaminate the entire annual flow of the Savannah River above the present drinking water limit”. As well, the study finds that “Low-energy beta particles, like those emitted by tritium, are often much more efficient at causing harm than currently assumed by regulations.” This risk analysis is another reason to recommend closure and decommissioning of this facility located in the midst of a residential/business complex.

As it is now known that there is no safe dose of radiation and even the smallest dose can cause cancer and other health effects (Biological Effects of Ionizing Radiation VII (BEIR VII) National Academy of Sciences, 2005 <http://www.nuclearactive.org/news/070605.html>, the CNSC should strive to eliminate risks to the environment and human health of the citizens of Canada and, in this case, particularly the area of Pembroke and others in the vicinity and downriver.

These points are elaborated on in other reports and studies below, highlighting the need to protect in particular, women, the developing fetus, growing children and young girls in puberty from exposures to tritium at any dose ideally.

Biological Effects of Ionizing Radiation (BEIR) VII reconfirmed that there is no safe level of exposure to radiation and that low levels can cause cancer. (The EU is well informed of the more effective impacts of low routine doses of ionizing radiation according to research evidence by Dr. Abram Petkau, 1999.) Even exposures to background radiation cause some cancers. Additional exposure causes additional risk. The BEIR VII report also found that the risk of cancer was greater to women and children, the younger the children, the greater the risk, females being at greater risk. Especially sensitive to the effects of tritium are rapidly growing cells such as fetal tissue and young girls' developing breasts, genetic materials and blood forming organs. Tritium can affect protein precursors that will make up the chromosomal strands in the DNA which can damage the DNA creating a mutational effect. The results of all these processes can result in cancers, miscarriages, birth defects, sterility, hypothyroidism, etc., not only in those directly affected but also in their offspring and theirs. A connection to heart disease and stroke, possible genetic damage was also discussed.

Recently Enunciated Impacts of Tritium on Women's Health:

As presented, January, 2008 at the Canadian Nuclear Safety Commission (CNSC) Tritium workshop in Ottawa, the understanding the dosage of Tritium to women is now estimated by Dr. Richard B. Richardson, (Chalk River, Atomic Energy of Canada

Limited (AECL), International Commission on Radiological Protection (ICRP)) via the computer model he developed at McMaster University where he is an Adjunct Professor, (as well as holding the same position at McGill University, (Genmod PC for Windows AECL) to be 45% higher than the dose to the "standard man." (The basis of many health protection standards is an adult Caucasian male, called "Standard "or "Reference Man" - see Appendix B) Dr. Richardson's research illustrates that the dose coefficient for women is under calculated, underscoring that Canadian women are not protected by the current regulation. Nor will they be in the new gender models the ICRP has recently agreed upon. At the workshop, Alexandra McKee-Bennett, BA, RN, MSN, RM pointed out that there is now a clear understanding from the excellent computer models that Dr. Richardson has created which proves for all radionuclide intakes female dose coefficients, individual and collective for acute HTO (water) intake is 21% higher than males due to 1 Bq/L being more concentrated in female's smaller mass.. Dose coefficient, individual and collective, for unspecified organic (3H) compounds ICRP Organically Bound Tritium (OBT) model adult female OBT intake is 45% more than "standard " man.

This reality is further complicated by the fact we use animal studies and their fat content (rat) = 10% whereas Canadian normal body mass = 18 to 25 %. Body Mass Index (BMI) of 29 = obese = 13% of 52 yr. olds (Canadian data). Because of this knowledge, she states that morally and ethically we must now act on these important findings

ICRP has been presented with this information and as noted, Dr. Richardson is an ICRP committee member, but it may not change their position to reflect the Canadian reality. Dr. Richardson was concerned with the exposures to the number of women now working at AECL and the CNSC. Alexandra Bennett feels then, it behooves the CNSC to decide if the Canadian public, whose health they are mandated by law to protect, will now use the Canadian models developed by Dr. Richardson to protect all Canadians. She observed that there was support by several scientists for this position. Dr. Richardson's models will be available to other Canadian Nuclear scientists in 1 year.

We hope that the CNSC will still strongly reflect what to many present at the CNSC Ottawa meeting was indeed some of the most important exposition on and explanation of the health impacts of Tritium on women's bodies

The Developing Fetus

Another significant pathway for human harm from elevated tritium levels is via female human infants, as Dr. Edwin Radford of the University of Pittsburgh University testified to the Parliamentary Select Committee of Ontario Hydro (1980). He stated:

"A female infant is born with all the eggs and ova she will ever produce as a mature woman. Those ova are formed during a relatively short period during her time in utero. If the "building materials" in utero available during that short time are defective - specifically if available hydrogen is tritiated, an inordinately high percentage of her ova will incorporate that defective material. Since tritium has a radioactive half life of 12 years, the majority of that would have already undergone radioactive decay by the time she would enter her own reproductive years. That radioactive decay would

disproportionately disrupt her genetic material in her ova, and her offspring, in two different ways: by irradiating the surrounding genetic material with a very well-placed beta particle and by converting a "meaningful" tritium of hydrogen atom e.g. in a crucial gene in the DNA code into a nonsensical helium atom, thereby causing genetic damage." As we well know, there are and always will be pregnant women, developing children and young girls in puberty which must be taken into account. It used to be thought that "only the dose made the poison", however, it is now known that the timing of exposures can be just as or more important than the dose (Steingraber, 2001). It is now well understood in the discourse of children's health and the environment that the tiniest amounts of radiation and/or chemicals at the time of these "windows of vulnerability" can have major impacts on their present and future health for this reason. In terms of risk assessment (basically permission to pollute a particular amount), does it not call into question standards of any "acceptable" levels of radiation exposures during these critical windows of rapid cellular growth when there is such vulnerability to abhorrent growth?

For these and other reasons, the International Joint Commission (IJC) 7th Biennial Report on the Great Lakes (1994) recommended that radionuclides with a half life of greater than 6 months be included in the list of persistent toxic substances, and that governments work toward virtual elimination of these substances under the Great Lakes Water Quality Agreement, and that strategies for virtual elimination of these pollutants from waste streams be implemented. (Recommendation 12 to federal and state/provincial governments, 7th Biennial Report, Feb. 1994.)

The implications were that radioactive substances should be regulated like other hazardous materials/chemicals that are being forced to zero discharge or serious reductions in pollution.

Concerns regarding CANDU Reactors and Tritium

Although CANDU reactors produce 30 times more tritium than US light water reactors (UNSCEAR Sources and Effects of Ionizing Radiation: Report for the General Assembly, 1977. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), what also must be taken into account is that in addition to Canadian nuclear facilities, there are U.S. nuclear reactors' other radionuclides on the other side of Lake Ontario as well.

To highlight these health concerns on women, the fetus and children, on Feb 20, 2008, over 3000 U.S organizations and individuals urged President Bush to "Protect Most Vulnerable from Radiation Exposure". They requested the Executive Order to Shift Federal Regulation Basis from "Reference Man" to "Groups Most at Risk - Pregnant Women and Children" (Appendix B).

And for cancer risks to the general public, see:

[Environmental and Occupational Causes of Cancer: A Review of Recent Scientific Literature](#), Richard Clapp, Genevieve Howe, Molly Jacobs, Boston University, School of Public Health and Environmental Health Initiative, University of ~Massachusetts, Lowell, September, 2005. (This study lists the various cancers and the

chemicals/radiation they are related to (p 10) "**The State of the Science by Cancer**", the **relationship of ionizing radiation to bladder, bone, brain, breast, colon, leukemia, liver, lung, multiple myeloma, nasal and nasopharynx, stomach and thyroid cancers.**

Additional Concerns

In addition to the above mentioned studies and reports, among other reasons for PCN's opposition to the license amendment requested by SRB Technologies are that gaseous tritium lights are an unsafe product during manufacture, use and disposal. As Pembroke resident, Lynn Jones has written:.. "glass is not a suitable container for tritium gas. Tritium gas oxidizes inside glass tubes (1). Glass acts as more of a sponge than a container for tritium gas (2). Tritium oxide is 20 thousand times more hazardous to humans than tritium gas. Discarded tritium lights are leaching large quantities of tritium oxide into groundwater at landfills around the world including Scotland, Italy, South Africa and the United States. (1, 3) The situation may be worse here because regulations allow for disposal of used exit signs in Canadian landfills. Foreign regulators are grappling with how to ensure that these products are disposed of only in secure radioactive waste storage facilities (3)." References: 1) Tritium in Scottish Landfill Sites, May 2000,

<http://www.sepa.org.uk/pdf/publications/technical/TritiumInScottishLandfillSites.pdf>

2) <http://www.ctio.noao.edu/pipermail/ccd-world/1998/001900.html>

3) Senate Hearing, Radiation Levels at Landfills, Pennsylvania, June 28, 2006
<http://www.senatormjwhite.com/environmental/062806/transcript-062806.pdf>

Background on PCN:

Over the years, members of PCN have become informed, knowledgeable and thus have participated with many other organizations and individuals to support the Advisory Council on Environmental Standards (ACES) Report in 1994 and 1995 calling for the reduction and eventual elimination of radioactive Tritium emissions from nuclear facilities in Ontario. At the time, many were very disappointed that the ACES recommendations were not adopted despite the fact that there were over 2000 letters and cards in support of them. More recently some of us have been part of the Toronto Cancer Prevention Occupational and Environmental Working Group which initiated the discussions with Toronto Public Health, the Board of Health (see Appendix A), City Council (**Re: Ionizing Radiation and Public Health in the City of Toronto (GTA) in relation to the refurbishment and expansion of nuclear power reactors and facilities on Lake Ontario**) and the subsequent letter by the Medical Officer of Health, Dr. David McKeowan to the then Minister of the Environment, Laurel Broten, leading to Tritium being included in the Ontario Drinking Water Advisory Council process. Information and regulation of the carcinogen, mutagen and teratogen, Tritium fit in the consideration of proposed legislation on Community Right to Know and Toxic Use Reduction currently under deliberation in several jurisdictions.

In his letter (Sept.27, 2006), Dr. McKeowan stated: "On behalf of Toronto City Council and the Toronto Board of Health, I am requesting that the Government of Ontario review the Ontario Drinking-Water Quality Standards for Tritium and other radionuclides.

Specifically, the City of Toronto asks the Province of Ontario to adopt more health-protective standards, and to give further consideration and weight to the 1994 recommendations of the Ontario Advisory Committee on Environmental Standards (ACES). City Council's decision on this issue is attached for your reference. **The current Ontario Drinking-water Quality Standard for Tritium is 7,000 becquerels per litre (Bq/L), (O. Reg. 169/03, as amended to O. Reg. 248/06). The 1994 ACES report recommended immediate adoption of a 100 Bq/L standard, reduced to 20 Bq/L within five years. Had Ontario adopted these recommendations, the standard would already be at the more protective level of 20 Bq/L.**

While much our work on tritium reduction and eventual elimination has been related to emissions from nuclear power plants, the same concerns and analysis apply to tritium being released from SRB Technologies into the Pembroke sludge which can contaminate local wells and drinking supply and eventually make its way into the Ottawa River, the main drinking water supply of Ottawa citizens.

To prevent the production of tritium in Ontario, the discussion of the source of tritium, CANDU nuclear reactors, must be included. Although the electricity needs of Ontarians are beyond the scope of this submission, Prevent Cancer Now endorses the energy framework as described in the Toronto Cancer Prevention Coalition (TCPC) letter to the Toronto Board of Health (Appendix A) which bears repeating here. "...The TCPC fully endorses the principles and recommendations of the letter by Dr. David McKeown, MDCM, MHSc, FRCPC, Toronto Medical Officer of Health to Premier Dalton McGuinty regarding the Ontario Power Authority Supply Mix Advice report, December 2005 EBR #PO05E0001 (Feb 3, 2006). Dr. McKeown calls for a sustainable energy strategy for the province composed of a combination of measures, in the following order of priority: demand management (energy efficiency and conservation) approaches and supply from low-impact ecologically sustainable renewable sources rather than by nuclear energy." It also concurs with recommendations contained in the Pembina/CELA Report, Power for the Future Towards a Sustainable Electricity System for Ontario, that nuclear power plants be phased out by 2020, thus stopping all such releases (www.cela.ca, www.pembina.org)

Indeed, at its May 2007 conference in Ottawa, PCN passed a number of resolutions relating to the implications of ionizing radiation, cancer, health and nuclear power expansion etc. Members of PCN recently participated in the Ontario Drinking Water Advisory Council (ODWAC) hearings on tritium standards which have implications for SRC Technologies particularly if the CNSC goes ahead with the licensing of the plant against the concerns and recommendations of environmental health scientists, physicians, scholars, many residents of the area as well as other ordinary citizens.

General Recommendations on Tritium, provided to the City of Toronto which led to Ontario's inclusion of Tritium into the ODWAC process: Some broad implications for SRB Technologies

1. Given the cumulative and synergistic issues, and numbers of chemicals and radionuclides to which people are exposed, as well as threshold issues, PCN recommends

more stringent standards immediately. Lower limits are achievable and they make sense, at a minimum for now, to use a similar idea about the "acceptable" level of risk as is used for chemicals, called for by ACES. There is much catching up to do as the current Ontario Drinking Water Objective for Tritium is 7,000 becquerels per litre (Bq/L) and as stated in 1994, ACES recommendations of immediate adoption of a 100 Bq/L standard, reduced to 20 Bq/L within five years, were ignored by the government of the day due to pressure from the nuclear industry.

2. Ontario needs to join other leading jurisdictions in the world which have more stringent standards - the EU Tritium in water Standard is 100Bq/L, California is at 15 Bq/L and Colorado, 18 Bq/L. **Moreover, it is of great significance that Ontario Power Generation (OPG) has stated in their ISO 140001 QA documents that 100Bq/l is now an achievable standard for Tritium in water and therefore the reduction of 7000Bq/L to the federally proposed 3000Bq/L should not be acceptable.** Therefore the ACES report 100Bq/L to 20Bq/L within 5 years is the largest standard we must agree to for this time.

Because of the now available evidence presented on health impacts, PCN recommends that the CNSC adopt the precautionary principle in its recommendations on SRB Technologies. If it is to err at all, the committee should err on the side of caution when assessing the hazards of Tritium releases and should, at the start, reiterate the recommendations of the Advisory Council on Environmental Standards (ACES) on Tritium. Thus, PCN calls for the CNSC to emulate recommendations to ODWAC for Ontario, advocating the goal of zero discharge in Pembroke as soon as possible

Thus PCN concurs with the late Charles Caccia, Senior Fellow, Institute of the Environment, University of Ottawa and former Member of Parliament in his statement ...urging that the SRB's request be turned down. "It seems only reasonable to urge the Commission not to entertain any application by SRB until SRB comes forward with the required financial guarantees and an approved decommissioning plan. In addition, the concerns expressed by the Ottawa Riverkeeper regarding the desirability of achieving a better understanding of the water contamination problem offer another valid reason for turning down the current application" (presentation to CNSC, 2008).

We thank you for your attention and anticipate that your report will consider this evidence and these recommendations.

Sincerely,

Dorothy Goldin Rosenberg MES, PhD
Board Member, Prevent Cancer Now
Environmental Health Lecturer, the Ontario Institute for Studies in Education, University of Toronto
Member, Toronto Cancer Prevention Coalition Occupational and Environmental Working Group
Volunteer Education Coordinator, Women's Healthy Environments Network (WHEN)
Executive Producer, Toxic Trespass, an NFB Co Production on children's health and the

environment

Associate Producer, Principal Research Consultant "Exposure: Environmental Links to Breast Cancer

Endnotes:

The Petkau Effect, Revised Edition, 1990, by Ralph Graeb, Translated from German by Phil Hill, and published by Four Walls Eight Windows, New York, 1994. ISBN: 1-56858-019-3.

Having Faith: An Ecologist's Journey to Motherhood. Sandra Steingraber. New York: Perseus Publishing, 2001.

Other important studies and recommendations attest to the dangers of Tritium, including:

The Safety of Ontario's Nuclear Reactors (The Select Committee on Ontario Hydro Affairs, 1980) which contains important scientific information about tritium and carbon 14;

Report of the Porter Commission , 1978, commenting on the increasing levels of radionuclides in the Great Lakes;

Committee Examining Radiation Risk Internal Emitters (CERRI) Report, UK, (www.cerrie.org) pointing out that short track emitters can be significantly more dangerous than previously estimated;

Appendix A

May 10, 2006

To: the Toronto Board of Health, Chair John Filion

From: the Occupational and Environmental Carcinogens Working Group of the Toronto Cancer Prevention Coalition

Re: Ionizing Radiation and Public Health in the City of Toronto (GTA) in relation to the refurbishment and expansion of nuclear power reactors and facilities on Lake Ontario

The Occupational and Environmental Carcinogens Working Group of the Toronto Cancer Prevention Coalition is writing to you to express our concerns regarding the public health implications of the Ontario Power Authority recommendation to expand nuclear power generation in Ontario. This decision is premature. The risks to health and safety from routine releases, accidents, transport and radioactive waste make the pursuit of energy alternatives imperative. Yet the Province has barely begun to explore these alternatives.

The Toronto Cancer Prevention Coalition states that although we are exposed to a wide variety of cancer causing substances in the workplace and the environment, this is not inevitable. By combining a scientific approach grounded in the precautionary principle with smart public policies designed to prevent pollution, we can promote health and prevent cancer in a comprehensive, integrated and sustainable way (Preventing Occupational and Environmental Cancer: A Strategy for Toronto, May 2001).

Our working group fully endorses the principles and recommendations of the letter by Dr. David McKeown, MDCM, MHSc, FRCPC, Toronto Medical Officer of Health to Premier Dalton McGuinty regarding the Ontario Power Authority's Supply Mix Advice report, December 2005 EBR #PO05E0001 (Feb 3, 2006). Dr. McKeown calls for a sustainable energy strategy for the province composed of a combination of measures, in the following order of priority: demand management (energy efficiency and conservation) approaches and supply from low-impact ecologically sustainable renewable sources rather than by nuclear energy.

As well we endorse, Dr. McKeown's recommendations that the Province of Ontario undertake a full health assessment of all energy options including the lifecycle of nuclear by products and nuclear waste as well as catastrophic nuclear accidents. Health care cost avoidance should be considered for all alternatives in such a review.

Consideration of these issues raises the spectre of the safety of our current use of nuclear energy which includes routine emissions to the environment, and the transportation and storage of radioactive materials throughout the region. These uses add to the burden of the radionuclide use in many medical and scientific endeavours in our local environment. (1) We need to ensure the prevention of exposure to these hazardous and cancer causing substances.

We concur with recommendations contained in the Pembina/CELA Report, Power for the Future Towards a Sustainable Electricity System for Ontario, that nuclear power plants be phased out by 2020 stopping all such releases (www.cela.ca, www.pembina.org)

There are a few further steps which we feel that the City could take to further our understanding of the impacts of nuclear power and, increase protection from tritium and other radionuclides from routinely entering the drinking water of the GTA from existing nuclear facilities on Lake Ontario (one quarter of Canadians depend on the Great Lakes for their drinking water).

~
1. ~~~~~The City of Toronto should test and report information on tritium and other radionuclides both in the raw water of Lake Ontario and in Toronto's drinking and include these results in your annual report on drinking water required by the Ontario Drinking Water Standards.~

There has been considerable concern over the setting of standards in Ontario for tritium at or near to background levels. Our current standards are far more permissive than those of other jurisdictions. In 1994 an extensive review of these standards was done by the Ontario Advisory Committee on Environmental Standards (ACES). The recommendations of this expert Committee was that the level of 7,000 Bq/L be reduced initially to 100 Bq/L and progress to 20 Bq/L within five years. Those recommendations were rejected by the Ontario Government at the time.

2. ~~~~~The City of Toronto should request that the current Ontario Government revisit the recommendations of the ACES committee and consider the more health protective standard be required (2).

In combination, these two actions would go a long way to addressing the reality of our cities proximity to nuclear reactors and act as a deterrent for future nuclear expansion.

We have appended further background information to this letter to reinforce our concerns about the impacts of Ontario's proposals for reliance on nuclear power for the future on public health of Torontonians (3).

Thank you for your attention and we look forward to your response to our recommendations.

Sincerely

Ruth Grier
Co Chair Toronto Cancer Prevention Coalition, Occupational and Environmental
Carcinogens Working Group
c/o 74 Arcadian Circle,
Etobicoke, Ontario M8W 2Y9

Cc to: Dr. David McKeown, Medical Officer of Health
The Honourable Dalton McGuinty Premier of Ontario

The Honourable Donna Cansfield, Minister of Energy
The Honourable Laurel Broten, Minister of Environment
The Honourable George Smitherman, Minister of Health and Long-Term Care
Dr. Sheila Basur, Chief Medical Officer of Health
Mr. Ian Carr, Chief Executive Officer, Ontario Power Authority
Dr. Peter Love, Chief Energy Conservation Officer, Ontario Power Authority

Appendix to the Board of Health Letter:

(1). Along with the problem of solid nuclear waste is the question of the regular emissions of radioisotopes from nuclear power plants into air and water. Human beings can receive exposure to organically bound tritium through the ingestion of plants and animals exposed in an effluent pathway in addition to direct uptake through inhalation, absorption and drinking contaminated water. The CANDU reactor emits tritium as well as carbon 14 and other radioisotopes. Tritium is a radioactive isotope of hydrogen that combines readily with oxygen to form radioactive water. It binds easily with organic molecules including DNA.

The International Agency for Research on Cancer (IARC) lists a number of radionuclides as proven causes of cancer including ones produced from the mining, milling manufacturing and use of uranium fission in nuclear power plants. Recent research on the effects of even very low levels of ionizing radiation shows that no level is safe to health. In July, 2005, the U.S. National Academies of Science released a major report on the health effects of ionizing radiation, Biological Effects of Ionizing Radiation (BEIR) VII <http://www.nuclearactive.org/news/070605.html>. This document reconfirmed that there is no safe level of exposure to radiation and that low levels can cause cancer. Even exposures to background radiation cause some cancers. Additional exposure causes additional risk. The BEIR VII report also found that the risk of cancer was greater to women and children, the younger the children, the greater the risk, females being at greater risk.

Especially sensitive to the effects of tritium are rapidly growing cells such as fetal tissue and young girls' developing breasts, genetic materials and blood forming organs. Tritium can affect protein precursors that will make up the chromosomal strands in the DNA which can damage the DNA creating a mutational effect. The results of all these processes can result in cancers, miscarriages, birth defects, sterility, hypothyroidism, etc., not only in those directly affected but also in their offspring and theirs. A connection to heart disease and stroke, possible genetic damage was also discussed.

(2) Since the Walkerton water tragedy, there has been a major focus on water quality in Ontario and in Canada as a whole. Environment Canada describes good drinking water as being devoid of disease causing organisms, harmful chemicals and radioactive matter such as radionuclides. The Ontario Ministry of the Environment (Drinking Water Systems Regulation O. Reg. 170/03, 2003, June 2003 p7), says that the ingestion of radionuclides in drinking water may cause cancer in individuals exposed and hereditary damage in their children... It is assumed that no threshold exists below which the probability of induced effects is zero. ~

Ontario's drinking water standard is 7,000 Bq per litre, a level that is far more lax than the European Union's standard of 100 Bq per litre or the U.S. figure of 740 Bq per litre. (California last year issued a report calling for an even tougher health protection standard of 15 Bq per litre.) The Ontario government rejected an advisory panel (the Advisory Council on Environmental Standards (ACES) recommendation in 1994 to adopt 100 Bq per litre as the standard. Tritium, like all radioactive substances, is considered a health risk because it can cause cancer. While there is still considerable regulatory uncertainty about what constitutes an unsafe exposure in Ontario, the BEIR VII, National Academy of Sciences 2005 report clearly illustrates that there is no safe dose.

3. Further References:

Tritium, Properties, Metabolism, Dosimetry

http://www.cerrie.org/committee_papers/Paper_9-01.doc

Health and Environmental Issues Linked to the Nuclear Fuel Chain, Gordon Edwards, Ph.D., for the Canadian Environmental Advisory Council

http://www.ccnr.org/ceac_B.html~~~~

Recommendations of the European Committee on Radiation Risk (ECRR), Health Effects of Ionizing Radiation Exposure at Low Dose for Radiation Protection Purposes, Regulators Edition, Brussels, 2003

Appendix B

For immediate release: Wednesday, February 20, 2008

For further information: Arjun Makhijani (301) 270-5500 or (301) 509-6843 (cell)

3,000+ Organizations and Individuals Urge President Bush "Protect Most Vulnerable from Radiation Exposure"

*Request Executive Order to Shift Federal Regulation Basis
from "Reference Man" to Groups Most At Risk – Pregnant Women, Children*

Takoma Park, Md., February 20, 2008: More than 3,000 groups and individuals today sent a [letter to President Bush](#) urging him to shift the basis of many U.S. radiation health protection standards from an adult Caucasian male model, called "Reference Man," to those most at risk, specifically including children and pregnant women.

Signers include elected officials, including Georgia State Senators Nan Grogan Orrock and Regina Thomas; health professionals' organizations, including the American Public Health Association; faith-based groups, including the National Council of Churches; well-known environmental advocate Lois Gibbs; and many physicians, children's health advocates, environmental justice organizations, women's groups, and more.

The [letter](#) calls on President Bush to direct all federal agencies – including the Environmental Protection Agency (EPA), Department of Energy, and Nuclear Regulatory Commission – to review their exposure standards and bring them into line with the spirit of Executive Order 13045 on the Protection of Children From Environmental Health Risks and Safety Risks.~ Many federal radiation protection standards are based on "Reference Man;" however, other groups – including women, children, and the embryo/fetus – are often more sensitive to the harmful effects of radiation.~

"[Reference Man](#)" is officially defined as a Caucasian male who is 20 to 30 years old, weighs 154 pounds, is five feet seven inches tall, and is "Western European or North American in habitat and custom." Reference Man is often used to set federal rules and regulations, such as limits on how much residual radiation will be allowed after a contaminated site is cleaned up. Reference Man is part of EPA's Federal Guidance Report No. 11, which is still widely used as the basis of radiation dose calculations.

"A central principle of environmental health protection – protecting those most at risk – is missing from much of the U.S. regulatory framework for radiation," explained Arjun Makhijani, Ph.D., president of the Institute for Energy and Environmental Research (IEER), which initiated the letter. "Women's higher cancer risk per unit of radiation exposure is not properly reflected in current regulations. Neither is the possibility of early miscarriages or fetal malformations potentially caused by radiation exposure."

"It is essential that our government take the necessary steps to not only acknowledge the

risk differential when looking at the dangers of radiation exposure among pregnant women and children, but to also protect the health of these vulnerable populations," said Georges C. Benjamin, MD, FACP, FACEP (E), executive director of the American Public Health Association.

"Georgians are concerned about radioactive contamination of the Savannah River from waste at the federal Savannah River Site," said Georgia State Senator Nan Grogan Orrock.~ "People catch and eat fish from the river. Many communities depend on the river for their drinking water. As an elected official, a woman, and a mother, I ask the federal government to do its job and set health standards that protect all of us, not just adult men."

The signers are asking President Bush to issue a Presidential Executive Order requiring all federal agencies and departments to:~~~~~

- ~~~ - Review their definitions of "Reference" persons and modify them as necessary so that all rules protect those most at risk;
- ~~~ - Review their rules regarding protection of prospective parents and pregnant women in the workplace;
- ~~~ - Update the computer models used to estimate dose and risk for regulatory purposes to take into account the embryo/fetus and children (and others).

In addition, the letter seeks support for legislation requiring federal health and environment regulations to protect those most at risk as well as funding for research on the human health effects of combined exposure to radiation and toxic chemicals.

The letter is also being sent to key members of Congress with a cover letter asking them to hold federal agencies accountable for radiation exposure standard-setting processes. It is also being sent to presidential candidates to ask what they will do if elected to protect the most vulnerable from harm from radiation exposure.

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The letter to President Bush and other documentation are available online at www.healthyfromthestart.org

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Special Newsletter Issue Healthy from the Start: Building a Better Basis for Environmental Health Standards--Starting with Radiation, in *Science for Democratic Action*, February 2007 [PDF 700kB]

Report Science for the Vulnerable: Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk, October 19, 2006 [PDF 750kB, 107 pages]

Comments to the Science Advisory Board of the EPA on "Reference Man" and Radiation Protection, August 30, 2007 [PDF 175 kB, 12 pages]

(2) Dr. Simon Carroll wrote the following addendum to the study referred to below: Germany's federal office for radiation protection (BfS) issued a statement supporting the results of the childhood cancer study (see below). The statement was issued jointly with the authors of the investigation, the German Childhood Cancer Registry (GCCR).

In addition, on their web-site, the BfS states that a translation of the study into English will be made available shortly. See:

<http://www.bfs.de/en/kerntechnik/papiere/Expertengremium.html>

Press Release 014 as of 2007/12/19

BfS and GCCR jointly support results of the childhood cancer study

The main results of the KiKK study are reliable, and are shared by all parties involved in the study. That is the result of a meeting between the contractor of the study, the Federal Office for Radiation Protection (BfS) and the authors of the investigation, the German Childhood Cancer Registry (GCCR). The meeting was held after media had repeatedly reported on a dissent between the contractor and the authors of the study in the days following its publication. BfS President Wolfram König: We decided to take this step because we agree on all main results. There was only disagreement on questions not directly associated with the commissioned part of the study. People living near nuclear power plants have a particular interest that we jointly meet the challenge resulting from this study."

BfS and GCCR emphasise the high quality of the study. „The study shows that the risk for children under five years of age to contract leukaemia increases the closer they live to a nuclear power plant", Prof. Maria Blettner, head of the study, points out. The study is thus an essential component in answering the issue of health effects in the vicinity of reactors, which has been discussed for about 30 years, since it applied a new approach which is epidemiologically more ambitious than previous studies.

BfS and GCCR also agree that no statements on the causes of the increased cancer rates can be derived from the study. König: Due to the fact that the risk clearly depends on the distance to the reactor sites there are indications of possible connections but there is no proof". Current knowledge of radiation-biological effects cannot explain the interrelations between normal operation of nuclear power plants and the increased number of leukaemia cases. Blettner: I think that this study provides us with a good basis for making progress in finding the general causes of leukaemia". BfS has planned to hold an expert

meeting in spring 2008 where the causes that can lead to childhood cancer are to be discussed with experts of various disciplines.

This German study was carefully carried out with a very large population living in the vicinity of 16 nuclear power plants. There was a statistically significant correlation between cancer/leukemia among children under 5 and their proximity to (or distance from) a nuclear power plant. Moreover, this correlation remained significant when any one nuclear plant was taken away and the other 15 were studied. Thus the results are the strongest ever obtained, and the methodology was, according to all reports, exemplary. Gordon Edwards. PhD

Reuters Newspaper article

Child cancer risk higher near nuclear plants: study Sat Dec 8, 2007

BERLIN (Reuters) - A German study has found that young children living near nuclear power plants have a significantly higher risk of developing leukemia and other forms of cancer, a German newspaper reported on Saturday.

"Our study confirmed that in Germany a connection has been observed between the distance of a domicile to the nearest nuclear power plant and the risk of developing cancer, such as leukemia, before the fifth birthday," *Suddeutsche Zeitung* newspaper quoted the report as saying.

The newspaper said the study was done by the University of Mainz for Germany's Federal Office for Radiation Protection (BFS). A copy of the report was not immediately available. The researchers found that 37 children within a 5-kilometer (3-mile) radius of nuclear power plants had developed leukemia between 1980 and 2003, while the statistical average during this time period was 17, the paper said. The newspaper cited an unnamed radiation protection expert familiar with the study who said its conclusions understated the problem. He said the data showed there was an increased cancer risk for children living within 50 kilometers of a reactor. German Environment Minister Sigmar Gabriel said in a statement that he would examine the study. He said the BFS should also evaluate its findings. Germany plans to prematurely shut down all of its nuclear power plants by the early 2020s.

(Reporting by Louis Charbonneau)

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