INTERNATIONAL INSTITUTE OF CONCERN FOR PUBLIC HEALTH (IICPH)

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Chair, Darlington New Build
Joint Review Panel
c/o
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Re: Submission to Joint Review Panel Public Hearing on the Darlington New Nuclear Power Plant project Proposal by Ontario Power Generation (OPG)

Dear Mr. Graham;

This written submission summarizes the issues that IICPH wishes to raise as an Intervenor at the Joint Review Panel [“Panel”] Public Hearing. IICPH will further expand on these matters at its oral presentation.

Introduction

This submission will argue that the proposal by Ontario Power Generation (OPG) is seriously flawed. It has not given due consideration to the precautionary principle in every aspect of the EIS. It has not addressed the full range of cumulative environmental impacts and the detrimental effects on the environment and human health arising from this project over time. It has not assessed the full cost of the project (from cradle to grave). It fails to promote sustainable development, because it does not consider sustainable clean energy options and conservation as alternatives to new nuclear facilities.

It is our view that allowing this project to be carried out will do great and totally unnecessary harm to the environment, health, and economic well-being of millions of people now and in the future. It could even cause mass destruction of people and property, far beyond anything for which adequate compensation is possible. For these reasons, and many others, the Panel can only fulfill its responsibility to the public by recommending that this proposal be rejected.

The issues that IICPH will address in this submission are:

1) Environmental Impact Statement (EIS) - Overview of Guiding Principles
2) Proposed Reactor Designs
3) Site Preparation and Construction Phase
4) Enrichment
5) Nuclear Waste
6) Accident Scenarios - Risk
7) Cumulative Effects
8) Public Health and Safety
9) Energy/Climate Change
10) Costs/Liability
11) Alternatives

1) Environmental Impact Statement (EIS)-Overview of Guiding Principles

The Environmental Impact Statement (EIS) of the proponent is intended to examine the potential environmental effects, including cumulative effects, of all phases of the proposed project, site preparation, construction, operation, refurbishment if required, decommissioning and abandonment, and address all requirements for a Licence to Prepare Site [EIS Guidelines January]. [1] The EIS forms the basis for the public review by the Joint Review Panel established pursuant to the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act.*

According to the Guiding Principles of the EIS (Section 2),

> *"Environmental assessment is a planning tool used to ensure that projects are considered in a careful and precautionary manner in order to avoid or mitigate the possible adverse effects of development on the environment and to encourage decision-makers to take actions that promote sustainable development and thereby achieve or maintain a healthy environment and a healthy economy."*

Regarding the application of the precautionary principle (Section 2.5), the proponent must indicate how the precautionary principle was considered in the design of the project. For example,

> *"The proponent must demonstrate that all aspects of the project have been examined and planned in a careful and precautionary manner in order to ensure that they do not cause serious or irreversible damage to the environment and/or the health of current or future human generations; and*
>
> *provide that contingency plans explicitly address worst-case scenarios and include risk assessments and evaluations of the degree of uncertainty."*

With respect to promoting sustainable development, the EIS Guidelines (Section 2.4) state that

> *"Sustainable development seeks to meet the needs of present generations without compromising the ability of future generations to meet their own needs."*

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[1] Guidelines for the Preparation of the Environment Impact Statement for Ontario Power Generation's Darlington New Nuclear Power Plant project, January 2009 http://www.ceaa-acee.gc.ca/050/document-eng.cfm?document=32057

In the Summary of its Environmental Impact Statement document (p. 6), the proponent concludes that [2]

> *"...the New Nuclear at Darlington project will not result in any significant environmental effects. Most importantly, no significant adverse effects on the health and safety of workers, members of the public or non-human biota are anticipated."*

Given the magnitude of this project and the timespan for the construction and operational phase, let alone potential refurbishment, decommissioning and abandonment, coupled with the never-ending problem of nuclear waste, it is inconceivable that such a conclusion could be valid.

Therefore we urge the Panel to consider whether the EIS has sufficiently or adequately addressed the complete life cycle of the project in a precautionary manner, and in a manner that promotes sustainability, in accordance with the guiding principles of the EIS.

2) Proposed Reactor Designs

The proponent is considering a range of designs to deliver up to 4800 MW of power to the grid. As yet, no decision has been made on a specific reactor type. OPG anticipates that these reactors would have approximately a 60-year operating life, possibly including mid-life refurbishment. [3]

The reactor designs currently proposed are listed below. Three designs, classed as Generation III+ reactors, use low enriched uranium fuel (LEU) at various levels of enrichment. [4] The EC-6 is a Generation III reactor, which is an enhancement of the current CANDU -6 reactors.

Reactor Design	Vendor/manufacturer	Moderator/ Coolant	Enrichment	No. of reactors
ACR-1000 - Hybrid	Atomic Energy of Canada Limited (AECL)	heavy water / light water	up to 2.5%	4
AP1000 – PWR*	Westinghouse	light water	up to ~ 4.5%	4
US EPR -PWR	Areva	light water	up to 5%	3
Enhanced CANDU 6 (EC-6)	AECL	heavy water	0% - uses natural uranium	4

*PWR- pressurized water reactor

All of the proposed Generation III+ reactors are essentially enhancements of existing reactors, and are not yet in operation. Models have been developed to estimate their operational life, and evaluate their safety features (additional accident resistance, and improved containment design to mitigate accidents and human-induced events.)

[2] Summary of the Environmental Impact Statement for the New Nuclear at Darlington project: http://www.opg.com/power/nuclear/darlington/EIS%20Public%20Summary%20September%202009.pdf
[3] The "project for EA Purposes" is defined within a bounding framework, the Plant Parameter Envelope (PPE), which brackets the range of variables to be assessed for the different design options [ES-3].
[4] EIS p.2-13,43,44

The EC-6, which is not discussed in the EIS, was presented by OPG as an additional alternative. [5]

The failure to specify the specific reactor design and the corresponding number of reactors (three or four), which are undeniably the central component of the proposal, leads to a high degree of uncertainty with respect to the preparation of the site (excavation and construction), the specific structures and requirements dependent on the type of fuel (enriched or natural uranium), and the ancillary costs of the project. Unless the choice of a reactor is specified, these very significant aspects of the proposal cannot be properly assessed.

Nuclear fuel: According to the EIS, [EIS 2.3.1].

> *"nuclear reactor fuel for typical Generation III reactors is manufactured off-site and delivered to the generating facility in various configurations depending on the reactor type (e.g., fuel rod assemblies or fuel bundles)".*

This contributes significantly to the uncertainty about this project and the proposed designs. It is essential to know where the fuel is to be manufactured, the processes involved (i.e. enrichment), where the fuel rods are manufactured, and the resulting implications and risks, such as those associated with enrichment and the transportation of nuclear material.

Models: For models to be valid as predictors of performance and safety, they must be complete, accurate, and tested against actual performance. As none of the proposed reactors is in service, models of them cannot be tested against their performance. Furthermore, no reactor to date has operated for the projected lifetime of 60 years.

Enriched uranium: Three of the proposed designs use uranium enriched to different degrees. The process of enrichment involves repetitive weeding out of the fissile U-235 from non-fissile U-238 to reach the desired percentage of enrichment. This process produces extremely hazardous waste, and is very energy-intensive.

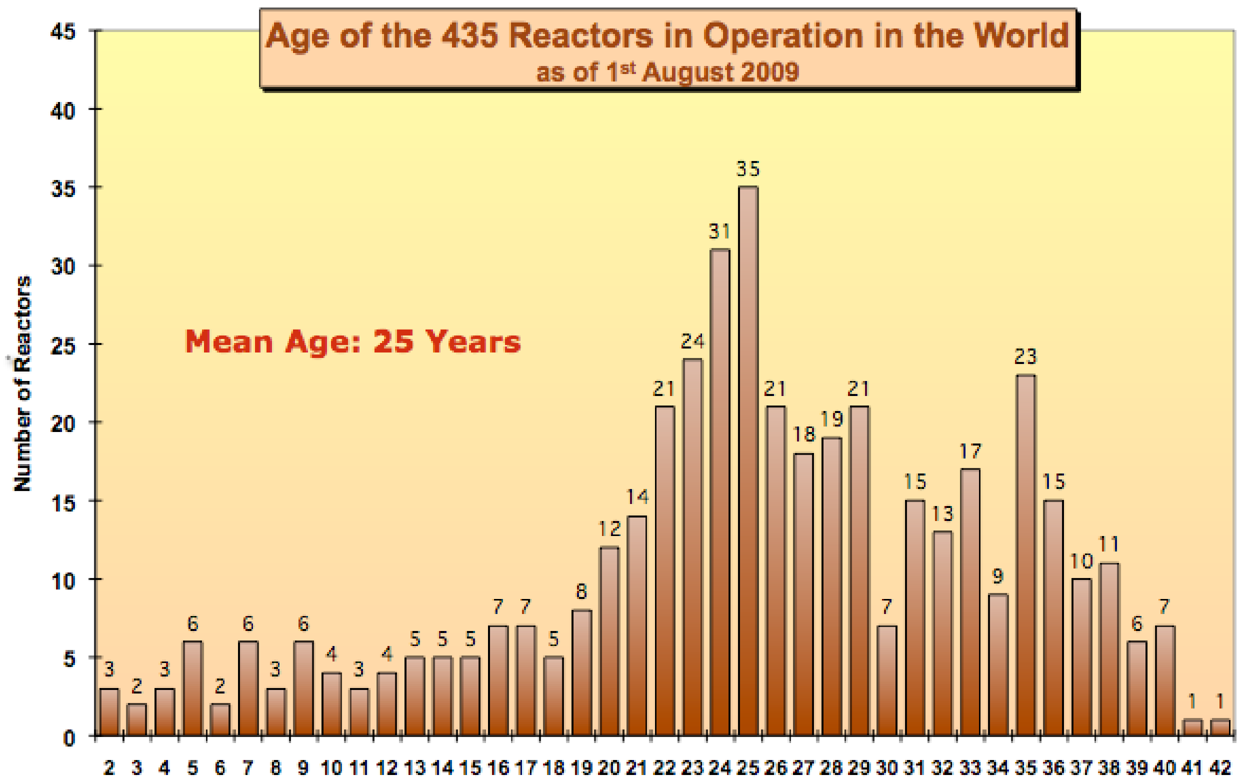
- There are no enrichment facilities in Canada, and all current reactors in Canada use natural uranium. There is only one enrichment facility in the U.S., which is slated to close in 2013.
- Where will the supply of enriched fuel come from? What fuel fabricating facility is to manufacture the enriched-uranium fuel rods?
- Criticality Safety Standards: Any operation that handles enriched uranium must ensure that the conditions for a sustained nuclear reaction (criticality) are not created. However, since power reactors in Canada have not used enriched fuel, **a Canadian set of criticality safety standards does not exist**. [EIS 7.3.3.2 p. 7-66]

Viability of vendors/manufacturers: What assurance is there that the vendors and/or manufacturers will provide the reactors in proper working order and ensure their safety? What is their responsibility in this regard, and what happens if they default?

The future of AECL is unknown, and work on their proposed reactor designs has been delayed. How does this affect the viability of their proposed reactors?

[5] Refer to OPG Response to the JRP Request Regarding Alternative Technologies - OPG New Nuclear at Darlington project http://www.ceaa.gc.ca/050/documents/44871/44871E.pdf

Operational Lifespan: The nuclear industry tends to project long lifetimes for its plants. However, the history of the nuclear industry has not borne this out. The average age at which existing reactors have shut down is about 22 years (although the median age is much lower). To date, only two reactors have lasted longer than 40 years. Given this experience, the projected estimates of 60-year lifetimes for new reactors at Darlington are probably unrealistic.



Source: Mycle Schneider Consulting *IAEA-PRIS, 2009*

Even though new reactors (Generation III+) may be designed to be more reliable and safer than the present fleet of reactors, they will be prone to unforeseen problems, as has been the case with earlier generations of reactors. [6]

3) Site Preparation and Construction Phase - Effect on Health and Environment

This phase is projected to extend for about fifteen years, from 2010 to 2025 [EIS 1.15]. This is only a conceptual timeframe. Projects of this complexity and nature could extend well beyond the proposed time period, and this has typically been the case for nuclear projects.

This phase consists of work on the site such as clearing, excavation, crushing and removal of existing soil and rock, lake infilling and bottom dredging, and construction of ancillary facilities, cooling towers, and waste management facilities. This soil and rock contain

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[6] Schneider M., Thomas, S et al: The World Nuclear Industry Status Report 2009, pp.16-18, 60-61

radioactive substances and other contaminants from approximately 20 years of operating existing reactors. Such massive disturbance of this soil and rock would result in the release and disbursement of highly dangerous radioactive substances, many long-living, to all environmental media and habitats (aquatic, terrestrial and non-human biota) and to humans.

In addition, it would result in excessive emissions of "dust", which consists of air pollutants including particulate matter (fine and coarse, both inherently toxic to human health, and containing toxic metals, some of them radioactive), volatile organic compounds (VOCs), sulphur dioxide (SO_2), nitrous oxides (NOx), polycyclic aromatic hydrocarbons (PAHs), and many other contaminants. In Canada, many of these substances have been found toxic under the *Canadian Environmental Protection Act* (CEPA 1999).

The 40 hectare infill and dredging in Lake Ontario that is proposed would disturb the aquatic habitat, which has already been compromised by existing operations at Darlington.

The major structural projects and industrial operations occurring at the same period (St. Mary's cement, which is directly adjacent to the site, the construction of roads and major highways, the Durham incinerator, etc.) combined with the construction activities at the Darlington site, would have a cumulative impact that would harm air quality, groundwater, surface water, and terrestrial and aquatic habitats. Restoration and mitigation may never be able to repair the harm done by this massive disturbance to the site.

The stability of the four existing reactors and the ancillary facilities may also be affected by all the excavation, infilling and construction activities. We question what efforts have been made to prevent any damage to these facilities.

The health, both mental and physical, of workers and residents nearby may be seriously compromised during these operations and long after. Of greatest concern is the impact on vulnerable populations (children, pregnant women, the elderly) and people whose health is already compromised (e.g., asthmatics).

Current guidelines and standards can not be considered an adequate safeguard for human health. They are bound to change and become more stringent with time as scientific understanding grows of the hazards presented by these substances, and the ways they damage human health and the environment. Therefore it is no reassurance that according to the EIS, the current standards for some of the pollutants are being met, or that emissions are well below regulated limits.

4) Enrichment

"Enriched uranium" refers to isotopic mixtures of uranium that contain a higher percentage of the fissile isotope U-235 than the 0.7% found in natural uranium. Light water reactors require 3% to 5 % of U-235 (light-enriched uranium (LEU)).

All methods of enrichment require uranium to be in the form of uranium hexafluoride (UF_6), known as "hex". Once UF_6 is enriched, it is shipped to a fuel fabricating facility where it is chemically converted to uranium dioxide (UO_2) before being manufactured into fuel rods.

The process for the enrichment of UF_6 is carried out in repetitive stages to weed out U-238, bit by bit. Currently, the two types of commercial enrichment processes are the gas centrifuge, and the older and much more energy-intensive gaseous diffusion technique.

In the gaseous diffusion process, UF_6 gas is forced through a series of porous membranes through which U-235 atoms pass slightly faster than the heavier U-238 atoms. The process is repeated many thousands of times before the desired concentration of U-235 is reached, usually from 3% - 5%.

These diffusion plants are enormous physical structures. They consume huge amounts of energy, require extensive support facilities, and generate large amounts of waste, much of which is highly hazardous. Enrichment accounts for almost half of the cost of nuclear fuel, and about 5% of the total cost of the electricity generated.[7]

In the U.S., the only operating uranium enrichment facility for years has been the Paducah Gaseous Diffusion Plant (PGDP) in Kentucky, built in 1952 and owned by the U.S. Department of Energy (DOE). It is slated to close in 2013.[8]

Associated health and environmental effects

Enrichment plant operations generate hazardous, non-hazardous, and radioactive wastes, including polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs) technetium-99 (Tc-99), and multiple isotopes of uranium, above all depleted uranium (DU), which is essentially U-238.

PGDP has contaminated groundwater with VOCs, Tc-99, and uranium. In addition uranium, thorium, and transuranic elements (e.g., plutonium and neptunium) have been detected in off-site sediments and surface water near PGDP. Trichloroethylene (TCE) and PCBs have been found in site soils.[9]

A major hazard in both the uranium conversion and uranium enrichment processes comes from the handling of uranium hexafluoride (UF_6), which is chemically toxic as well as radioactive. UF_6 is very reactive with water and forms extremely toxic corrosive hydrofluoric acid and highly toxic uranyl fluoride (UO_2F_2).

Hydrofluoric acid causes skin burns, and, after inhalation, damages the lungs. Further health hazards result from the chemical toxicity to the kidneys of the uranium in uranyl fluoride, and from its alpha radiation.

Conversion and enrichment facilities have had a number of accidents involving uranium hexafluoride. The most potentially destructive hazard in gaseous diffusion plants is the possibility of mishandling the enriched uranium, which could create a criticality accident (an inadvertent nuclear chain reaction).

Since all the Generation III+ reactor designs require enriched uranium, the Panel must consider, in its evaluation of the project, the enormous implications that enrichment has for human health and the environment, and its contribution to nuclear waste.

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[7] http://www.world-nuclear.org/info/inf28.html

[8] No gas centrifuge commercial production plants are currently operating in the United States, but there are planned projects awaiting approval. http://www.nrc.gov/materials/fuel-cycle-fac/arevanc.html

[9] http://www.epa.gov/region4/waste/npl/nplky/paducaky.htm

5) Nuclear Waste

Nuclear waste is the Achilles' heel of the nuclear industry. It is an inescapable by-product of nuclear power.

Of all types of nuclear waste, the most dangerous is the spent fuel from nuclear reactors. This "High Level Radioactive Waste" consists of over 200 deadly radioactive elements, such as plutonium, cesium, krypton, strontium, radon, and iodine, and many other highly toxic substances, including lead and arsenic. Many of these radioactive substances have extremely long half-lives, guaranteeing their presence and that of their dangerous progeny for millions of years. This waste must be kept completely isolated from the environment for very long periods of time, essentially forever. To recycle or re-process this waste makes it even harder to contain, and makes plutonium available, which could be used for nuclear weapons.

Apart from the radioactive fission products from the reactor fuel, radioactive activation of elements occurs wherever neutrons impact other nearby material. This contaminates the surrounding air, water, pipes and containment buildings. Over time, this makes a nuclear plant unstable and all of it becomes radioactive waste.

The fuel bundles last anywhere from one to two years, after which they are removed from the reactor by remote control, and transferred to water-filled pools (referred to as a Spent or Irradiated Fuel Bays) for a period of about 10 years. They are then transferred to dry storage containers, and placed in appropriate facilities, specific for the fuel type. All spent fuel is stored at the site of the reactor that produced it.

These storage methods cannot be assumed to be reliable beyond a few hundred years, because of problems such as the following:

- Radioactive iodines (one with a half-life of 15.7 million years and the other, 8 days) are highly reactive gaseous fission products. Over time, they can cause corrosion in the metal cladding of the bundles, resulting in cracks or breaches.[10]
- Containers made of "corrosion-resistant" copper and steel are being proposed to enclose the fuel bundles. However, copper artefacts from an old warship raised from the Stockholm Harbour have shown a level of decay, challenging the scientific wisdom that copper only corrodes when exposed to oxygen. [11]

No material has yet been discovered that is impervious to all chemical and radiological assaults for a million years.

As of June 30, 2010, approximately 2.1 million bundles of spent fuel (containing 44,000 tonnes of heavy metal (t-HM))from Canada's nuclear power reactors were in storage at the reactor sites. If no new reactors are built, depending on whether some reactors are to be refurbished, the total number of used fuel bundles produced to end of life is projected to

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[10] www.stoller-eser.com/Quarterlies/iodine.htm

[11] http://www.guardian.co.uk/environment/2009/nov/14/copper-nuclear-containment-vasa-sweden

range from 2.8 million bundles (no refurbishment) to around 5.1 million (56,000 t-HM to 102,000 t-HM), assuming refurbishment extends operating life for 30 years. [12]

Of the three Generation III+ reactor designs proposed in the EIS, over their projected 60-year lifetime, the additional spent fuel produced is projected to be[13]:

a) ***AECL ACR 1000 -*** 770,400 used fuel bundles (12,480 t-HM).
b) ***Westinghouse AP1000 -*** 10,800 PWR fuel assemblies (5,820 t-HM).
c) ***AREVA EPR -*** 9,900 PWR fuel assemblies (5,220 t-HM)

With respect to the "alternative" design proposed by OPG, the EC-6, the total mass of fuel used during the lifetime of the reactor is estimated at 31,322 tonnes. [14]

Depending on the proposed design, the Darlington proposal would add anywhere from 5,200 tonnes of spent fuel to 31,322 tonnes, over the projected operating period.

The Nuclear Waste Management Office (NWMO), under the *Nuclear Fuel Waste Act (NFWA)* is charged with developing a long-term management approach for disposing of used fuel nuclear waste.

The NWMO has stated that

> "*used nuclear fuel will need to be contained and isolated from people and the environment essentially indefinitely."*[15]

According to the proponent, since the responsibility for used nuclear fuel is subject to a separate federal approvals process, it does not have to be addressed in the EIS.

We argue otherwise. It is irresponsible and inappropriate for the proponent not to address what is arguably the most contentious issue faced by the nuclear industry. This omission in the environmental assessment process would completely invalidate it.

Furthermore, according to the EIS Guidelines [8.7];

> *''Where this plan identifies that radioactive or hazardous wastes or used fuel are expected to be managed by an organization other than the proponent, the EIS must describe at a conceptual level the methods that can be used to ensure that these materials are managed in a manner the protects health, safety and the environment.''*

In keeping with the role and mandate of the Panel in the review to carry out an environmental assessment of the complete life cycle of the project, we recommend that the Panel require that the management of used nuclear fuel, for as long as it remains

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[12] Nuclear Fuel Waste projections in Canada –2010 Update Nuclear Waste Management Organization NWMO TR-2010-17 December 2010 http://www.nwmo.ca/uploads_managed/MediaFiles/1678_nwmotr-2010-17_nuclearfuelwast.pdf
[13] Ibid p. 6: Note that each fuel assembly can contain between 200-300 fuel rods.
[14]Comparison of PPE (Plant Parameter Envelope) values to EC-6 Values & Discussion of Potential Impact, p. 3 http://www.ceaa.gc.ca/050/documents/44871/44871E.pdf
[15] NWMO, *Choosing a Way Forward: The Future Management of Canada's Used Nuclear Fuel, Final study November 2005* P. 15
http://www.nwmo.ca/uploads_managed/MediaFiles/341_NWMO_Final_Study_Nov_2005_E.pdf

hazardous, be included in the assessment. Otherwise, the validity of assessment process will be fatally flawed.

> *"We are saying to our descendents that the wastes we leave them are their burden, their lookout, their danger—because we couldn't be bothered to find a safer way to generate electricity".* Carl Sagan (1993)

More than 50 years after the first commercial nuclear power plants went operational in the United Kingdom and the United States, the world's 270,000 tonnes of spent fuel remain in limbo. Jorgen Tritton, former German Environment Minister on nuclear power reactors has stated:

> *"as far as the long-term management of radioactive wastes is concerned, we are fundamentally no wiser than we were 30 years ago. The use of nuclear power is and will remain an enormous global risk, especially for future generations ".*

Low Level and Intermediate Level Radioactive Waste: (L& ILRW)

Two options are being considered for managing L&LRW, namely, transporting the waste offsite to be managed at an appropriately licensed nuclear waste management facility (e.g., the Western Waste Management facility-WWMF); or managing the waste in a new low and intermediate level radioactive waste management facility on the DN site. (EIS 2.6.20, 2.6.11]

As of 2008, the total amount of L&LRW produced by nuclear power plants is approximately 90,000 m^3. If no further plants are built, the projected total for 2050 would be about 175,000 m^3. [16] The proposed new reactors would add a significant portion of L&LRW to this inventory, considering that there are four reactors (This would represent about 20% of all operating reactors in Canada).

It is apparent that the management of this waste has not been effectively explored in the EIS. Does WWMF have the capacity to store this waste? What proportion would be stored on site?

The proponent should be expected to provide this information, as it also pertains to other matters, such as the construction of facilities to store the waste, and the transportation of nuclear waste. IICPH requests that this information be provided.

6) Accident Scenarios

i) Overview

Unforeseen events and consequences from technical malfunctions and human error have been and continue to be part and parcel of nuclear power. Very serious accidents have already occurred, above all the one at Chernobyl, so they cannot be dismissed as not being "credible", as the proponent and the nuclear industry are doing.

Nuclear plants are not like any other plants. If something goes wrong, it can cause a major disaster, and result in irreversible harm to the health and environment of thousands and even millions of people, as the Chernobyl accident did.

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[16] Inventory of Radioactive Waste in Canada 2009 p.35
http://www.llrwmo.org/en/pdf/Inventory%20Reports/English%20Inventory%20Report%202009.pdf

So how can the nuclear industry extend the lifetime of these plants without compromising safety and reliability even further? How can they ignore the possibility of human error, when human error was the primary cause of the Chernobyl catastrophe and the partial meltdown at Three Mile Island?

If the nuclear industry really believed that the potential for serious accidents was not "credible", then they would not refuse to construct and operate their facilities unless they are indemnified from paying the full costs of clean up and compensation in the event of an accident, as they are by the Nuclear Liability Act. Because the liability of the nuclear industry is limited to an amount for which they can buy insurance, they can afford a catastrophic accident since the public has to bear most of its cost. This lowers their incentive to do everything possible to prevent such an accident, for the sake of increasing their profit.

Ignoring the potential risks of a major accident is contrary to the precautionary principle, which requires a project to err on the side of caution, especially where there is a large degree of uncertainty, or the risk of very great harm. Some risks, such as the risk of mass destruction of people and property, are simply too great to take.

ii) Relevant EIS Guidelines

According to the EIS Guidelines [Section 12.2], nuclear accidents consist of all accidents and malfunctions with radiological consequences. They include accidents directly involving the reactor core; accidents involving any other on-site facilities containing radioactive substances (including spent fuel storage facilities and waste handling facilities); accidents associated with off-site transportation of radioactive waste; and "out of core criticality" accidents.

In an operating reactor, an active fuel assembly contains radioactive isotopes with half-lives ranging from seconds to millennia. After the reactor is shut down, or a fuel assembly becomes spent (i.e., it is discharged from the reactor), the assembly's inventory of each isotope declines at a rate determined by the isotope's half-life. Thus an atmospheric release from an operating reactor would contain short- and longer-lived isotopes, while a release from a spent-fuel-storage facility would contain only longer-lived isotopes. That difference has implications for the environmental impacts of a release, and for the emergency response that would be appropriate.[17]

The EIS Guidelines further state that

> *"The EIS must identify and describe the probability of possible malfunctions or accidents associated with each reactor design considered and with other facilities in the nuclear power plant that contain radiological substances and must consider the potential adverse environmental effects of these events."*

> "*The proponent must credibly demonstrate that it meets the safety goals defined in CNSC Regulatory Document RD-337, "Design of New Nuclear Power Plants", [Reference 10], with some margin on frequency, consequence or both. These safety goals are meant to ensure that the risk*

[17] Gordon R. Thompson, INSTITUTE FOR RESOURCE AND SECURITY STUDIES, November 2008 http://stopdarlington.org/uploads/GPaccidentsandmalfuctionsDarlington-19-11-08.pdf p. 32

posed by a nuclear power plant to members of the public living near the plant is small compared with the risks to which they are normally exposed, and the releases they describe are bounding for all designs."

The Guidelines require a high-level safety analysis that must include a system level probabilistic safety assessment, or an equivalent level and type of information.

According to Section 2.6 of the Guidelines, in carrying out this assessment

"the proponent must document how it used scientific, engineering, traditional and other knowledge to reach its conclusions. Assumptions must be clearly identified and justified. All data, models and studies must be documented such that the analyses are transparent and reproducible. All data collection methods must be specified.

The uncertainty, reliability and sensitivity of models used to reach conclusions must be indicated. The sections in the EIS regarding existing environment and potential adverse environmental effects predictions and assessment must be prepared using best available information and methods, to the highest standards in the relevant subject area. All conclusions must be substantiated.

The EIS must identify all significant gaps in knowledge and understanding where they are relevant to key conclusions presented in the EIS. The steps to be taken by the proponent to address these gaps must also be identified."

iii) Out of Core Criticality

The term criticality safety is used to describe the measures that are undertaken to prevent an inadvertent sustained nuclear chain reaction outside of the reactor core. Operations that handle fissile material (enriched uranium) must ensure that the conditions for a sustained nuclear chain reaction or criticality are not created inadvertently [EIS 7.3.3.1]. This can happen as a result of improper spacing or moderation of enriched uranium fuel assemblies.

Out of core criticality can also occur anywhere that enriched uranium fuel is present, including fuel fabricating plants, transportation vehicles, and on-site storage facilities.

The proponent maintains that "an inadvertent out-of-core criticality event is considered not credible". This statement is itself not credible, since such events have already happened. Furthermore, the proponent's own assessment of the consequences of such a "hypothetical event" claims to show that public evacuation would not be triggered, even though this has already happened in Japan. [EIS p. 7-66] This assessment also acknowledges "that workers in the immediate vicinity of such an event would be subject to substantial risk". [ES 17]

iv) Accidents Affecting Stored Spent Fuel[18]

At nuclear power plants using enriched uranium fuel, the pools used to store the spent fuel currently employ high density racks, to maximize the amount of spent fuel that can be stored in each pool. This practice has been adopted because it is the cheapest mode of storage for spent fuel.

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[18] Ibid p.35

This high-density configuration suppresses convective cooling of fuel assemblies if water were lost from a pool. The loss of water from a pool would, across a range of water-loss scenarios, lead to spontaneous ignition of the zirconium alloy cladding of the most recently discharged fuel assemblies.

The resulting fire would spread to adjacent fuel assemblies and propagate across the pool. Extinguishing the fire, once it had been initiated, would be difficult or impossible. Spraying water on the fire would feed an exothermic reaction between steam and zirconium. The fire would release a large amount of radioactive material to the atmosphere, including tens of percent of the pool's inventory of Cesium-137. Large areas of land downwind of the plant would be rendered unusable for decades. Loss of water could arise in various ways as a result of an accident or an intentional, malevolent act.

v) Cumulative Impacts across the Site

At the Darlington site, new nuclear power plants would be added to a site where plants are already operating. An EIS should consider the cumulative impacts of all the hazardous facilities on the site, including nuclear power plants and facilities for storing spent fuel and other radioactive wastes. In the context of accidents and malfunctions, it would be especially important to consider the combined outcomes of an event that could affect more than one facility, such as an earthquake, or a malevolent act affecting site services.

vi) Probabilistic Risk Assessment (PRA)

Direct empirical data for calculating PRAs is limited, but this is the only basis for such calculations that has any scientific validity. Worldwide operating experience of commercial nuclear power plants through 2008 will be about 13,400 reactor-years (RY), and Canadian experience will be about 580 RY. Two events involving substantial damage to a reactor core have occurred worldwide while that experience was accruing, at Three Mile Island (TMI) in 1979, and at Chernobyl in 1986.

At Three Mile Island (TMI) Unit 2 in 1979, the reactor core was severely damaged, but there was a comparatively small radioactive release to the environment. At Chernobyl Unit 4 in 1986, a substantial fraction of the core inventory of radioactive material was released to the atmosphere.

This limited experience allows one to estimate the probability of a core-damage accident as 2 per 13,400 RY, or 1.5 per 10,000 RY; and the probability of a large atmospheric release as 1 per 13,400 RY, or 0.7 per 10,000 RY.

This is far greater than the estimate of 1 per million RY, the threshold specified by the CNSC for a nuclear accident scenario to be credible for consideration in an environmental assessment. [EIS 7.3.2.4] This threshold is not supported by experience to date.

It is absolutely essential to take seriously the possibility of a serious accident involving substantial releases of radioactivity. Even if these accidents are considered unlikely, the consequences are extremely severe, and public concerns are intense. To choose to ignore this possibility is a serious compromise that society cannot afford.

Chernobyl

The Chernobyl catastrophe in 1986 is the worst nuclear power plant disaster in history, causing thousands of deaths and leaving behind a highly radioactive uninhabitable wasteland. Over 800,000 people were brought in for the "clean-up" immediately after the explosions at the reactor.

In response to "experts" who concluded that the adverse consequences for health were not as significant as previously thought, the former UN Secretary-General Kofi Annan voiced another view[19]:

> *Chernobyl is a word we would all like to erase from our memory. But more than seven million of our fellow human beings do not have the luxury of forgetting. They are still suffering, everyday, as a result of what happened...The exact number of victims can never be known. But three million children demanding treatment until 2016 and earlier represents the number of those who can be seriously ill...their future life will be deformed by it, as well as their childhood. Many will die prematurely.*

More than three billion people inhabit areas contaminated by Chernobyl's radionucleides. Radioactive contamination from the Chernobyl meltdown spread over 40% of Europe (including Austria, Finland, Sweden, Norway, Switzerland, Romania, Great Britain, Germany, Italy, France, Greece, Iceland, Slovenia) and wide territories in Asia (including Turkey, Georgia, Armenia, Emirates, China), northern Africa, and North America. Nearly 5 million people (including, more than 1 million children) still live with dangerous levels of radioactive contamination in Belarus, Ukraine, and European Russia. [20]

Twenty-five years after the disaster, the sarcophagus constructed to "cover" the reactor is crumbling and liable to collapse. Portions of the core of the reactor are still exposed to the elements.

7) Cumulative Effects

The EI Guidelines (Section 13, p.52, 53) note that

> *"The proponent must identify and assess the cumulative adverse and beneficial environmental effects of the project in combination with other past, present or reasonably foreseeable projects and/or activities within the study areas.*
>
> *projects that are conceptual in nature or limited as to available information may be insufficiently developed to contribute to this assessment in a meaningful manner."*

In Canada, cumulative effects assessment is a requirement under the Canadian Environmental Assessment Act (CEAA) 16(1). The central task of EIA is to safeguard the sustainability of the ecosystem in the face of development that might compromise that sustainability.

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[19] Chernobyl: Consequences of the Catastrophe for People and the Environment (Annals of the New York Academy of Sciences, Volume 1181). November 2009. Alexey Yablokov, Vassily Nesterenko and Alexey Nesterenko, consulting editor Janette D. Sherman-Nevinger p. 2

[20] Ibid p.5

A cumulative effects approach assesses the full range of human-generated aggregate stresses, (i.e., additive, interactive, synergistic, multiple sources, spatial and temporal) on the ecosystem over time, from cradle to grave, that is the complete life cycle.

Accordingly, the role of the Panel in the review is:[21]

> *to carry out an environmental assessment of the complete life cycle of the project in accordance with the Canadian Environmental Assessment Act and to review the application for a Licence to Prepare a Site under the Nuclear Safety and Control Act.*

For a project of this complexity and dimension, any and all effects on the ecosystem are cumulative and long-term.[22] Thus, it is absolutely essential that an assessment of cumulative effects include the broadest possible scale of activities over a timescale and area that must extend well beyond the project's construction phase, operation, decommissioning and abandonment, and not be confined to a "study area" that does not address the full range of potential adverse environmental and health effects of the project.

In fact, we would argue that given the degree of uncertainty in various aspects of this project, it is critical that the approach to assess cumulative effects be broadened to the fullest extent, in accordance with the charge to the Panel, from cradle to grave, and well beyond.

However, the EIS limits its consideration of cumulative effects to activities within the study area. It does not consider the full impact of the entire nuclear chain, from obtaining nuclear fuel (mining, milling, refining, enrichment, manufacturing fuel rods), through to operation, refurbishment, decommissioning and abandonment, nor does it consider the ***final*** disposal of radioactive waste (spent fuel and low level radioactive waste). It does not address the possible impact of malfunctions or accidents, not only for the new proposed reactors, but also for the existing reactors. Thus, it does not consider *the complete life cycle of the project.*

The cumulative effects of malfunction or accident scenarios are excluded from consideration in the EIS

> *"because these scenarios have a very low probability of occurrence and Canadian EA guidance indicates that such events should be assessed as "unique scenarios", not together with the more likely effects of normal operational activities. [ES 16-17]*

IICPH recommends that the Panel examine the cumulative impacts on human health and the environment of the entire life cycle of the project, and of all aspects of the nuclear chain, and of all nuclear facilities proposed and existing in the entire region (Darlington, Pickering, and Cameco). It must address the problem of nuclear waste disposal.

By excluding these topics, the EIS has completely ignored the most serious environmental impacts of its proposal. Above all, it must insist that in accordance with Section 2.5, Precautionary Approach, Guidelines of the EIS, that the proponent

> *"provide that contingency plans explicitly address worst-case scenario and include risk assessments and evaluations of the degree of uncertainty."*

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[21] Public Hearing Procedures http://www.ceaa-acee.gc.ca/050/documents/46908/46908E.pdf

[22] P.N. Duinker and L.A. Greig. 2006. The impotence of Cumulative Effects Assessment in Canada: Ailments and ideas for redeployment. Environmental management Vol. 32, No.2, pp. 153-161

8) Public Health and Safety

i) Overview

In evaluating the risks and costs to human health and the environment of this project, it is imperative to taken into account, cumulatively, all stages of the nuclear chain, from cradle to grave.

This includes mining, milling, processing (refining), enrichment and transportation, in addition to construction, operation and maintenance, decommissioning, abandonment and waste. It is also necessary to consider the impact of malfunctions and accidents, including worst-case scenarios.

Uranium mining and milling result in vast amounts of radioactive and non-radioactive solid and liquid wastes (tailings), which contaminate air, waterways, local aquifers, and soil for eons. These mining sites remain radioactive for many thousands of years.

The crushing of ore produces fine radioactive dust particles containing uranium and its progeny, including radon, a potent lung carcinogen. This dust can easily travel 1,500 km in just a few days. The tailings also generate radon gas continuously.

The long-term generational impacts of the proposed project on human health must be assessed, with special attention to workers and vulnerable populations (the foetus, children, women, especially pregnant women, the elderly, and the immune-compromised) taking into account all possible contaminants (radiological and non-radiological), not only in the local area, but over a far more extensive area than the regional study area indicated in the EIS [ES-7]. A worst-case nuclear accident would have a devastating affect on a large, highly populated region of North America.

The current guidelines and standards for many pollutants cannot be applied to a project of this duration. They are subject to change, of necessity, becoming more stringent as scientific understanding grows of the health hazards presented by these substances. This applies to a wide range of air pollutants, including radioactive substances.

For example, the substance hydrazine is used in the boilers of power plants as an oxygen scavenger/corrosion inhibitor. About 90% of the emissions of hydrazine in Canada are to water, the biggest sources being the three nuclear power plants at Pickering, Darlington and Bruce.

Hydrazine is a non-threshold carcinogen, that is, there is a probability of harm at any level of exposure. It has recently has been designated toxic under the Canadian Environmental Protection Act (CEPA 1999)[23]. This will require the nuclear industry to adopt new preventative measures to minimize releases of hydrazine.

The EIS concludes that hydrazine presents no harm to the general public, or to the environment, other than perhaps some issues with groundwater. However, workers are potentially at risk of exposure from spills etc. [EIS Section 2.3 p, 7.23-25]

[23] Proposed Risk Management Approach for Hydrazine January 2011 environment Canada Health Canada http://www.ec.gc.ca/ese-ees/BF03ABB4-6EDF-40F3-9456-D9081647C9FB/Batch10_302-01-2_rm_EN.pdf

"Workers may be exposed to higher concentrations of hydrazine during cleanup activities for the spill; however, the use of proper personal protective equipment and hazardous material cleanup procedures will provide adequate protection against adverse health effects."

Not only are workers exposed to cancer-causing radiation, they are also exposed to a non-threshold carcinogen. The interaction and potential synergy between different carcinogens is not well understood, so a precautionary approach requires adequate safeguards against them in the Environmental Assessment.

ii) Radiological Substances - Safe Levels

First and foremost, there is no safe level of exposure to ionizing radiation. This has been clearly acknowledged in the latest publication in the National Academy of Science series "Biological Effects of Ionizing Radiation", the BEIR VII Report. Therefore, from a health perspective, the maximum safe dose of any ionizing radiation is zero. Any other value set for a safe dose is based on the degree of risk, that is, the degree of harm to human health and the environment, that is tolerated by regulatory bodies. [24]

The current prescribed safe dose limits set by the International Commission on Radiological Protection (ICRP), using the unit sievert (Sv), are: [25]

> Members of the public (with the exception of occupational exposure) - 1 mSv/yr [milliSievert per year] (In special (infrequent) circumstances, an effective dose of up to 5 mSv in a year may be permitted).
>
> Nuclear Energy Workers (NEWs) - 100 mSv over 5 years (i.e. an average of 20 mSv/yr) with a maximum of 50 mSv in a single year.

The level of exposure for nuclear workers is based on the expectation that 3.2 excess cases of fatal cancer per 100 workers would be generated over a 40-year career. For other non-radiological industrial toxicological situations, 1/10,000 to 1/million fatalities are considered acceptable.[26] The nuclear industry should be required to meet the same standards as all other industries in Canada.

Radiation damage can affect any part of a cell, and can interfere with many cellular processes. Most importantly, damage to the genetic material of the cell can lead to cancer, non-cancerous tumours, birth defects, hereditary illness, and immune system diseases. Any amount of exposure to ionizing radiation is harmful.

The Sievert, the equivalent dose to a tissue, is a risk-based unit of measurement that estimates the probability that a given exposure will result in a fatal cancer. [27] Basing risk on fatal cancers alone does not take into account other radiation-related health effects.

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[24] BEIR VII report: http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/beir_vii_final.pdf

[25] Ionizing Radiation-Safety Standards, Health Physics Society, rev. 2003 http://www.hps.org/documents/publicdose03.pdf

[26] International Commission on Radiation Protection: ICRP Document 60: 1990 Recommendations of the ICRP. Oxford, UK: Pergamon, Elsevier Science.

18) World Information Service on Energy-Uranium Project www.wise-uranium.com.

[27] Measuring radiation and Assessing its effects:

The ICRP limits are used in the EIS to evaluate health risks resulting from the "bounding radiological malfunction or accident scenarios". The EIS states [EIS 7-36]:

> *"As accident scenarios are a one time occurrence, the 50 mSv maximum annual dose is used as the regulatory dose limit for comparison to the worker dose resulting from the accident".*

IICPH does not accept the methodology or underlying assumptions made in calculating the ICRP limits and other units based on these limits, such as Derived Release Limit (DRL) models, which set legal upper bounds for releases to the environment from nuclear facilities regulated by the CNSC.

These limits do not make proper allowance for doses that occur over a number of years. They ignore the accumulation of radionucleides in the environment and in individuals, in particular the most vulnerable (children, the foetus). They place nuclear workers, and their families, at an unacceptably high risk. In fact, the IARC (International Agency for Research on Cancer) study of nuclear workers found that radiation-related cancer rates of Canadian nuclear workers are higher than those of other nuclear workers receiving the same radiation dose.[28]

The current regulated limits are unacceptable as a guarantee of safety, especially as there is more than sufficient evidence that there is no safe level of exposure to ionizing radiation.

iii) Tritium

All nuclear reactors routinely release radioactive material into the air and into the water that is used to cool them. Because Canadian reactors depend on heavy water as a moderator, they release tritium to the environment.

Both gaseous and aqueous forms of tritium (HT and HTO respectively) are very radioactive and pervasive. HT permeates most materials, including rubber and many grades of steel, with relative ease. HTO, which is chemically identical and physically similar to ordinary water, very rapidly mixes everywhere.

Tritium is absorbed through inhalation, ingestion and dermal absorption. Inhalation of tritium is the most dangerous portal, because it is absorbed into the body more readily than by ingestion or skin absorption. [29]

Tritium is a carcinogen, mutagen, teratogen and developmental toxin easily absorbed into the body. It becomes incorporated into DNA and disrupts the genetic code of men's and women's reproductive cells. It easily crosses the placenta, which raises concern for spontaneous abortions, stillbirths, and congenital malformations and diseases. The cells most at risk from tritium are those dividing at the time of exposure (precursor cells for the ovum), the embryo, and nerve cells.

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http://www.sievert-system.org/WebMasters/en/frame.php?page=contenu_mesure.html%23tit2

[28] Dr. Rosalie Bertell: Health effects of tritium. (*Health Effects of Tritium*, Submitted to the CNSC, November 27, 2006)

[29] Reference: CNSC 2009: CNSC Tritium Releases and Dose Consequences in Canada in 2006, p. 17, 18 http://nuclearsafety.gc.ca/pubs_catalogue/uploads/CNSC_Release_and_Dose_eng_rev2.pdf

Since tritium spontaneously disintegrates, the resulting recoil excitation can disrupt chemical bonds. These disruptions, when repeated, cause chronic diseases such as allergies or hormonal dysfunction.

In addition to the study noted above on nuclear workers, a number of studies in Canada have demonstrated the health detriments of tritium, including an increase in the number of fatal birth defects and neonatal deaths in the area of the Pickering nuclear facility, an increase in Down's syndrome and central nervous system anomalies in births in the Pickering area, and an increase in child leukemia deaths near the Bruce plant. [30]

The current Canada Guideline and Ontario Drinking Water Quality Standard for tritium is 7,000 Bq/L, which is based on the permissible ICRP dose limit of 1 mSv/year (lowered to 0.1 mSv in water). [31]

It has been recommended that the Ontario Drinking Water Guideline for Tritium be revised to 20 Bq/L. [32] This level relates to heath effects from long-term, chronic exposure over a lifetime of 70 years, and limits the lifetime risk to about one excess fatal cancer per million people. This matches the current Canadian Federal (and Provincial) limit for other chemicals, which are set at levels that provide a lifetime risk of 1-10 excess fatal cancers per million people.

The current "standard" of 7,000 Bq/L corresponds to a risk of 350 excess fatal cancers per million people from just *one year's* consumption of drinking water, not a lifetime (70 years). The risks used to determine standards for radioactive substances in Canada, such as for tritium in drinking water, must be at least as stringent as for non-radioactive chemicals.

According to the Canadian Nuclear Association, a level of 20 Bq/L is achievable without significant cost to the nuclear power industry. In fact, in Table 1 of the CNSC study on Standards and Guidelines for Tritium in Drinking Water, levels of tritium in drinking water near nuclear stations tend to be below 20 Bq/L for the most part. None are anywhere near the current standard. [33]

iv) Other Radionucleides

In addition to tritium, all functioning reactors routinely release many other radioactive substances to the air and into the cooling water. The noble gases xenon 137 and krypton 90 decay relatively quickly into the deadly cesium 137 and strontium 90 radionucleides. Cesium 137 accumulates in muscle, including the muscle of animals such as cattle, pigs and sheep; strontium 90 accumulates in bone. Other radioactive isotopes of xenon, krypton and argon are also released. Iodine 131 is mostly trapped by filters, but can escape in accidental releases. It is highly toxic to the thyroid, particularly in children.[34]

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[30] Dr. Rosalie Bertell: Health effects of tritium. (*Health Effects of Tritium*, Submitted to the CNSC, November 27, 2006)

[31] CNSC Standards and Guidelines for Tritium in Drinking Water (January 2008) http://nuclearsafety.gc.ca/pubs_catalogue/uploads/info_0766_e.pdf

[32] http://www.odwac.gov.on.ca/reports/052109_ODWAC_Tritium_Report.pdf

[33] Canadian Nuclear Safety Commission (CNSC) Catalogue number INFO-0766 Standards and Guidelines for Tritium in Drinking Water http://nuclearsafety.gc.ca/pubs_catalogue/uploads/info_0766_e.pdf

[34] Human Health Implications of Uranium Mining and Nuclear Power Generation

A recent study in Germany (2008), the German KiKK (kinderkrebs kerntechnik) study, provided evidence of a relationship between a child's risk of leukemia, and residential proximity to a nuclear power plant. This effect was consistent across all sixteen nuclear power plants in Germany, meeting the researchers' criteria for size and duration of operation, and was detectable as far as 50 km from the nuclear facility.[35]

v) Dose Limit Issues

The ICRP methodology, and its underlying assumptions for calculating the internally absorbed dose, are flawed for a number of reasons.[36]

- ICRP recognizes only severe genetic effects in live-born offspring, and does not take into account cases such as miscarriage and stillbirth, teratogenic effects (such as congenital malformations and diseases), or childhood asthma. [37]
- Salient factors such as chronic exposure, non-cancerous effects, the damage done by tritium to DNA, and chronic illnesses due to non-functional enzymes, hormones and essential proteins are not considered, despite evidence that these effects occur.
- ICRP applies a Relative Biological Effectiveness (RBE) Factor of 1 for tritium in determining its dose limit. The RBE value of 1 for tritium is controversial. Based on several factors mentioned above, and a consensus of scientific research, the RBE for tritium is severely underestimated and needs to be increased by a factor of two to three. [38]
- The ICRP risk-based system of protection relates to "reference persons", and does not take account of age, size and sex differences in its risk factors.
- As the largest tritium polluter, Canada has an obligation to provide arm's length independent research, and not rely on the ICRP for advice on regulatory standards. It should not continue to support the ICRP permissible public dose limit of 1.0 mSv/year, which is neither protective nor precautionary.

Dr. Cathy Vakil M.D., C.C.F.P., F.C.F.P. Dr. Linda Harvey B.Sc., M.Sc., M.D. http://pgs.ca/wp-content/uploads/2008/03/human-health-im ation2009-21.pdf

[35] Spix C., Schmiedel S., Kaatsch P., Schulze-Rath R., Blettner M. Case-Control Study on Childhood Cancer in the Vicinity of Nuclear Power Plants in Germany 1980-2003. Eur. Journal of Cancer 2008; 44:275-284; also http://www.bfs.de/en/kerntechnik/kinderkrebs/kikk.html

[36] Dr. Rosalie Bertell: Health effects of tritium. (*Health Effects of Tritium*, Submitted to the CNSC, November 27, 2006)

[37] Straume T and Carsten AL (1993) Tritium radiobiology and relative biological effectiveness. Health Phys. 65:657-672.Teratogenic risks for tritium have been estimated to be six-fold higher than the risks of fatal cancers.

[38] **Relative Biological Effectiveness Factor (RBE):** The sievert, is the product of the absorbed dose by a dimensionless "quality factor" *Q*, the RBE, which depends on radiation type, and by another dimensionless factor *N*, dependent on all other pertinent factors such as the part of the body irradiated, the time and volume over which the dose was spread, and even the species of the subject. As per most government regulations, the RBE [Q] for electron and photon radiation is 1, for neutron radiation is 10, and for alpha radiation t is 20.

vi) The Bystander Effect [39]

Radiation-induced bystander effect creates the possibility that extra-nuclear and extracellular effects may also contribute to the final biological consequences of exposure to low doses of radiation.

There is evidence that when targeted cytoplasmic irradiation results in mutation in the nucleus of a cell that is directly hit, nearby cells that are not directly hit contribute to the genotoxic response of the cell population. The progeny of these "bystander" cells show an increase in genomic instability, as evidenced by an increase in delayed mutations and chromosomal aberrations many generations afterwards. This indicates the need for a comprehensive assessment of the bystander issue, particularly among genetically susceptible populations.

Summary Comments

In conclusion, a single radionucleide can cause a lethal cancer, and damage to DNA that may be carried to future generations. This is why there is no safe dose of any radionuclide. This is confirmed by the fact that human exposure, measured in sieverts, estimates the probability that a given exposure will result in a fatal cancer. This acknowledges that human casualties are an inevitable result of releasing radionucleides into the environment, and merely strives to keep these casualties at an "acceptable" or "reasonable" level.

But no level of casualties is "acceptable" or "reasonable" to a population that has not chosen to accept them by giving the informed consent that scientific ethics require, nor is even a single casualty "acceptable" to the unfortunate individual and family that suffer it.

9) Energy/ Climate Change

The proponent concludes that the project will have no effect on climate change, nor will climate change have an effect the project. [EIS 6.4]

The proponent has estimated annual greenhouse gas (GHG) emissions resulting from the preparation and construction phase and the operational phase using emission factors. [EIS Tables 6.4-1 and 6.4-2, p. 6-55] It has concluded that the project's GHG emissions in comparison to Ontario's total GHG emissions in any given year are negligible.

However, these figures only account for one small part of the emissions of GHGs from nuclear energy. Many other factors were omitted from consideration, such as[40]:

- The emissions of GHGs from burning fossil fuels in every stage of the nuclear chain, including mining, milling, refining and enriching of uranium, and making fuel bundles for the reactors;
- The emissions from all the transportation required throughout the nuclear chain, and from extra traffic to and from the site during all phases of the project;
- The emissions from facilities (e.g., steel and cement plants) caused by supplying material for construction; and

[39] NIH Program Project on Radiation Bystander Effects: Mechanism; Columbia University Center for Radiological Research www.radiation-bystander.columbia.edu/
[40] "*Nuclear Power: the energy balance*" by J.W. Storm and P. Smith (2005) download here

- The energy required to cool the spent fuel rods.

The EIS also failed to address the fact that nuclear power plants are huge water consumers, and particularly vulnerable to the effects of flooding from climate change. Excessive heat in rivers and lakes can also close a facility for safety reasons.

With respect to Climate Change models, the EIS comments on the

> *"intrinsic challenges in the modeling process, including the uncertainties present in the developed methodologies and the limitations of downscaling approaches"* [EIS 6.4.2 , 6-57]:

and further states that,

> *"'the models use equations that govern a set of theoretical concepts and methods, and that the grids used by the models to provide estimated projections are often very coarse."*

These comments fly in the face of the strong scientific consensus that climate change is a growing reality, and they cannot be taken seriously. Furthermore, nuclear power is far from being carbon neutral, and the contribution to climate change from every stage in the nuclear chain must be properly assessed.

10) Costs/Liability

In the EIS, OPG indicated that it did not have a cost estimate for the project since no decision has been made with regard to technology or vendor, which makes costs for the project "unclear". [EIS Financial Considerations p.10.81-2]

The one cost that was indicated was with respect to the Environmental Assessment, which was indicated to be approximately $20 - $25 million over a three to four year period.

With respect to ensuring effective cost management, OPG indicated that

> *"if it is directed to proceed with new nuclear, schedule and cost performance commitments would be built into the contract and the builder would be required to provide things such as performance guarantees and a turnkey agreement to limit the risk of cost overruns."*

Any new nuclear reactor is a very expensive proposition, requiring government subsidies and insurance guarantees, and a skilled workforce. Cost overruns and long lead times, coupled with uncertainties as to completion dates, are inherent in the nuclear industry. Many billions are needed for decommissioning and legacy wastes. As no major power plant has been decommissioned, the true costs are not known.

The true financial cost has been hidden by extensive government subsidies, unrealistically low limits on the facility's liability for accidents, leaving the costs of waste storage for an indefinite future, and the costs for decommissioning, out of pricing structures. [41]

The escalating costs that have already plagued the industry should absolutely prevent the construction of any new reactors. Only very large government subsidies, and government protection against legal liability, have kept the nuclear industry alive. No other industry is allowed to evade its financial, social and environmental responsibility to such an extent.

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[41] Schneider M., Thomas S. et al: The World Nuclear Industry Status Report 2009

Throughout their history, Canadian reactors have been plagued by technical problems, leading to cost overruns and reduced power generation. The initial estimate for Darlington Station in Ontario, Canada's last-built nuclear reactors was $ 5 billion. The cost has nearly tripled to $14 billion or more, a cost passed on to Ontario's taxpayers, and one for which the people of Ontario are still paying (the stranded debt).

11) Alternatives

Under Section 7.2, Alternatives to the project, CEAA requires an examination of alternatives, but the Guidelines limit the analysis of alternatives to ones that

> "*meet the project's need and achieve the project's purpose from the perspective of the proponent."*

The guidelines further state that

> *"Alternatives to the project need not include alternatives that are contrary to Ontario's formal plans or directives. However, the EIS must explain where this rationale has been applied to exclude consideration of possible alternatives to the project."*

At present, Ontario has no approved plan, only a draft directive. Therefore, this restriction with respect to the scope of alternatives does not apply.

Furthermore, under Section 14 (EIS Guidelines Capacity of Renewable Resources, p. 53);

> *"The EIS must describe the effects of the project on the capacity of renewable resources to meet the needs of the present and those of the future. The EIS must identify those resources likely to be impacted by the project, and describe how the project could affect their sustainable use. The EIS must also identify and describe any criteria used in considering sustainable use. Sustainable use may be based on ecological considerations such as integrity, productivity, and carrying capacity."*

Clearly, the proposed project *does* have an impact on the capacity of renewable resources to meet the needs of the present and those of the future. The construction of power plants from non-renewable nuclear fuel is a non-sustainable way to generate electricity, and is an impediment to the development of renewable sources and sustainable energy for present and future needs.

Therefore, it is recommended that the Panel examine renewable sources of energy and conservation as an alternative to the new nuclear plants. This examination should include a comparative study of the costs and benefits with respect to environmental, health, socio-economic and technical factors, including the impact of worst-case accident scenarios and of radioactive waste. This must be done to a level of detail which is sufficient to allow the Panel and the public to properly compare the project with alternatives, such as renewable energy and conservation.

Conclusion

Nuclear power has presented the greatest and most serious dilemma of the industrial age. It creates the possibility of mass destruction of people and property. And there is no safe dose of ionizing radiation. A single radioactive atom lodged in the lung can cause lung cancer. There is no way to eliminate nuclear waste, and no way to keep it completely contained for a million years o that no atoms can escape.

The only real solution is to not generate it in the first place. In the interests of protecting public health and the environment now and for future generations, and in considering the need for precaution, IICPH urges the Panel to recommend that this project be rejected.