CMD 25-H2.73

Date: 2025-05-08

Written Submission from the Canadian Coalition for Nuclear Responsibility

Mémoire du Regroupement pour la surveillance du nucléaire

In the matter of the

À l'égard d'

Ontario Power Generation Inc.

Ontario Power Generation Inc.

Application to renew power reactor operating licence for the Darlington Nuclear Generating Station

Demande concernant le renouvellement du permis d'exploitation d'un réacteur de puissance pour la centrale nucléaire de Darlington

Commission Public Hearing
Part-2

Audience publique de la Commission
Partie-2

June 24-26, 2025

24-26 juin 2025

Minimizing Radiological Risks
Without
Minimizing Public Accountability

an intervention by

The Canadian Coalition for Nuclear Responsibility

presented to

The Canadian Nuclear Safety Commission

on the occasion of the

Proposed Licence Renewal for OPG's

Darlington Nuclear Generating Station

prepared by

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Canadian Coalition for Nuclear Responsibility

May 8, 2025

List of Recommendations

Recommendation: CCNR urges CNSC to grant Darlington no more than a five-year licence, to incentivize the public to remain engaged on matters of radiological safety. Under no circumstance should a licence of more than ten years be countenanced.

Recommendation: CNSC staff should be required to report to the Commissioners and to the public on a regular basis what efforts have been made to drastically reduce the routine releases of radioactive materials into the environment from Darlington.

Recommendation: All radioactive releases from Darlington should be posted on-line in real time so the public can be properly notified of those releases as they happen.

Recommendation: In accordance with its mandate to disseminate objective scientific information, CNSC should publicly declare that it is not correct for anyone to say that nuclear energy is "clean" (or non-polluting).

Recommendation: Darlington Nuclear Generating Station should not be given an operating licence for more than five years. At all future licencing hearings for Darlington, OPG's detailed plans for dismantling the Darlington reactors should be spelled out and the public should be invited to weigh in on those plans from a health and safety perspective.

Recommendation: CNSC staff be instructed by the Commission members to conduct a peer review of the calculations that led to 100 trillion becquerels of cesium-137 as an acceptable estimated "source term" for a severe nuclear accident at Darlington.

Recommendation: OPG should not be given an operating licence for a period of more than five years, and all future licencing hearings for Darlington should include a reconsideration of Emergency Measures in accordance with a rmore realistic estimated source term.

Introduction

The Canadian Coalition for Nuclear Responsibility (CCNR) is a federally incorporated not-for-profit organization that was federally incorporated in 1978. CCNR has intervened in nuclear licensing hearings for nuclear reactors, uranium mines and uranium processing facilities, as well as radioactive waste facilities, for almost fifty years.

CCNR wishes to intervene in the 2025 hearings for the relicensing of the Darlington Nuclear Generating Station (DNGS). The subject matter of this short written intervention will be addressed in more detail during CCNR's oral intervention at the Part 2 hearings, assuming that CCNR will be added to the agenda of those hearings.

CCNR will adress four issues:

1) CCNR is opposed to granting a 30-year licence. We recommend a licencing period of five years ideally, to allow for maximal public interaction on the safety issues itemized below. Under no circumstances should a licence be granted for more than 10 years.

2) CCNR is aware that CNSC has a legal responsibility to drastically reduce or eliminate all unreasonable radioactive emissions to the environment, but we see little evidence that CNSC is exerting any sustained effort to force Ontario Power Generation (OPG) to reduce the very large routine emissions of radioactive hydrogen (tritium), radioactive carbon-14, radioactive noble gases, and radioactive fission products such as iodine-131 and iodine-129, from DNGS.

3) Neither OPG nor CNSC has any operating experience with the complete dismantling of a defunct CANDU reactor. In addition, there are currently no waste disposal facilities to receive the large volumes of intermediate and low-level radioactive waste that will result from such an operation. There is a proactive need to allow public scrutiny of the decommissioning plans for DNGS and an upward revision of the financial liability that may be involved in the context of a detailed consideration of the dismantling options that might be employed and the categories and volumes of radioactive waste resulting from that operation.

4) Emergency Planning in the event of a serious nuclear accident at DNGS is currently based on an unrealistically low assessment of the "source term". The source term refers to the amount of radioactivity released to the environment following a severe core damage accident. It is usually expressed in terms of the becquerel count of cesium-137 escaping Into the atmosphere as a metallic vapour. Unless and until this low-ball source term estimate is corrected, emergency plans will be inadequate to cope with such an accident.

1. OPG's request for a 30-year operating license

The Canadian Coalition for Nuclear Responsibliity (CCNR) urges the Canadian Nuclear Safety Commission (CNSC) not to grant a 30-year operating licence to Ontario Power Generation (OPG) for the existing Darlington Nuclear Generating Station (DNGS).

The first unit at Darlington started operation 35 years ago. A second unit began 33 years ago. The remaining two units started up just 32 years ago. The exorbitant cost over-run during the construction of DNGS was an important contributing factor that led to the break-up of Ontario Hydro in 1999, and the creation of CNSC in 2000. Now OPG is requesting that CNSC forego any meaningful public hearings on licensing for a span of time almost equal to the entire operating history of the plant up to now, and the entire history of CNSC itself.

Granting a 30-year licence would drastically limit the public's abilty to provide input on the operations of DNGS – including radioactive emissions, radioactive wastes, safety-related reactor incidents, and plans for radioactive demolition of the core structures at end-of-life. Such a licensing decision would seriously erode public trust in the efficacy of the regulatory regime for nuclear power in Canada. In effect, an entire generation of public input providers would be skipped over. For that matter, many of the CNSC staff members who attended to the granting of the 30-year licence will also likely be gone.

The CNSC is expected to review the financial guarantee for decommissioning the Darlington plant every five years. The plant's safety analysis is expected to be reviewed every 10 years. Why should public input be so underappreciated that it only has to be considered once in three decades? Suspicions of regulatory capture can only be intensified when regulatory staff meets with industry representatives behind closed doors, decade after decade, without any meaningful public involvement. After all, the CNSC's primary legal obligations are to the Canadian public, the Canadian environment, and the international community – not to the licencee. Without reasonably frequent public hearings, without listening to the concerns of the public directly, staff may come to regard those legislated responsibilities as more abstract than real. The staff of the licensee and the staff of the regulator become of one mind; the public is seen as an unwelcome intruder.

Ultimately, this is not good for the CNSC or for OPG. CCNR believes it is also not good for the public, or for the trust that CNSC wishes to enjoy from the public.

Recommendation: CCNR urges CNSC to grant Darlington no more than a five-year licence, to incentivize the public to remain engaged on matters of radiological safety. Under no circumstance should a licence of more than ten years be countenanced.

2. Routine emissions of radioactive materials

The international unit of radioactivity is the becquerel. Each becquerel indicates one radioactive disintegration per second. One curie (an older unit) is equal to 37 billion becquerels. All radioactive disintegrations are damaging to nearby living cells.

On an annual basis, Darlington releases several hundred trillions of becquerels of radioactive hydrogen (tritium). Tritium is readily incorporated into all living things in the form of radioactive water molecules, as a result of ingestion, inhalation, or absorption through the skin. Tritium emissions from Darlington are far greater than corresponding tritium emissions from any other power reactors in the world, except for other CANDU reactors. Although CNSC and OPG staff are both quick to point out that these tritium emissions are "within regulatory limits", that does not exonerate CNSC from the responsibility of requiring that such emissions be kept "As Low As Reasonably Achievable", in accordance with the ALARA principle.

All radioactive emissions are ionizing. Ionizing radiation is acknowledged to be a Class 1 carcinogen. No carcinogenic material should be disseminated freely into the environment without the strictest possible controls, regardless of whatever regulatory limits that may have been established arbitrarily by fiat. There is no science-based rationale for Canada's tritium standards. Nor is it honourable to allow such very large releases of radioactive hydrogen to continue unabated for decades without any discernible effort to drastically reduce them. Indeed, what efforts have been made or will be made to cut these emissions by orders of magnitude? Is that even a goal? Or is the operating licence for a nuclear power reactor also a licence to pollute?

Radioactive tritium cannot be removed from tritium-contaminated water by any existing municipal water treatment plant, so this radioactive water – an indiustrial waste byproduct from DNGS – passes directly into the bodies of those who use the water for drinking or cooking. Ingestion of tritium-contaminated fruits, vegetables or meats can't be prevented.

Similar considerations apply to routine emission of radioactive carbon-14 from Darlington, which are reported to be about a trillion becquerels per year or more. Since carbon-14 has a radioactive half-life of 5,700 years, carbon-14 emissions accumulate in the environment as each year's emissions are simply added to previous year's emissions. Carbon-14 from DNGS has been accumulating already for over 30 years, and it will continue to accumulate for the next 30 years if the licence is granted as requested. Thus 1 trillion becquerels turns into 60 trillion becquerels. What is CNSC or OPG doing to prevent this from continuing?

As the Select Committee on Ontario Hydro Affairs reported back in 1980,

> *Carbon-14 and tritium are of comparable and special concern for similar reasons.*
>
> - *First, they each have long half-lives: 5,730 years for carbon-14 and 12.3 years for tritium. Long half-lives allow them to accumulate in the environment around a reactor and in the global biosphere.*
> - *Second, they are easily incorporated into human tissue. Carbon-14 is incorporated into the carbon that comprises about 18 percent of total body weight, including the fatty tissue, proteins and DNA [molecules]. Tritium is incorporated into all parts of the body that contain water.*
>
> *Thus the radiological significance of both elements is not related to their inherent toxicity, as each is a very low energy form of radiation, but to their easy incorporation in the body.* from *The Safety of Ontario's Nuclear Reactors*

As it happens, carbon and hydrogen are the basic elemental building blocks of all organic molecules. When tritium and/or carbon-14 is ingested, inhaled or absorbed, a fraction of those radionuclides are incorporated directly into the organic molecules of the body, including DNA molecules. These are called "organically-bound" radionuclides. There are no other radionuclides that play such an essential role in the body. Testimony before the Select Committee on Ontario Hydro Affairs in 1979 by Dr. Edward Radford (Professor of Environmental Epidemiology at the Graduate School of Public Health, University of Pittsburgh) indicates that short pulses of tritium absorbed by a pregnant woman can have a life-long effect on an unborn daughter by causing genetic damage to the girl's eggs – damage that will persist throughout her life and could affect her eventual offspring. (From the transcript of the hearings, reproduced at www.ccnr.org/tritium_2.html#radf .)

For these reasons, OPG should be required by CNSC to publicly report all radioactive emissions on-line in real time, so that vulnerable citizens such as children and pregnant women can choose to vacate the area when sudden large releases of triium occur. In 2023, in just one week, 6,469 curies = 239 trillion becquerels of tritium were released. That's comparable to a year's release of tritium from one unit happening in just one week. Yet the public has no way of knowing about this sudden massive leak of tritium in order to do what they can to protect themselves and their unborn babies.

Other routine radioactive emissions from DNG include gamma-emitting noble gases – radioactive isotopes of krypton, argon and xenon – whose emissions are measured in the tens of trillions of units called TBq-Mev. Each TBq-Mev is equivalent to the spontaneous radioactive emission of one trillion particularly powerful gamma rays (one Mev) per second. The main route for radioactive exposures to the public is due to "skyshine" – that is, penetrating gamma radiation, given off by an invisible "cloud" of radioactive gases passing overhead. These gases are heavier than air and so they tend to stay close to the ground

Radioactive noble gases escape from the nuclear fuel through tiny holes or gaps in the metallic fuel bundles. Tritium and carbon-14, on the other hand, are mainly produced outside the fuel. They are created by stray neutrons colliding with the non-radioactive heavy water moderator molecules in a process called “neutron activation”. That’s why it is so much easier for tritium and carbon-14 to escape into the environment – they don’t have to migrate out of the leaking fuel bundles. However, radioactive varieties of iodine do escape from the fuel, because when heated iodine “sublimes” into a gaseous form that can escape from the fuel with some difficulty. Routine emissions of radioactive iodine from Darlington are measured in millions of becquerels rather than trillions of becquerels.

Nevertheless, radioactive iodine is dangerous, especially to children and embryos. When released as a gas, radioactuive iodine is absorbed into plants – including grass – and is concentrated by two or three orders of magnitude in the milk of cows. When consumed, or inhaled, the radioactve iodine goes to the thyroid gland where it can cause cancer or help precipitate hypothyroidism. Although these routine releases are orders of magnitude smaller than the radioactive iodine released following a major reactor accident with severe fuel damage, nevertheless it is carcinogenic (cancer-causing). Carcinogens, as a general rule, do not have a safe “threshold” of exposure – reducing the dose does not rule out cancer causation but simply reduces the number of expected cancer cases.

The International Commission on Radiological Protection (ICRP) – a body from which Canadian authorities derive most of their radiological exposure standards – has been crystal-clear in its recommendations regarding the strict limitation of all preventable radiation exposures. It is a three-step process. First, no radiation exposure should be allowed without a clear justification; second, regulatory limits should be set to indicate when exposures will be clearly unacceptable; third, efforts must be made to ensure that actual exposures are kept as far below those regulatory limits as possible. (ICRP 60, 1999).

Recommendation: CNSC staff should be required to report to the Commissioners and to the public on a regular basis what efforts have been made to drastically reduce the routine releases of radioactive materials into the environment from Darlington.

Recommendation: All radioactive releases from Darlington should be posted on-line in real time so the public can be properly notified of those releases as they happen.

Recommendation: In accordance with its mandate to disseminate objective scientific information, CNSC should publicly declare that it is not correct for anyone to say that nuclear energy is “clean” (or non-polluting).

3. Dismantling a defunct CANDU reactor

Within the core area of a nuclear reactor, stray neutrons are constantly impinging upon nearby materials. By absorbing a stray neutron, a non-radioactive atom can frequenlty be transformed into a radioactive one. For example, non-radioactive cobalt-59 – a common impurity in steel – becomes a highly radioactive gamma emitter called cobalt-60, simply by absorbing a stray neutron. By the time the reactor is shut down, the construction materials in the core area of the reactor have become so intensely radioactive that they can only be handled robotically, with heavy shielding to protect the workers.

See the table below for some examples of radiation doses from core components from a CANDU reactor shortly after shutdown. The radiation dose is measured in an older unit, called a rem. The LD50 – the "lethal dose for 50% of people exposed within 30 days" – is 400 rems. That means if a group of people were exposed to 400 rems of radiation, all of them would get sick (from "radiation sickness") and half of them would die within a month.

Radiation Fields from Reactor Components

Item	Dose Rate	Lethal Dose (LD50 = 400 rems)
Pressure Tube	850 rems/hr	death in 28 minutes
Thermal Shield	260,000 rems/hr	death in 5.5 seconds
Calandria Shell	49,000 rems/hr	death in 29 seconds
Dump Tank	12,000 rems/hr	death in 2 minutes

Source: Pickering Preliminary Nuclear Decommissioning Cost Study

For this reason, OPG has planned that the complete dismantling of the core area of a defunct CANDU reactor will be postponed for about 40 years after shutdown to allow much of the cobalt-60 to to disappear, because most of the readioactive cobalt atoms will have disintegrated. Cobalt 60 has a half-life of about 4.25 years, meaning that half of the atoms will have disingtegrated in that period of time. After 9.50 years – that's two "half-lives" – only one-quarter of the original amount of cobalt-60 will remain. After 40 years, the intense gamma radiation from cobalt- 60 will have diminished by almost three orders of magnitude (i.e. by a factor of almost 1000).

However, there are many other newly created radioactive materials in the core area of the reactor, and some of them have extremely long half-lives – such as nickel-15, with a half-life of 76,000 years, and chlorine-36, with a half-life of 310,000 years, not to mention carbon-14 with its 5,700 year half-life. So all of this material will have to be isolated from the environment of living things for a period of time far longer than the span of recorded human history.

These long-lived materials do not give off such intense penetrating radiation as cobalt-60, but they can be biologically very hazardous if inhaled or ingested. Even workers wearing protective equipment can inadvertently contaminate their bodies when removing their protective gear. During a retubing operation at Pickering many decades ago, workers were contaminated with carbon-14 dust and carried that contamination into their homes for a period of several weeks. More recently, over 500 workers were contaminated with airborne plutonium dust for a poeriod of several weeks during the refurbishment of Bruce unit 1. In both cases, the contamination was not detected by the standard radiation monitors in place at every nuclear power plant. In both cases, the radioactive contamination was only detected when air samples were analyzed and the offending materials were identified.

Even equipment far removed from the core of the reactor can become long-lived radioactive waste. For example, the entire primary cooling circuit that carries superheated heavy water from the core of the reactor to the boilers (called steam generators) becomes contaminated with dozens of radioactive materials. These contaminants originate in the core area and are transported by the circulating water. In this way the 16 Darlington steam generators (each weighing about 380 tonnes) will become long-lived radioactive waste. See the following chart with figures published by CNSC indicating the radionuclides in one of the Bruce A steam generators after it was removed from the reactor.

You will notice that the radioactive contaminants clinging tightly to the Bruce steam generator pipes include 8 materials with a half-life of over a million years, 13 with a half-life of over 100,000 years, and 19 with a half-life of over 1000 years. Considering only the long-lived istopes, the total radioactivity level in this solitary steam generator is over 8 billion becquerels (that’s 8 billion disintegrations per second, a rate which will not diminish signficantly for many many centuries). That’s why these pieces of equipmant have become radioactive junk. But they are dangerous opieces iof junk, as they also pose health and environemntal risks for countless millennia to come.

During the final decommissioning of the Darlington reactors, when the radioactiuve structures are dismantled, resulting in thoudans of truckloads of radioactive rubble, there is a serious concern that the local environemnta will become irrevocably contaminated with radioactive waste materials. Dust that can contaminate the clothing or the lungs of workers, can equally well blow in the wind and contaminate people and property far from the reactor site. The public should be fully informed of the precise details of OPG's plans for radioactive demolition, and given a chance to have their own input into those plans. It is possible, indeed highly likely, that a detailed examination of those plans will lead to the need for a greatly enhanced fianncial guarantee on the part of OPG to ensure that those plans can be carried out safely and to the complete satisfaction of local residents. It is also important that ratepayers learn the true cost of nuclear decommissioning, which will give a more realistic assessment of the total cost of nuclear-generated electricity.

Here is a partial list of radioactive contaminants inside a used steam generator from one of the Bruce reactors. The amount of radioactivity is expressed in becquerels per cubic metre; one becquerel corresponds to one radioactive disintegration every second. (Source: OPG)
http://www.nwmo.ca/uploads_managed/MediaFiles/539_ReferenceLowandIntermediateWasteInventoryfortheDGR.pdf (p. 50)

For Scientists / Engineers			For Citizens / Decision Makers		
Symbol	Half-Life (y)	Amount (Bq/m3)	Name	Half-Life (years)	Amount (becquerels per cubic metre)
Ag 108	1.3E+02	2.3E+02	Silver-108	130 y	230
Am-241	4.3E+02	5.9E+07	Americium-241	430 y	59 000 000
Am-243	7.4E+03	3.8E+04	Americium-243	7 400 y	38 000
C-14	5.7E+03	7.6E+07	Carbon-14	5 700 y	76 000 000
Cl-36	3.0E+05	1.4E+04	Chlorine-36	300 000 y	14 000
Cm-244	1.8E+01	1.4E+07	Curium-244	18 y	14 000 000
Co-60	5.3E+00	1.2E+09	Cobalt-60	5.3 y	1 200 000 000
Cs-134	2.1E+00	1.9E+06	Cesium-134	2.1 y	1 900 000
Cs-135	2.3E+06	2.2E+01	Cesium-135	2 300 000 y	22
Cs-137	3.0E+01	2.2E+07	Cesium-137	30 y	22 000 000
Eu-152	1.3E+01	1.8E+06	Europium-152	13 y	1 800 000
Eu-154	8.8E+00	1.6E+07	Europium-154	8.8 y	16 000 000
Eu-155	5.0E+00	3.0E+07	Europium-155	5 y	30 000 000
Fe-55	2.7E+00	5.8E+09	Iron-55	2.7 y	5 800 000 000
I-129	1.6E+07	6.3E+00	Iodine-129	16 000 000 y	6.3
Nb-94	2.0E+04	2.9E+05	Niobium-94	20 000 y	290 000
Ni-59	7.5E+04	2.0E+05	Nickel-59	75 000 y	200 000
Ni-63	9.6E+01	2.9E+07	Nickel-63	96 y	29 000 000
Np-237	2.1E+06	1.8E+03	Neptunium-237	2 100 000 y	1 800
Pu-238	8.8E+01	1.0E+07	Plutonium-238	88 y	10 000 000
Pu-239	2.4E+04	1.2E+07	Plutonium-239	24 000 y	12 000 000
Pu-240	6.5E+03	1.7E+07	Plutonium-240	6 500 y	17 000 000
Pu-241	1.4E+01	5.5E+08	Plutonium-241	14 y	550 000 000
Pu-242	3.8E+05	1.7E+04	Plutonium-242	380 000 y	17 000
Ru-106	1.0E+00	8.4E+08	Ruthenium-106	1 y	840 000 000
Sb-125	2.8E+00	2.1E+07	Antimony-125	2.8 y	21 000 000
Se-79	1.1E+06	7.6E+01	Selenium-79	1 100 000 y	76
Sm-151	1 9E+01	7.6E+01	Samarium-151	19 y	76
Sn-126	2.1E+05	1.2E+02	Tin-126	210 000 y	120
Sr-90	2.9E+01	1.8E+07	Strontium-90	29 y	18 000 000
Tc-99	2.1E+05	2.8E+03	Technetium-99	210 000 y	2 800
U-234	2.5E+05	1.9E+04	Uranium-234	250 000 y	19 000
U-235	7.0E+08	3.2E+02	Uranium-235	700 000 000 y	320
U-236	2.3E+07	3.6E+03	Uranium-236	23 000 000 y	24 000
U-238	4.5E+09	2.4E+04	Uranium-238	4 500 000 000 y	24 000
Zr-93	1.5E+06	3.8E+02	Zirconium-93	1 500 000 y	380
TOTALS					

Recommendation: Darlington Nuclear Generating Station should not be given an operating licence for more than five years. At all future licencing hearings for Darlington, OPG's detailed plans for dismantling the Darlington reactors should be spelled out and the public should be invited to weigh in on those plans from a health and safety perspective.

4. Emergency Planning and the Source Term

In the event of a severe nuclear accident causing extensive fuel damage – up to and including a complete core meltdown – one of the nastiest radionuclides to be released into the environment is cesium-137. This radionuclide is a powerful gamma emitter, similar to cobalt-60 in that respect. It is emitted as a radioactive metallic vapour that is extremely mobile in the environment. It condenses on cool surfaces such as soil, skin, leafy plants, and buildings. Once bonded to such surfaces it is very difficult to dislodge. It is readily ingested by animals such as sheep, cows, caribou and boars, often making the meat unfit for human consumption. Because it has a 30-year half-life, it remains in the environment for centuries. It is easily monitored and mapped because of the gamma rays that it emits.

In the event of a major nuclear accident causing severe fuel damage, there are dozens of other radionuclides released , but emergency planners focus on cesium-137. The other radioactive releases can be estimated from the amount of radioactive cesium. Also, cesium-137 contamination levels are used to determine the evacuation zones and the human exclusion zones associated with the accident's consequences/

Following the 2011 triple meltdown at Fukushima-Daiichi in Japan, nuclear regulators around the world – including the CNSC – came to the realization that one must be prepared to deal with the consequences of severe nuclear accidents regardless of the low probability that may be calculated ahead of time based on imperfect information. In particular, Michael Binder, in his role as Chairman of the CNSC, directed CNSC staff to prepare a report detailing the potential consequences of a severe nuclear accident at Darlington. The result was a 2015 report published by CNSC entitled ***Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures.*** That document eatimates the "source term" for such an accident by citing a release of 100 trillion becquerels of cesium-137 into the environment.

The present emergency planning associated with a hypothetical major accident at Darlington is based upon this estimated release of 100 trillion becquerels of cesium-137. However, if the actual source term is orders of magnitude greater than 100 becquerels of cesium-137, all existing emergency measures will be unable to cope with such an event.

The Canadian Coalition for Nuclear Responsibility believes that the estimated "source term" published by CNSC is vastly underestimated. CCNR urges the Commissioners to instruct its staff to submit their calculations to outside peer review from independent nuclear scientists in order to arrive at a more reaistic estimate of the likely source term from a severe nuclear accident at Darlington. That more realistic source term estimate should then be used as the basis for Emergency Planning going forward.

Why do we at CCNR think the CNSC source term estimate is too low? There are a number of reasons. To begin with, it is estimated that the cesium-137 released from the Chernobyl nuclear accident in 1986 was about 80,000 trillion becquerels. That is 800 times greater than the hypothentical source terms estimated by CNSC staff.

More to the point, we have determined how CNSC staff actually arrived at this low figure of 100 trillion becquerels of cesium-137, by examining the 2015 document ***Study of Consequences of a Hypothetical Severe Nuclear Accident and Effectiveness of Mitigation Measures.***. In paragraph one of section 3.1, the authors of the report state that, by definition, a "large release" of radioactivity is any release containing more than 100 terabecquerels of cesium-137. Anything less does not even qualify as a large release.

Then, in the second paragraph of section 3.1, the authors arbitrarily select the lowest possible number, namely 100 terabecquerels, as their assumed large release . In doing so they ignore their own definition, that all large releases must be greater than that. So the authors of the CNSC report have simply chosen the lowest possible number that can be used to describe a large radioactive release, and they have used that number as an estimate of what a large release at Darlington would be. The authors fail to describe any realistic accident scenario that would in fact result in such a small release of cesium-137.

Using straightforward calculations, we estimate that a typical Darlington core contains a total of at least 55,000 trillion becquerels of cesium-137. Since there are 480 fuel channels in each Darlington reactor, each channel contains about 55,000/480 = 114.6 trillion becquerels of cesium-137. At a temperature of 1500 degrees C (well below the melting point of the fuel) the exposed fuel will release about 25% of the cesium inventory in one hour. All of the cesium released from the overheated fuel will escape from the calandria because the rupture disks will have ruptured, providing an unfiltered pathway for the cesium vapour to escape into the containment. Given the fact that each of the 480 fuel channels has a potential to release 57 trillion becquerels of cesium-137, it is impossible to believe that only 100 trillion becquerels of cesium-137 will find its way out into the environment, given the relatively leaky containment system that exists at Darlington.

Recommendation: CNSC staff be instructed by the Commission members to conduct a peer review of the calculations that led to 100 trillion becquerels of cesium-137 as anacceptable estimated "source term" for a severe nuclear accident at Darlington.

Recommendation: OPG should not be given an operating licence for a period of more than five years, and all future licencing hearings for Darlington should include a reconsideration of Emergency Measures in accordance with a rmore realistic estimated source term.