IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

AMENDED DECLARATION OF GORDON EDWARDS, PH.D.

I, Gordon Edwards, declare as follows. I make my statements under penalty of perjury.

1. My name is Gordon Edwards. I am the co-founder and President of the Canadian Coalition for Nuclear Responsibility (CCNR), and an international consultant on nuclear issues, including uranium mining, reactor safety, nuclear weapons proliferation, radioactive waste management, and the health effects of ionizing radiation. CCNR is a not-for-profit Non-Governmental Organization that was founded in 1975 and federally incorporated in 1976. I am the principal researcher at CCNR and the chief spokesperson for the organization. I have attached my curriculum vitae to this statement as Annex A.

2. I graduated from the University of Toronto in Mathematics, Physics and Chemistry (1961) with a B.Sc. and a Gold Medal in Mathematics and Physics. I attended the University of Chicago under a Woodrow Wilson Fellowship where I earned Master's degrees in Mathematics (1962) and in English Language and Literature (1964). After four years teaching at the University of Western Ontario (1964-1969) I earned a Doctor of Philosophy (Ph.D.) degree in Mathematics at Queen's University (1972).

3. In 1973 I was hired by the Science Council of Canada, a government agency, to coordinate an ambitious study of the Role of the Mathematical Sciences in Canadian society, from educational curricula in mathematics to applications of mathematics in industry, business, government, finance, environmental protection, energy planning, and scientific research. The results were printed in 8 volumes (1974) and copies were deposited in every university library in Canada.

4. While I was a doctoral candidate at Queen's University I co-founded an international science-based ecology organization called Survival (1970) with members in 13 countries. I served as the English Language editor of Survival magazine from 1970 to 1974. As editor of Survival I solicited and published articles by leading experts in nuclear science and radiation health effects such as John Gofman, Karl Z. Morgan, and Rosalie Bertell.

5. In 1977 I was retained by the Cluff Lake Board Inquiry into Uranium Mining in Saskatchewan to cross-examine experts in the nuclear field on a daily basis for a period of three weeks. In 1978 I was retained by the Ontario Royal Commission on Electric Power Planning to cross-examine Canadian experts in the nuclear field on a daily basis for a period of three months. In both cases the topics included questions of reactor safety, high-level nuclear waste, nuclear weapons proliferation, and health effects of exposure to radioactive materials.

6. For the last 40 years I have provided consulting services on nuclear issues to governmental and non-governmental bodies at the provincial, territorial, national and international levels. Last year, for example, I was retained by the Office of the Auditor General of Canada to serve on a three-member external advisory committee during a Performance Audit of the Canadian Nuclear Safety Commission. Additional details can be found in my curriculum vitae.

7. The liquid target residue material proposed for shipment from Chalk River, Ontario to the Savannah River Site is very dangerous. Based on Canadian data supplied by the Canadian Nuclear Safety Commission (CNSC), found in Table 2 of their 2014 Technical Assessment Report, less than seven one-thousandths of one percent (0**.**007 %) of the radioactivity of the target residue material (in Becquerels) is due to the uranium isotopes, and more than 99**.**993 % of its radioactivity is due to dozens of other radioactive elements. These other radioactive elements include radioactive isotopes of niobium, zirconium, rhodium, ruthenium, iodine, xenon, tellurium, barium, cesium, lanthanum, cerium, praseodymium, neodymium, europium, neptunium and plutonium.

8. To call this target residue material HEUNL (highly enriched uranyl nitrate), as is done by CNSC throughout its 2014 Technical Assessment Report and by DOE throughout its 2015 Supplement Analysis is scientifically incorrect. Uranyl nitrate is a specific chemical compound having only one radioactive element, and that is uranium, whereas this target residue material is dominated by a host of other radioactive isotopes. Many of those additional isotopes are gamma emitters, giving off penetrating radiation (think of an x-ray machine), but there are also alpha and beta particles emanating from the waste.

9. I compared the concentrations of two dangerous gamma-emitting isotopes in the target material, cesium-137 and barium-137m, with the corresponding concentrations in the liquid high-level radioactive waste stored in hundreds of tanks at the DOE Hanford Reservation in Washington State. The cesium-137 levels in the liquid target residue material are four times (4.02 times) greater than those in the high-level radioactive liquid waste at Hanford. I confirmed a similar ratio of 4.32 between the barium-137m concentrations in the two liquids.

10. Table 5 of the 2012 AECL Memo lists 123 different fission products (with mass numbers less than 200) and Table 4 lists 7 actinides (with mass numbers greater than 200) that are associated with this target residue material.

11. The 2013 DOE Supplement Analysis (SA), Appendix A, contains Table 3 (page A-7) labeled “Content of a Fully Loaded NAC-LWT Shipping Cask”. It lists only 13 fission products (mass number less than 200), compared with the 123 fission products that are listed in the 2012 AECL Memo. There is no indication in the text that the list given there is in any way incomplete.

12. In the 2014 CNSC Technical Assessment Report, Table 2 (page 9) is entitled “Concentration of radionuclides in the solution”. It lists 21 fission products (mass number less than 200), and again there is no indication in the text that the list is incomplete. Moreover, of the

21 fission products listed in the CNSC document, only 6 of them are listed in the 2013 DOE SA Appendix. It is evident from internal evidence, even without the list of 123 fission products in the 2012 AECL Memo, that both lists published by CNSC and DOE are incomplete.

13. The discrepancies in these three radioactive inventories, all of them purportedly descriptions of the same liquid target residue materials that would be hauled from Chalk River to SRS, raise questions as to whether DOE's risk analysis is based on a complete understanding of the radioactive contents of the liquid target residue material. The existence of such conflicting and inconsistent information implicates the quality of the risk assessment and calls into question its adequacy for assessing the significance of environmental impacts which may occur if the shipments go forward, notably in the case of spillage.

14. I have also calculated an estimate of the radiological effects of those fission products and actinides that are listed by DOE and CNSC and have applied it to the drinking water supply of Washington, DC for purposes of illustration. In particular, the Georgetown Reservoir supplies drinking water for Washington DC. It holds 530,000 cubic meters of water, which is the same as 530 million litres. *[See the sidebar at https://en.wikipedia.org/wiki/Georgetown_Reservoir]*

15. The EPA maximum "derived concentration" of cesium-137 in drinking water is 200 picocuries per litre [pCi/l], which is the same as 7**.**4 Becquerels per litre [Bq/l]. [See https://www.epa.gov/sites/production/files/2015-09/documents/guide_radionuclides_table-betaphotonemitters.pdf]. According to the EPA, this concentration of cesium-137 would deliver a radiation dose of 4 millirems per year for a member of the public drinking that water on a regular basis; accordingly, it is the maximum concentration allowed by the EPA for drinking water. Any concentration above that level would render the water undrinkable.

16. One litre of liquid target residue material from Chalk River contains 70 billion Becquerels of cesium-137. [This is from Table 2 of the 2014 CNSC Technical Assessment Report. The corresponding figure from Table 3 of the 2013 DOE SA Appendix is roughly the same, at 63 billion Becquerels of cesium-137 per litre of TRM.]

17. So the volume of water that could be contaminated to the maximum amount allowed, by the cesium-137 contained in just one litre of this liquid waste as reported by CNSC, would be (70 billion Becquerels) / (7**.**4 Becquerels per liter) = 9**.**46 billion liters of water. That's 17**.**85 times larger than the capacity of the Georgetown reservoir. *It would require 17 or 18 times the volume of water in the Georgetown reservoir to dilute just one litre of this radioactive liquid waste down to the EPA-permitted level of contamination of cesium-137*. And that is examining only one of the 123 radionuclides in the liquid waste that are listed in the 2012 AECL Memo.

18. One lire is equivalent to a thousand cubic centimetres. Thus it would require only 1000 / 17**.**85 = 56 cubic centimetres of liquid target residue material, which is less than 2 fluid ounces, to make the water contained in the Georgetown reservoir undrinkable, due to the cesium-137 content alone. This is ignoring all other radionuclides.

19. Each shipment will be carrying 232.4 litres of liquid, so we are talking here about one quarter of one tenth of one percent of one shipment (actually 0.024%) as the amount needed to ruin a city's water supply, based on cesium-137 alone, and using Washington DC as an example.

20. I decided to redo the calculations above using a more extensive selection of the radionuclides present in the target residue material, namely, those listed in the CNSC and DOE documents. I calculated the concentration of each radionuclide (in Becquerels per litre) that would result if just one litre of this material were diluted in the 530 million litres of the Georgetown reservoir. Using the EPA "derived concentrations" for each radionuclide listed in the target residue material, I then calculated the annual dose to a member of the public drinking that water on a regular basis.

21. My calculations are given in Annex B. I converted the EPA limits, expressed in picocuries per litre, to Becquerels per litre, by multiplying them all by 0.037. This is exactly right since 1 picocurie = 0.037 Becquerels. Bearing in mind that (1) the tables of radionuclides given by CNSC and DOE are incomplete; and (2) some radionuclides listed in those two tables had to be ignored because they are not found in the EPA table, it follows that the doses calculated by me in Annex B are severely underestimated.

22. Using only CNSC and DOE data, one litre of liquid target residue material diluted in the Georgetown reservoir would give an annual dose of at least 1910 millirems/year based on the CNSC inventory data, or a dose of at least 1390 millirems per year based on the DOE inventory data, for an individual drinking that water on a regular basis. Again, these are underestimates, as indicated in the previous paragraph. Since (1910 mrem) / (4 mrem) = 477.5, one litre of target material in liquid form dumped into the Georgetown reservoir would contaminate the water to a level that was more than 477 times greater than the maximum contamination level allowed by EPA regulations for drinking water, if we use the inventory numbers provided in the CNSC 2014 Technical Assessment Report. If we use instead the DOE 2013 SA inventory figures, then we arrive at a level of contamination that is 1390 / 4 = 347.5 times greater than the maximum degree of contamination allowed by EPA.

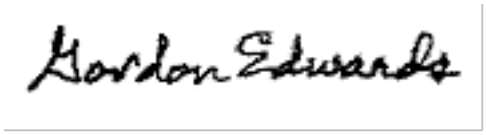
23. Thus a single litre of this radioactive liquid is more than enough to utterly ruin an entire city's water supply, exceeding the EPA drinking water standards by at least one or two orders of magnitude. And that's considering less than one quarter of one percent of the 232.4 litres of liquid target residue material in one truckload.

24. On page 15 of the 2014 CNSC Technical Assessment Report, it is stated that if 0.033 percent of the liquid target residue material were to escape from the container, everything would be acceptably safe -- the environment and human health would be well-protected. This CNSC analysis is reported on page 16 of the 2015 DOE SA without any independent verification or critique by DOE. But 0.033 percent of 232.4 litres is more than 76 cubic centimetres, and that would be more than enough to make the water in the Georgetown reservoir undrinkable, just based on the concentration of cesium-137 alone (see paragraphs 18 and 19 above).

25. Clearly, the CNSC's accident analysis did not fully take into account the consequences of 0.033 percent of the contents of just one load of liquid target residue material entering into the drinking water of a community. If we take just the radionuclides listed in the 2014 CNSC Technical Assessment Report into account, 76 cubic centimetres of the liquid target residue material spilled into the Georgetown reservoir would result in a dose of 146.5 millirems for a member of the public drinking that water on a regular basis. That is more than 32 times greater than the maximum dose allowed from drinking water by the US EPA. It is also greater than the maximum radiation dose allowed by the CNSC from drinking water, which is 0.1 millisieverts per year (10 mrem/year) under normal conditions and 1 millisievert per year (100 mrem/year) under emergency conditions. [These CNSC drinking water standards are cited on page 9 of the CNSC Environmental Assessment Information Report, attached as an Appendix to the 2014 CNSC Technical Assessment Report. They are also cited on page 17, Table 2-6, of the 2015 DOE SA.]

26. If the target residue material were in a solid form, even if it fell into a reservoir of drinking water or a river, lake, or stream, it could perhaps be retrieved intact with a minimum degree of contamination of the receiving water body. The situation is very different when the radioactive material is in liquid form. It would be essentially irretrievable.

27. DOE's reassuring statements are either unaccompanied or unexplained by any calculations whatsoever, and have apparently not been subjected to any critique from other agencies, departments, or the public.



Gordon Edwards
(dated) November 23, 2016

Curriculum Vitae – Gordon Edwards

November, 2016

Personal:

Born: July 18, 1940, Lansdowne, Ontario **Citizenship:** Canadian

Education:

Queen's University	Ph.D.	Mathematics	1972
University of Chicago	M.A.	English Literature	1964
University of Chicago	M.S.	Mathematics	1962
University of Toronto	B.Sc.	Mathematics & Physics	1961

- Academic Awards -

University of British Columbia:
National Research Council Post-Doctoral Fellowship 1972

Queen's University:
Queen Elizabeth II Doctoral Fellowship 1971
Canada Council Doctoral Fellowship, 1970
National Research Council Doctoral Fellowship, 1969

University of Chicago:
U. of Chicago Teaching Fellowship 1962-63
Woodrow Wilson Fellowship, 1961

University of Toronto:
Gold Medal in Mathematics and Physics, 1961
Arthur W. Anglin Memorial Scholarship, 1960
First Agnes Kelly Award in Math & Physics 1957

- Non-Academic Awards -

YMCA Peacemaker Medallion 2014
The Rosalie Bertell Lifetime Achievement Award 2007
The Nuclear Free Future Award, Window Rock, Arizona 2006
White Owl Conservation Award 1985

Teaching Experience

- College and Undergraduate University -

Vanier College	Professor, Mathematics and Science	1974 to 2010
Concordia University	Environmental Studies	1974 to 77
U. of British Columbia	Calculus and Vector Geometry,	1972/73
Queen's University	Differential Equations, Linear Algebra	1969 to 72
University of W. Ontario	Abstract Algebra, Analysis, & Shakespeare	1962 to 64
University of Chicago	Finite Mathematics, Logic, Calculus	1962 to 64
University of Toronto	Differential Equations for Engineers	1960/61

- Honorary Appointments -

Concordia University, Adjunct Professor: Science & Human Affairs 1976 to 79

- Post-Graduate Courses -

Concordia University Chemistry in Society *(Masters level course)* 1976
McGill University Biology in Society *(Masters level course)* 1977

Work Experience (non-teaching)

- Appointments -

Science Council of Canada, Nation-wide study of Math in Canada 1973/74
Fire Marshal of Ontario, Ontario Lightning Rod Inspector 1958 to 61

- Consulting Work -

Citizens of Renfrew County	extending the licence of Chalk River Labs	2016
Office of the Auditor General	external advisory committee, CNSC audit	2015
CLC-Nuclear Waste Management	challenges of Nuclear Fuel Waste in Canada	2015
Citizens of Renfrew County	radioactive liabilities at Chalk River Labs	2011
Mouvement vert Mauricie	EA intervention, Darlington New Build	2011
Mining Watch Canada	EA intervention, Matoush Uranium project	2010
Serpent River First Nation	workshop: health hazards of uranium mining	2009
Conférence régionale des élus de la Côte-Nord	uranium exploration & mining	2009
Nunavut Planning Commission,	issues on uranium exploration and mining	2007
Congress of Aboriginal Peoples,	issues on high-level radioactive waste	2006 & 07
Inuit Tapiriit Kanatami,	issues on high-level radioactive waste	2006 & 07
Chippewas of Nawash First Nation,	dry storage of irradiated nuclear fuel	1998
Ontario Siting Task Force,	siting a radioactive waste repository	1990 to 93
Cdn. Environmental Advisory Council (CEAC),	*nuclear power & radioactivity,*	1990 to 92
Energy Mines & Resources,	"Energy Options" ~ public consultation	1987
U.S. NRC Safety & Licensing Board,	*reactor safety at Turkey Point (Miami, Florida)*	1985
Auditor General of Canada,	re. comprehensive audit of AECB	1985
National Film Board of Canada,	energy policy & uranium mining	1978, 84-85, 88-90
C.T.V. television network,	depleted uranium and nuclear weapons	1985
T.V. Ontario (Toronto),	nuclear safety issues in Ontario [doc series]	1984
Prince Edward Island Electric Power Inquiry,	*externalities of the Point LePreau nuclear power plant in New Brunswick*	1982
Select Committee on Ontario Hydro Affairs (Legislature)	*reactor meltdowns, uranium processing issues, and radioactive waste management options*	1978/79
Ontario Royal Commission on Electric Power Planning,	*reactor safety, radioactive waste, reprocessing, and cross-examination of experts (5 months)*	1977/78
Consumer & Corporate Affairs,	nuclear economics in Canada	1977/78
United Steelworkers of America,	radon exposure standards for new homes	1977/78
Science Council of Canada,	consultant on radiation health effects,	1977 & 78
C.B.C. "The Nature of Things",	health effects of atomic radiation,	1977
Cluff Lake Board of Inquiry on Uranium Mining (Saskatchewan),	*issues related to the uranium fuel chain and cross-examination of experts (5 weeks)*	1977

- Invited Testimony to Legislative Committees -

House of Commons Standing Committees:

Natural Resources Committee,	on future of Canada's nuclear industry	2016
Natural Resources Committee,	proposed steam generator transport	2011
Natural Resources Committee,	the isotope production crisis	2008
Natural Resources Committee,	nuclear liability and compensation act	2008
Foreign Affairs Committee,	plutonium and the MOX initiative	1998
Energy Mines and Resources Cttee,	nuclear energy & sustainability	1991
Environment and Forestry Cttee,	high level radioactive wastes	1987
Consumer & Corporate Affairs,	issues related to food irradiation	1987
National Resources & Public Works,	management of nuclear wastes	1978

Commission permanente de l'énergie et des ressources,	les options énergétiques	1983
Legislative Assembly, NWT (Yellowknife),	uranium mining in arctic regions	1980/81
Energy Committee, New Brunswick Legislature,	CANDU reactor safety analysis	1979
Commission permanente de l'énergie et des ressources,	le nucléaire au Québec	1977
Prince Edward Island Legislature,	nuclear power issues in Eastern Canada	1974

-

Expert Testimony -

US Federal court, Washington DC	deposition on liquid nuclear waste	2016
Quebec Tribunal on Agriculture,	hazards of radioactive OKA residues	2000
US Federal court, Kalamazoo MI	transport of weapons grade plutonium	2000
Federal Court, Ottawa	dry storage of irradiated nuclear fuel	1999
DFAIT, Gov't of Canada, Ottawa	expert group on nuclear weapons policy	1999
National Energy Board, New Brunswick,	externalities of nuclear power	1980
US Atomic Safety & Licensing Board	safety of Turkey Point (Miami) reactor	1985
Select Committee on Ontario Hydro	reactor safety, nuclear wastes, uranium	1979/80
Royal Commission on Electric Power	radioactive waste and nuclear safety	1977/78
Cluff Lake Board of Inquiry	radioactivity, health & safety issues	1977

- Testimony at Environmental Assessment Hearings -

Quebec BAPE hearings on uranium	extending moratorium on uranium	2014
Deep Geologic Repository: Kincardine	critique of OPG EIS	2013/14
Darlington New Build - CEAA hearings	critique of OPG EIS	2011
Joint EA hearings: Matoush U project	critique of Strateco EIS	2010
Federal hearings: Midwest U project	critique of Midwest EIS	2007
Quebec BAPE hearings on Gentilly-2	Expansion of Waste Management Area	2004
Federal hearings on BRUCE spent fuel	dry storage of high-level radwaste	1998
US DOE hearings on MOX transport	proposed plutonium fuel shipments	1997
Federal hearings on spent nuclear fuel	AECL's proposed geologic repository	1990-97
Federal hearings on radioactive tailings	proposed Elliot Lake decommissioning	1996
Joint hearings on *Grande Baleine*	critique of H-Q energy demand analysis	1995
BAPE hearings on *Gentilly-2*	dry storage of high-level radwaste	1994
Joint hearings on Sask. Uranium Mines	uranium mill tailings management	1993
Federal hearings on Eldorado project	uranium refinery (UO_3 plant)	1978, 1980
Federal hearings on Brinex project	proposed uranium mine in Labrador	1979
Elliot Lake hearings on radon in homes	re-analysis of lung cancer risk data	1978

- Interventions at CNSC Licensing Hearings -

Darlington, Bruce and Pickering NPPs	extending operations & rebuilding	2015
SRB Technologies	betalight manufacture using waste tritium	2015
US DOE hearings on MOX transport	proposed plutonium fuel shipments	1997
Federal hearings on spent nuclear fuel	AECL's proposed geologic repository	1990-97
Federal hearings on radioactive tailings	proposed Elliot Lake decommissioning	1996
Joint hearings on *Grande Baleine*	critique of H-Q energy demand analysis	1995
BAPE hearings on *Gentilly II*	dry storage of high-level radwaste	1994
Joint hearings on Sask. Uranium Mines	radioactive tailings management	1993
Federal hearings on Eldorado project	uranium hexafluoride refinery	1978, 1980
Federal hearings on Brinex project	proposed uranium mine in Labrador	1979
Elliot Lake hearings on radon in homes	re-analysis of lung cancer risk data	1978

- Volunteer Work -

Planning Committee	World Uranium Symposium (Quebec City)	2015
Executive Director,	Green Energy Conference (Montréal),	1989 to 90
Member, Board of Directors,	Vanier College (Executive Committee 1990),	1987 to 90
National Steering Committee,	Canadian Peace Alliance,	1987 to 89
Member, Academic Council,	Integrated Science Program, Vanier College,	1985 to 87
Science Program coordinator,	Integrated Science Program, Vanier College,	1985 to 87
Chairman & President,	Canadian Coalition for Nuclear Responsibility	since 1975
Editor of *SURVIVAL*,	international ecology action magazine,	1970 to 74

Publications

- Mathematical Publications -

Background Study No. 26, A.J. Coleman, G. Edwards and K. Beltzner, *final report of Mathematics Study*, Science Council of Canada, 1976

Mathematical Sciences in Canada, A.J. Coleman, G. Edwards and K. Beltzner, *preliminary report of Mathematics Study*, Science Council of Canada, 1975

Mathematics in Today's World, ed. G. Edwards, pub. Science Council of Canada, *Proceedings of Three Ottawa Conferences:* I. Mathematics & Policy Planning II. Mathematics, Statistics & the Environment III. Mathematics & Technology (limited editions; copies deposited in all Canadian university libraries) 1974

"Beverton-Holt Model of a Commercial Fishery: Optimal Dynamics", C. Clark, G. Edwards & R. Friedlaender, *Journal of the Fisheries Research Board* 1974

"Primitive Elements in Symmetric Algebras," *Canadian Journal of Mathematics*, 1974

Lie Algebras of Infinitesimal Group Schemes, Queen's University Ph.D. thesis, 1972

An Introduction to Lie Algebras, G. Edwards & R. Pollack, *Queen's Papers in Pure and Applied Mathematics* (Queen's University Press), 1970

- Non-Mathematical Publications -

Canada and the Bomb, Past and Future – *Canadian Dimension Magazine* 2014

"Radiation is Invisible – but must the facts be hidden as well?", A C*ritique of the Strateco EIS for the Matoush U Project:* 2010

"Following the Path Backward", A C*ritique of the NWMO Report that was entitled "Choosing a Way Forward"*, CCNR publication 2005

"Nuclear Wastes: Past and Present", *Challenges to Waste Management:* Proceedings of the *Nuclear Waste Issues Conference* (Winnipeg), 1987

"Canada's Nuclear Trade," in *Roots of Peace*, pub. Between the Lines (Montreal), ed. E. Schragge, R. Babin, J-G. Vaillancourt, 1986

"Fuelling the Arms Race", *Ploughshares Monitor*, vol. VI no. 2, 1985

L'Énergie: un choix à faire, par G. Edwards et al. du *Regroupement pour la surveillance du nucléaire*, presenté à la *Commission permanente de l'énergie et des ressources*, de l'Assemblée Nationale du Quebec; publication du RSN, Feb 1983

"The Myth of the Peaceful Atom", in *Canada and the Nuclear Arms Race*, ed. Ernie Regehr & Simon Rosenblum, Lorimer & Sons (Toronto), 1983

"Canada's Nuclear Dilemma", in *Energy: Ethics, Power and Policy*, Journal of Business Administration, vol. 13, nos. 1 & 2, 1982

Risks Associated with the Purchase of Electricity from Point Lepreau, presented to *Prince Edward Island Electric Power Inquiry*, CCNR pub., June 1982

Nuclear Wastes: What, Me Worry?, *Updated Text*, presented to the House of Commons Standing Committee on Environment and Forestry, February 1987

Estimating Lung Cancers, summary of evidence presented to Elliot Lake Environmental Assessment Board on radon standards, CCNR publication, 1978
- expanded and updated version - 1985

Cost Disadvantages of Expanding the Nuclear Power Industry, Gordon Edwards, *Conference Board of Canada, Canadian Business Review*, v. 9, n. 1, Spring 1982

Nuclear Safety: Two Critical Papers, G. Edwards CCNR publication, 1980

Findings on Uranium Tailings & Nuclear Waste Disposal, ed. G. Edwards, March 1980

Nuclear Wastes: An Overview, transcript of testimony to the Select Committee on Ontario Hydro Affairs, CCNR publication, 1979

Nuclear Safety in a Canadian Setting, CCNR publication, presented to the Select Committee on Ontario Hydro Affairs, December 1978

Summary Argument to the Ontario Royal Commission on Electric Power Planning, by G. Edwards and R. Torrie, CCNR publication, April 1978
(I. The Nuclear Debate: A Metaphorical Framework; II. CANDU Safety.)

Nuclear Wastes: What, Me Worry? presented to the House of Commons Standing Committee on National Resources & Public Works, CCNR pub., February 1978
L'Energie, par G. Edwards et al. du *Regroupement pour la surveillance du nucléaire* presenté à la Commission permanente de l'énergie et des ressources, Assemblée Nationale du Quebec, publication du RSN, February 1977
Time to Stop and Think, brief to Prime Minister Trudeau, CCNR publication, March 1977
Non-Nuclear Futures for Ontario, Edwards, Hénaut & Rosenberg, CCNR September 1977
Science and Life, an anthology of teaching guides for HS Chemistry teachers, ed. G. Edwards, pub. Concordia University, 1976
Nuclear Power: A New Dimension in Politics, *Alternatives* , Trent Univ., Summer 1976
Nuclear power: Fact and Fantasy, includes speeches by A. Bateman (Manitoba Hydro), G. Edwards (CCNR), R. Hart (AECL), and A. Lansdowne (MEC), published by the Manitoba Environmental Council, 1975
SURVIVAL international ecology action magazine (nos. 1-14), ed. G. Edwards, 1970 to 74
Various articles on energy & nuclear power in the *Globe and Mail*, *Toronto Star*, *Montreal Gazette*, *Le Devoir*, and *La Presse*., some of them co-authored with others.

Major Invited Addresses

Health Issues related to Uranium & Rare Earths, Inuit Attiquirat (Narsaq, Greenland) 2016
Uranium, Radioactivity and Ionizing Radiation, IPPNW (Johannesburg, S. Africa) 2015
Nuclear Fuel Waste: Questions and Challenges, CLC-NWMO (White River, Ontario) 2015
Uranium: The Canadian Story, keynote address, World Uranium Symposium, (Quebec, QC) 2015
Nuclear Fuel Waste: History and Prospects, CLC-NWMO (Schreiber, Ontario) 2015
Uranium – its Uses and Dangers, Association of First Nations of Quebec & Labrador Seminar re. Environmental Assessment Hearings (Wendake Quebec) 2014
Nuclear Waste Governance in Canada, 19th Annual Meeting of the REFORM Group, Week-long seminar at Leopoldskron, (Salzburg Austria) 2014
Lessons From Fukushima, Manitoba Environmental Industries Assoc, Winnipeg 2014
In a Nuclear Weapons-Free World, Can We Still Have Nuclear Power?, Science-for-Peace/Pugwash Annual Lecture (Toronto, Ontario), 2013
Nuclear Labyrinth on the Great Lakes, keynote address, Nuclear Power and the Great Lakes Conference (Huron, Ohio), 2012
Nuclear Power – Challenges and Choices, keynote address, Fukushima Anniversary "Nuclear Labyrinth in Asia" conference (Hong Kong), 2012
Will Saskatchewan Host Ontario's Nuclear Waste?, (Pinehouse, Saskatchewan) 2011
Healing the Planet, keynote address, Physicians for Global Survival Conference (Montreal), 2009
From Uranium to Isotopes to Bombs, keynote address, Physicians for Global Survival Conference (Ottawa), 2009
Prescription for Survival, keynote address, Physicians for Global Survival Conference (Halifax), 2008
Nuclear Power: Hope or Hoax?, keynote address, University of Alberta (Fredericton), 2008
Uranium, the Shape-Shifter, keynote address (with Robert Del Tredici), "Nuclear Free Future" Conference (Salzburg, Austria), 2007
Radioactive Legacy of the Nuclear Age, keynote address (with Robert Del Tredici), "Coping with Nuclear Waste" Conference (Stockholm, Sweden), 2007
Global Importance of Uranium, keynote address, World Uranium Hearings (Salzburg, Austria), 1992

The Secret Life of Uranium, International Uranium Congress (Saskatoon), 1987

Legal Issues in Nuclear Waste Management, McGill University Law School, 1986
Nuclear Wastes & Nuclear Weapons, Globescope 86, Tufts University (Boston), 1986
Nuclear Wastes in Canada, Past and Future, Nuclear Waste Conference (Winnipeg), 1986

Nuclear Waste Management: Problems and Policy Options, member of the Technical Panel, Vermont Public Interest Research Group (Montpelier), 1985

Issues of CANDU Safety, Dalhousie University Law School (Halifax), 1982

Legal Aspects of Nuclear Power, Canadian Bar Association (Saskatoon), 1981

Nuclear Debate, sponsored by the Canadian Institute of Public Affairs, Supreme Court Justice Howard Krever presiding, April 1978

Nuclear Wastes, SCITEC seminar for MPs and Senators (Parliament Hill), 1977

Nuclear Issues, Whiteshell Nuclear Research Establishment (AECL, Pinawa, MB), 1976
Energy Days, televised live from the Prince Edward Island Legislature, 1976

Energy and People conference: Keynote Speaker, introduced by Robert Stanfield, 1975

- Television Features - ***(excluding news coverage)***

The Fukushima Nuclear Crisis, a three-week series of interviews on the Fukushima disaster featuring Gordon Edwards, CTV (90 min), 2011

The Nature of Things, special program on nuclear power featuring G Edwards and B Hawthorne (president of Bruce Power) CBC (60 min), 2010

The Nature of Things, special program on nuclear power and plutonium with G Edwards and A Mayman (ex-VP of AECL) CBC (60 min), 1998

Speaking Out, panel discussion with GE, Ontario Energy Minister, and VP of Canadian Nuclear Association, TV Ontario (90 min), 1986

Energy: Search for an Answer, one of a seven part educational series, produced by TV Ontario and Energy, Mines & Resources (30 min), 1984

The Evolution of Geometrical Thought, by G. Edwards, a series of five TV shows (30 min each), University of the Air (CTV),
I. Ancient Discoveries; II. Curved Space; III. Geometry of Shadows;
IV. Higher Dimensions; V. Topology: the "Rubber Sheet" Geometry. 1979

Quarterly Report on Energy, hosted by Barbara Frum, featuring G. Edwards et al, CBC TV (60 m), June 1979

The Watson Report, hosted by Patrick Watson, CBC TV (60 m), featuring G. Edwards et al on nuclear safety, May 1978

The Schulman File, hosted by Morton Schulman, City TV (60 m), featuring G. Edwards et al on nuclear issues, 1978

Cross-Examination of AECL Nuclear Experts, video-taped at the Ontario Royal Commission on Electric Power Planning, CCNR (50 m), 1977

A Power Trip, G. Edwards et al on renewable energy, CBC Ideas (radio, 60 m), 1977

The Great Debate, hosted by Pierre Berton, featuring Gordon Edwards vs. Edward Teller, Global TV (50 m.), October 1974

Nuclear Debate, hosted by the *B.C. Environmental Council* and broadcast on cable TV from the Vancouver Planetarium (120 m.), February 1973

Annex B

The annual radiation dose to a person drinking radioactively contaminated water is calculated, assuming just one litre of the radioactive liquid from Chalk River is spilled into a large reservoir containing a city's drinking water. For purposes of illustration, we use the Georgetown reservoir (530 million litres) that provides drinking water to Washington DC. The resulting annual radiation doses are several hundred times greater than the EPA maximum permissible dose of four millirems per year from radioactively contaminated drinking water.

Annual radiation dose for members of the general public drinking water from Georgetown Reservoir, if one litre of liquid target residue material were added to 530 million litres of water in that reservoir.
EPA drinking water standards have been converted to Becquerels per litre from Microcuries per litre.
CNSC dose is estimated using 21 fission products; DOE dose is estimated using 13 fission products.
The blended estimate combines the 21 FP listed by CNSCS and the 13 FP listed by DOE into a total of 28 FP.

		Contents of the FISST		Annual Radiation Dose		
radionuclide	EPA LIMITS Bq/l	CNSC 2014 Bq/l	DOE 2013 Bq/l	mrem/y based on CNSC '14	mrem/y based on DOE '13	blended estimate of dose
strontium-90	0.296		4.35E+10		1.11E+03	1.11E+03
yttrium-90	2.22		4.35E+10		1.48E+02	1.48E+02
yttrium-91	3.33		1.04E+04		2.36E-05	2.36E-05
zirconium-95	7.4	2.54E+10	4.66E+04	2.59E+01	4.75E-05	2.59E+01
niobium-95	11.1	6.63E+09	1.03E+05	4.51E+00	7.00E-05	4.51E+00
niobium-95m	---	2.55E+10				0.00E+00
ruthenium-103	7.4	1.81E+10		1.85E+01		1.85E+01
rhodium-103m	1,110	1.81E+10		1.23E-01		1.23E-01
ruthenium-106	1.11	5.46E+08	1.10E+09	3.71E+00	7.48E+00	7.48E+00
rhodium-106	---	5.46E+08	1.10E+09			
tellurium-127	33.3		8.23E+04		1.87E-05	1.87E-05
tellurium-127m	7.4		8.49E+03		8.66E-06	8.66E-06
iodine-129	0.037		1.27E+04		2.59E-03	2.59E-03
iodine-131	0.111	1.95E+10		1.33E+03		1.33E+03
xenon-131m	--	1.95E+10				
tellurium-132	3.33	1.03E+10		2.34E+01		2.34E+01
cesium-137	7.4	7.02E+10	6.29E+10	7.16E+01	6.42E+01	7.16E+01
barium-137m	--	7.02E+10				
barium-140	3.33	5.85E+10		1.33E+02		1.33E+02
lanthanum-140	2.22	5.85E+10		1.99E+02		1.99E+02
cerium-141	11.1	4.29E+10		2.92E+01		2.92E+01
cerium-144	1.11	8.19E+09	7.33E+09	5.57E+01	4.98E+01	5.57E+01
praseodymium-144	--	8.19E+09				
praseodymium-144m	--	8.19E+09				
neodymium-147	7.4	1.58E+10		1.61E+01		1.61E+01
promethium-147	22.2		3.13E+10		1.06E+01	1.06E+01
europium-154	2.22	8.40E+07		2.86E-01		2.86E-01
europium-155	22.2	1.95E+08		6.63E-02		6.63E-02
				1.91E+03	1.39E+03	3.18E+03
		Calculated annual doses:		1,910 mrem CNSC	1,390 mrem DOE	3,180 mrem Blended