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An international collaborative network of advanced scientific thinking
NGO in Special Consultative status with the Economic and Social Council of the **United Nations** (ECOSOC)

May 7, 2018

For the attention of

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Hon. Greg Fergus,

First of all, I wish to thank you for organizing the March 5 Town Hall Meeting, ***Forum on Chalk River*** at **UQO** in your riding. Some of our associates were thus able to exchange with the qualified interveners and to affirm professional observations. This keynote event has led to meeting you with our colleagues on April 5th on the interdisciplinary theme of clean soil, water and responsible waste management, with an emphasis on alternative **nuclear waste treatment** and **remediation**. We note from the April 12 Government of Canada announcement of the launching of an **Expert Panel on**

Sustainable Finance to enable clean growth an impetus and opportunity for innovative and remunerative rectification of a costly and hurting long-term state of affairs.

In our group meeting with you, we underlined *a priori*, based on 50 years of hands-on executive experience with landfills that, even in the cases of well-conceived and engineered designs, contaminants, quite toxic, end up deleteriously in soil and in water.

The very concept of landfill is illogical: it implies that all materials (in this case, aging barrels and containers, instruments, rods, construction debris, etc.) are lumped together, with no certainty nor predictability of what can happen between the contaminants. In this case, as well, one does not see a ***Hazard and Operability Study*** (***HAZOP***) methodology of considering everything that could possibly go wrong (used in software research). It applies to complex 'processes' such as nuclear waste whereby sufficient predictable and explicitly-identified information is available.

Our first suggestion is that nuclear waste be separated and segregated at source, and in sequence of decommissioning. This is also helpful for alternative on-site, real-time decontamination. One treats to radioactive depletion components such as rods as they are assessed and retrieved, at near range – without hazard to workers, with robotics ; one treats liquids, facility equipment items, structural remains, etc. specifically and with appropriate and the most efficacious technology and protocols than are pre-tested first for their ability to reduce as quickly as viable radioactivity levels.

Our second suggestion is to focus on methodologies that are not only much more affordable, with more immediate applicability in terms of timelines but also those than can lead to productivity and rapid returns on capitalization by offering options for stocks of not only commodities but also of rare earth elements.

The interest of PACE goes back to the demands of its co-founder, scientist **Senator Chesley W. Carter** who aspired that Canada avoid nuclear energy facilities that were imposed as a result of the energy crisis of the 1970s, by embarking instead on less expensive and less uncertain advanced clean energy production technologies that were then being considered, and since peer-reviewed internationally with the participation of our collaborative network, which includes Nobelists. (See the Annexes.)

Retrospectively, a comptroller exercise shows that had the **National Research Council of Canada** (under pressure from the **U.S. Secretary of State**) not contradicted the July 1976 initiative by the Rt. Hon. **Pierre E. Trudeau**, prime minister to embark on the clean energy path suggested by Senator Chesley W. Carter as spokesperson for our collaborative network, Canada would have probably remained with a deficit-less national budget, and free of need of GST taxation. This repudiation led to the massive federal subsidy of the nuclear energy programme in Ontario and the expensive maintenance of status quo with regards to oil & gas, several megaprojects in a response to the then energy crisis due to rise in oil prices.

We propose that an initiative been undertaken to develop a matrix, on the basis of a full testing in appropriate nuclear licensed facility in Canada to determine which currently described and, additionally other promising and peer-reviewed accelerated and radioactivity-depleting nuclear waste remediation systems and protocols are most adapted and optimised for their logistical decontamination with due regard to the environmental and hazards issues.

We do hope that this communication enables risk-free and enhanced-economic viability for Canada.

Dr. Andrew Michrowski, President

Joseph Kennedy, P.Eng. , Director

Some observations about Nuclear Waste Treatment

Under supporting conditions nature and its natural processes can remediate the most difficult and toxic contamination including radioactivity. Healthy and abundant microbial activity producing a multitude of enzymes can degrade, transform, and/or transmute any contamination. Treatment and de-contamination are carried out at the atomic, sub-atomic, and quantum levels.

If a for-profit enterprise got paid $1.3 billion to move contaminated material and bury the problem like what happened at Port Hope what are the incentives and open-mindedness of that same enterprise to do anything different at Chalk River and consider pursuing a treatment solution instead?

Sample options for Nuclear Waste Treatment (current examples)

*(More peer-reviewed options are in **Annex C**)*

The *AmoTerra* Process

The ***AmoTerra*** process offers a two–fold approach to the radioactive waste problem in relation to:

1. Radioactive materials that can be ashed to be intermixed with the AmoTerra proprietary mixtures, and secondarily :
2. Radioactive contaminated hard surface materials.

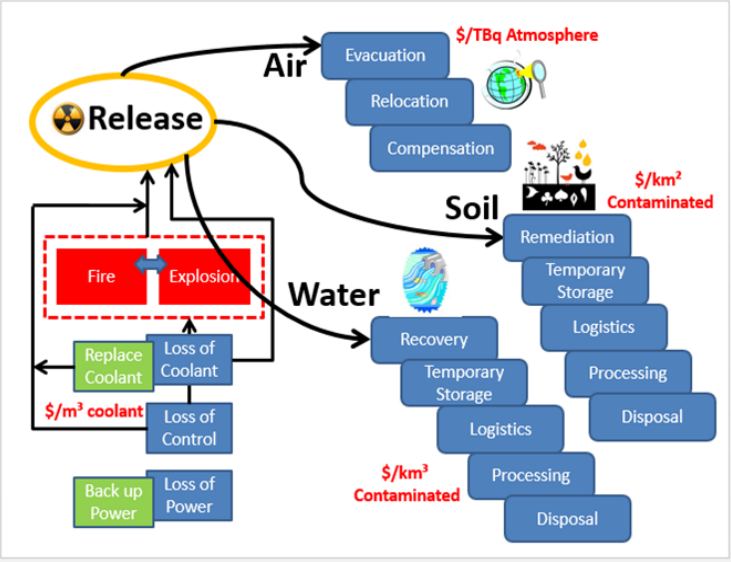
The first involves confined explosions involving proprietary mixtures of materials that include radioactive waste. Ignition of such mixtures causes nuclear transmutations resulting in reduced radioactivity (to near-background levels) following combustion, gradually over 1 to 4 days. This technique has been confirmed by the Italian ENEA and supported by the **French CEA** scientists as a serious candidate for treatment of waste stockpiles. The system, as currently designed, requires waste to be inserted into a chamber. The Canadian technology was granted an "Approval" (licence) from the **Ministry of Environment in British Columbia** to show that its process can be used to deplete low-level radioactive waste on a commercial scale. The process has been independently monitored since 2002 by a number of distinguished scientists, including(among others) the late Dr. **John Coleman**, Senior Research Scientist, **MIT**, retired Dr. **Philippe Duport**, as Director**, Low-Dose Radiation, University of Ottawa** and retired Dr. **John Johnson**, PhD, formerly Senior Scientist, **Hanford**. Research on what is the ***AmoTerra*** process was originally started by Dr. **John O'Malley Bockris** ("Father of electrochemistry") at **Texas A&M**. www.amoterra.ca .

To date, hard surface materials which are contaminated with radioactivity and which are to be disposed of are generally encased in concrete coffins and buried, resulting in significant increased volume of material being land filled or stored. ***AmoTerra***, using their proprietary laser technique, has demonstrated they can treat radioactive hard-surface materials, *i.e.*, stainless steel, in about 3 minutes -clean of contamination, thus re-usable. No longer is it needed to encase such contaminated hard surface objects in concrete: no longer is it necessary to abuse the earth by burying same.

Over time, the turnkey process has evolved to include, but noted limited to: accurate information on volumes and values of pollutant waste using an algorithm to pre-determine contents of waste streams with separation technologies capable of delivering where applicable:

- Families of isotopes
- Materials to be re-sold or recycled
- Accelerate the decay rate of nuclear waste to a matter of days *vs.* being stored and guarded for eternity.

Volume and cost information can be generated off-site, which means the tool ensures that employees are not put in harm's way while assessing noxious situations. The



calculations incorporate complex static and dynamic data, all of which can be updated progressively. The system applies to liquid waste, solid Waste and washable waste –*i.e.* protective clothing.

It has been demonstrated to lead to transmutation or transubstantiation of materials – rendering them back to their original components. This principle has been subsequently supported by **Mitsubishi** and the **US Naval Research**: however, both of these have worked with much smaller quantities of radioactive isotopes in contrast to the volume that ***AmoTerra*** process has demonstrated it can effectively deplete. At the end of the separation process families of isotopes can be stored until they are selected to address a particular chemical group. Thus, this process may generate rare earth elements, and even the emerging technology of Graphene – Silicon 2.0, with multiple applications being considered for worldwide commercialization.

Water For Life Technologies

There is an imperative and widespread need for new, economical approaches and technologies to improve water quality and this requires a fundamental change in attitude towards water from currently treating water as an inert commodity to treating water as a "living" substance. There are thirty some isotopes of water and even hydrogen and oxygen are much more complex than the conventional knowledge suggests.

Canadian ***Water For Life Technologies (WFLT)*** has been working with the quantum and atomic levels of water and its components and has developed an innovative and effective system to revitalize large bodies of water and soil. This is an effective, safe (no chemicals or power required) and low-cost system that improves soil and water eco systems including increasing oxygen throughout large bodies of water and soil. The treatment of large bodies of water and land areas is possible. With increased oxygen, aerobic conditions prevail to support nature's self-cleaning processes to clarify and purify water and soil. Installations of WFLT systems have been carried out in Canada, U.S., India, South Korea, and South America. Demonstration installations could be rapidly set-up at specific contamination sites at Chalk River (lagoons, tanks, soil) for up to a year in order to assess the effectiveness of its approach.

Logically Deduced Nuclear Geometry

Needless to say, after 70 years of captivity to an obviously deficient atomic model, we are way overdue for some serious reconsideration of our blind commitments to indeterminism that bars the way toward fantastic new discoveries including effective Radwaste treatment. A visionary future can only be had by opening our eyes to embrace new ideas based in solid logic and reasoning.

There exists the Canadian ***Lattice Nested Hydreno*** model developed by **Mark Porringa** for ***Zeropoint Techtonix*** Inc. (zptechtonix@gmail.com). This perspective is favourably assessed by the German **Bundesministeriums für wirtschaftliche Zusammenarbeit und Entwicklung** , the **Louis de Broglie Foundation**, founded by the Nobelist, and representatives from **EURATOM**, **CEA**, and **Kurchatov Institute**.

A critical revaluation of **Lord Rutherford**'s "Gold foil" experiment reveals some inappropriate assumptions indicating that the diameter of the nucleus may be a thousand times larger than the 10^{-15} m generally conceded to be true. The nuclear dimension is therefore about $1/100^{th}$ of the atomic radius. This revaluation has also been visually captured in experiments conducted by **IBM** and in analyses by researchers at **York University** on the basic structure of matter.

Questioning current approaches

How much effort was made by **AECL/CNL** to investigate nuclear waste treatment rather than taking the simple way out and creating a dumpsite? Dumping and storing may be a convenient and low cost short term solution but it always costs more than proper treatment in the end - for example $ billion clean ups. This is very similar to the federal government and oil industry approach to the "storage lagoons" related to the development of the Tar Sands in northern Alberta resulting in negative impacts to health and major watersheds in northwestern Canada. After all these years the oil industry is quite fat and happy NOT to have a solution (when many solutions are available) because then they would have to spend some extra money.

Let's assign an actual cost to these energy projects and properly account for the whole cost of production including waste disposal. Who is paying for the cleanup of Port Hope, Chalk River etc – the public! and who do you think will pay for the cleanup of the Tar Ponds??

Has there been a detailed ***Hazard and Operability (HAZOP)*** review of the proposed dumpsite proposal? To construct the proposed dumpsite about 15,000 trees will have to be taken down. These trees anchor the soil to the slope on which the proposed dumpsite is to be constructed. Our weather is becoming more extreme and excessive rainfalls are being experienced in several areas of the world. The Ottawa River watershed covers a huge area and if we receive such an extreme rainfall the **whole dumpsite could be flushed into the Ottawa River**.

There are nuclear waste treatment methods and promising technologies being pursued including **Stablex Canada**, located north of Montreal, which has been treating hazardous waste for at least 35 years. AECL is planning to transform Chalk River campus into a world-class nuclear research facility and it was suggested that AECL could be a world leader in the development of a safe nuclear waste treatment solution. AECL needs to do the right thing and invest in developing a responsible treatment solution for its nuclear waste rather than perpetuating the irresponsible dump and bury method.

There are many reasons why the public has little faith and major concerns for a nuclear waste dumpsite at Chalk River including the fact that **SNC Lavalin** a major owner of **CNL** and partner of **AECL** is currently in court facing criminal fraud and corruption charges.

This is a high risk initiative and if **AECL/CNL** insist on implementing a nuclear waste dumpsite at Chalk River then they need to set up a "***Community Assurance Fund for Remediation***" to be accessible at the full discretion of all communities between Chalk River and Ottawa-Gatineau. Because of the potentially high costs of remediation a community assurance fund of $2 billion would be appropriate.

Conclusion

Therefore, it would be a wise decision to pause and ***re-set the focus towards the development of a world class nuclear waste treatment system.***

Consider that Attorney **Charles Bonner**, representing US service members exposed to ***Fukushima fallout***, Jul 21, 2015. There are 250+ young sailors with all kinds of illnesses, with 3 deaths so far. One of the sailors came home and impregnated his wife. They gave birth to a little baby born with brain cancer and cancer down the spine, lived for 2 years, and died. (https://www.youtube.com/ watch?v=V0zGbG2dTvo&feature= youtu.be&t=645).

Note that doing the right thing conforms to the initiatives of the **United Nations ECOSOC** Integration Segment, with the focus on Innovative communities: "leveraging technology and innovation to build sustainable and resilient societies" that ended today. This is an initiative that promotes the integration of the 3 dimensions of sustainable development, both within and beyond the United Nations system.

> (1) discuss how policy makers can use integrated policy approaches to enhance resilience and inclusion as key enablers to achieve the 2030 Agenda at the national, regional and global levels;
>
> (2) serve as a platform for exchange of best practices on how technology and innovation can be leveraged as tools to effectively design a resilient future, while leaving no one behind;
>
> (3) showcase policy instruments and mechanisms that support risk management and reduction across the hazard spectrum, including external shocks and natural disasters;
>
> (4) discuss how technology and innovation, particularly pro-poor and gender-sensitive solutions, can support efforts to strengthen the resilience of public policy and governance structures through inclusiveness, participation and transparency with the view to fostering sustainable and resilient societies.

https://www.un.org/ecosoc/en/node/3613435

ANNEX A

Excerpts – with highlights

Submission to the **Canadian Environmental Assessment Agency Panel** reviewing the concept for deep geologic disposal of nuclear fuel wastes proposed by **Atomic Energy of Canada Limited**. August 8, 1995. 24 p.

Clean Energy Review

Our Association is pleased to submit this technical and scientific discussion to the Canadian Environmental Assessment Agency's (CEAA) Panel reviewing the concept for deep geologic disposal of nuclear fuel wastes proposed by Atomic Energy of Canada Limited (AECL). We are grateful for the participant funding provided by CEAA towards the review of the proposal as well as analysis of the broad range of nuclear fuel waste management issues.

We believe that our review is constructive and that it includes significant new expertise in frontier science and technology concerning nuclear fuel waste management. We also believe that our submission's thesis, ***if accepted and further investigated, will result in lower risk, in massive savings and will introduce a new area of exportable technological advantage and expertise for Canada****. It will also provide an infrastructure for an effective and efficient management procedure of nuclear waste in general.*

The review is the result of collaborative networking of scientists worldwide and we take pride in being able to organize this clean alternative initiative.

Acknowledgements

This submission has been prepared with the interventions of:

Lt. Col. (retired) Tom E. Bearden
Prof. Emeritus Dr. John O'M Bockris
Prof. Yull Brown
Prof. Pelayo Calante
Prof. Dr. Olivier Costa de Beauregard
Dr. Hal Fox
Lan Jin, M. Eng
Dr. Andrew Michrowski
Prof. Elizabeth A. Rauscher
Dr. Glen Rein
Lioudmila Ter, M. Eng
Prof. Emeritus William A. Tiller
Prof. Tom Valone, P.E.
William Van Bise, P.E
Prof. Meludin Veledar
Prof. Phillip Crabbé
Kristopher Weiss
....

Economic Considerations

The cost of disposal is to be included in the rates charged by Ontario Hydro, Hydro Québec and the New Brunswick Power for electricity. The amount charged is estimated to be adequate to fund the disposal's implementation, with the operation of a disposal facility as of 2025.

It is estimated by AECL that the siting and construction of a disposal facility would cost about $ 4 billion (1991 dollars). The facility would take about 25 years to complete. (Page 77)

The estimated cost of siting, construction, operation, decommissioning, and closing the pre-disposal facility are summarized in Figure 6-18 and Table 6-5 (as described in R-Facility). Here the cost (excluding the cost of transporting used fuel) is stated as being $ 13 to $ 18.65 billion (1991 dollars). Also excluded are financing, taxes and non-routine activities including waste retrieval, which could easily double this portion of estimates, depending on economic vagaries.

The estimates of the cost of transporting about 10 million bundles of used fuel from the nuclear generating stations to the disposal facility range from $ 440 to $ 770 million (1991 dollars) for road transportation and $ 1.41 billion to 2.14 billion (1991 dollars) for rail transportation. (Page 231)

The combined declared cost for the disposal concept can range from $ 18.85 to $ 19.91 billion (1991 dollars) + financing, tax and non-routine factors that could double the cost up to $ 40 billion.

No consideration appears to have been given to the cost of de-commissioning the nuclear power plants which are aging and fast approaching their 30-year life expectancy because of metal fatigue and crystallization by neutron bombardment. All metals in the first loop in the power plants -- reactor, steam generator, piping, water pumps, valves, filters are all radioactive and contaminated. **The materials in the second -- hermetic -- loop: metal cladding and concrete are also radioactive. No concept has been tendered for their safe disposal by AECL.**

The Buffer

The container would be separated from the rock by a dense buffer material, such as compacted mixture of sand and bentonite. (Page 118)

Two alternatives for emplacement of buffer have been investigated:

a) compacting the materials in place or,
b) using precompacted blocks.

There are advantages and disadvantages for both methods. If the buffer were compacted in place, the sequence of emplacement activities would be to place and compact all or most of the buffer material, drill holes in the buffer large enough to accept the disposal containers, place the containers in these holes, and close the holes by compacting more buffer material above the container. The potential for worker exposure to radiation would be lower than if the buffer were placed and compacted around a preplaced container. Also, the potential for damaging a container during the compaction process would be reduced. The general procedure would be suitable for both the in-borehole and in-room emplacement options. A detailed procedure would include provisions for quality control.

To use precompacted blocks in the in-borehole option, appropriately shaped blocks would be placed in the borehole, leaving a hole for the container. To use precompacted blocks in the in room option, the blocks could be placed on the floor of the room and them around the container. (Page 119, paragraph 5)

Montmorillonite, the principal clay mineral in *bentonite*, is the most surface-active of all clays, i.e., it has a large surface area and strong absorption capacity. This surface activity gives *bentonite* special properties, such as a low hydraulic conductivity and an ability to absorb water and swell. The hydraulic conductivity of *bentonite* can be decreased by increasing its density through compaction. (Page 124)

ANNEX B

Proceedings of Learned Societies Congress 2000
University of Alberta / Edmonton, May 29-30, 2000

Advanced transmutation process and its application for the decontamination of radioactive nuclear wastes

Andrew Michrowski [•] and **Mark Porringa** [••]

Abstract: *There are deviations to the standard model of radioactive atomic nuclei decay reported in the literature. These include persistent effects of chemical states and physical environment and the natural, low-energy transmutation phenomena associated with the vegetation processes of plants. The theory of neutral currents is proposed by Nobelist* ***O. Costa de Beauregard*** *to account for the observed natural transmutations, also known as the Kervran reaction. "Cold fusion" researchers have also reported anomalies in the formation of new elements in cathodes. This body of knowledge provides the rationale for the observed and successful and developed advanced transmutation processes for the disposal of nuclear waste developed by* ***Yull Brown*** *involving a gas developed by him with a stoichiometric mixture of ionic hydrogen and ionic oxygen compressed up to 0.45 MPa. The radioactivity in samples decreases by up to 97%, rapidly, simply and at low cost.*

Current model of decay

Since the discovery of natural radioactivity, it was generally believed that radioactive processes obeyed orderly, simple decay rate formulae and that nuclear processes operated completely independent of extra nuclear phenomena such as the chemical state of the system or physical parameters such as pressure or temperature. A solid body of scientific literature describes a small percentage variation of the order of 0.1 to 5% in the decay constant under a variety of chemical and physical conditions. [5, 6, 8, 10, 11, 21, 24]

The standard definition of half-life or half-decay time is the time taken by a given amount of a particular radioactive substance to undergo disintegration or decay of half of its atoms. Measured half-lives vary from less than a millionth of a second to billions of years in the case of Uranium. There are 4 modes of decay, three are named after the first three letters of the Greek alphabet, i.e., *alpha*, *beta* and *gamma* and the fourth is the recently discovered *proton decay.*
By way of review, for the Bohr-Rutherford model of the atom, the nucleus is composed of the heavy particles or hadron or the proton and the neutron, and is surrounded by a cloud of electrons (or light particles or leptons) the number of which depends on the atomic number (for neutral atoms) and also the valence state (for ionized atoms). *Alpha* particles are Helium nuclei, $_4He^2$ consisting of two protons and 2 neutrons; *beta* particles are electrons (negative charge) and positrons (positive charge) and *gamma* rays that are in the short wave length of the electromagnetic radiation band; the proton is a hadron. *Alpha* particles and protons are strongly interacting particles, as are all hadrons.

The current model of *beta* decay is that an inter nucleon neutron spontaneously decays into a proton and an electron (or *beta* particle and an anti-electron neutrino, $n^o \rightarrow p\cdot + e\cdot + \nu_C$. A neutrino is a zero-rest mass spin 1/2 particle that conserves momentum in the decay process. There are many pure beta emitters throughout the periodic table; Carbon ^{14}C and deuterium are two examples. Beta particles penetrate substance less deeply than gamma radiation but are hundreds of times more penetrating than alpha particles. *Beta* particles can be stopped by an inch of wood or by a thin sheet of aluminum foil, for example. The energy of most emitted alpha particles are stopped by a piece of paper and the most energetic gamma rays require a thick piece of lead or concrete.

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Electromagnetic radiation emission from atomic processes can be in the x-ray energy range and nuclear in the x-ray and gamma ray energy range.

It is believed that all radioactive atomic nuclei decay spontaneously without prior cause at a specific and steady decay rate that differs for each radioactive isotope. Some precise measurements of half-lives have been made which show deviations of the standard type decay curves that appear to depend on non-nuclear variable conditions in origin and structure.

Past measurements of variations in the decay constant $N = N_0 e^{-\lambda\pi}$ with $T_{1/2} = 0.693/\lambda$ are based on crude instruments from some 70 years ago. Later, with more sophisticated electronics, the value of λ of the decay of Beryllium ^{7}Be, was first shown in 1949 to deviate by 0.1% between atomic Be and molecular BeO. In 1965, the λ of Niobium, ^{90}Nb, is altered by 4% between the metal and the fluoride form, as discussed by **G. Emery**. **H. C. Dudley** reported on studies that have varied decay characteristics of twelve other radionuclides according to changes in the energy states of the orbital electrons, by reason of pressure, temperature, electric and magnetic fields, stress in monomolecular layers and other physical atomic conditions. [10]

The alteration of decay rates by non-nuclear processes may not be truly random and would seem to require a new theoretical model. As these decays occur, the term nuclear may need to be expanded to include reactions and processes involving the entire atom and even multi-atom crystal matrix forms rather than just mass-energy changes in only the nucleus. [19, 23, 24]

observed deviations from accepted decay laws

Not too well known is a quite prodigious body of work on the persistent effects of chemical states and physical environment on the deviation from the accepted decay law of nuclear decay rates. Theoretical as well as experimental research has been conducted. [5, 6, 8, 10, 11, 22, 24] In 1947, **R. Daudel** and **E. Segré** predicted that under certain conditions a dependence of the decay constant on the chemical and physical environment of the nucleus should be observable; subsequent to these predictions such a dependence was experimentally observed (with **R. F. Leinzinger** and **C. Wiegand**) in the K capture decay of ^{7}Be and the internal conversion decay of the 99m isomeric state of Technetium.

During the decay process, the chemical environment of the nucleus is changed, thus altering the decay constant. R. Daudel pointed out that the isomeric decay constant of the 2-keV isomeric state transition in the Technetium isotope ^{99m}Tc arose from a change in the electron density near the nucleus. **J. C. Slater** suggested that the faster decay rate observed for the $RtCO_4$ compound form is due to a *greater squeezing* of the Tc atoms with the metal Tc-Tc bond distance of 2.7 Å. Note that the symbol Å refers to the distance measure of one Angstrom which equals 10^{-8} cm.

A good example of the effect of a chemical change in the nuclear environment during radioactive decay is for the intensity change of the 122-keV E2 gamma ray observed for the ^{90m}Nb isomeric state of Niobium. This effect on the decay rate for the 21-second transition was an order of magnitude greater and in the opposite direction than observed in ^{99m}Tc and was achieved at **Lawrence Berkeley Laboratory** by **J. O. Rasmussen** and his colleagues, **J. A. Cooper** and **J. M. Hollander** in 1965. [24]

In 1975, **Elizabeth A. Rauscher** lengthened *beta* emissions for ^{20}Si simply by surrounding it with specifically designed matrix material, thus lengthening the decay rate by 6% with only 15 minute exposure, demonstrating the impact of environmental conditions on radionuclides.

natural transmutation

Natural, low-energy transmutation phenomena have been observed for centuries. In 1799, the French chemist, **Nicolas Louis Vauquelin** noted that hens could excrete 500% more lime that they take in as food, suggesting a creation -- transmutation of Calcium Carbonate. Scientific literature notes many similar phenomena that occur in vegetation processes of plants as well where new elements and minerals inexplicably emerge. Nobel Nominee Prof. **Louis Kervran** replicated these numerous findings and advanced very far the understanding of

natural, non-radioactive transmutations, acquiring in this pursuit a term for such transmutations, ***Kervran reaction***, while engendering solid physics support from the **Institut de Physique Théorique Henri Poincaré** physicist, **Olivier Costa de Beauregard**. He stated in 1974 that the theory of weak neutral currents accounts for the transmutations observed, with due respect for the physical laws of conservation. [7, 12, 13, 14] The theory of neutral currents gave its authors, **Sheldon Glashow**, **Abdus Salam** and **Steven Weinberg** the ***Nobel Prize for Physics*** in 1979. De Beauregard proposed the following equations for biological transmutation:

$n \rightarrow p + e^{-} + \underline{\nu}$	(1)
$p + \nu \leftrightarrow p + \nu'$	(2)
$p \leftrightarrow p' + \underline{\nu} + \nu'$	(3)

Table 1. **The Olivier Costa de Beauregard equations for biochemical transmutation**

These equations imply the conversion of a neutron (n) to a proton (p) by virtual exchange processes -- the neutral currents of Weinberg. These processes produce protons (p and p') of different energy levels and two neutrinos (ν and ν') of different energy levels; $\underline{\nu}$ represents the antineutrino and e^{-} the electron. In one state the proton will be bound to an atomic nucleus, and in the other state, it will be relatively free in a chemical binding.

***in vitro* transmutation**

Physicist Dr. **Andrija Puharich** was able to observe and photograph Kervran reactions *in vitro* by using a high-power dark-field microscope that was developed by the Canadian scientist, **Gaston Naessens**. Kervran reactions were documented by him to include the oxygen atom entering into a virtual nuclear reaction with p or n to yield ^{14}N or ^{19}F, by using an electrolytic process similar to that of Prof. **Yull Brown**, as disclosed by Puharich in his U.S. Patent 4,394,230, *Method and apparatus for splitting water molecules.* [20, 21]

There exists as well the phenomenon of transmutative "digestion". **L. Magos** and **T. W. Clarkson** of the British **Research Council Carshalton Laboratories** noted disintegration of the radioactive isotope ^{203}Hg ingested by rats, a volatilization which they ultimately attributed to such bacteria as *Klebsiella aerogenes*. [16]

cold fusion examples

On June 19, 1995, **Texas A&M University** hosted a low-energy transmutation Conference, sponsored by the "father of electrochemistry", Professor Dr. **John O'M Bockris**. Some of the papers that were presented noted anomalies in the formation of new elements in cathodes -- definitely not sourced from contaminations -- which were involved in cold-fusion experiments. For example: Drs. **T. Ohmori** and **Reiko Notoya**, both of **Hokkaido University**, reported Iron formation in Gold and Palladium cathodes, Potassium changing into Calcium, Cs^{133} producing an element of mass 134, and Na^{23} becoming Na^{24}; Dr. **John Dash** of **Portland State University** reported spots of silver, cadmium and gold protruding in palladium electrodes in both light and heavy water cells; Dr. **Robert Bush** of **California Polytechnic, Pomona**, reported strontium on the surface of nickel cathodes. [18]
Another development is the system that reduces radioactive material by electrolysis using palladium -coated microspheres of a beads as a catalytic agent was patented by James A. Patterson. [17]

low-temperature transmutation

Very pertinent is the long-term research by Dr. **Georgiy S. Rabzi** of the **Ukrainian International Academy of Original Ideas** who reported his analyses of the mechanism of low-temperature transmutation, which he has conducted since 1954. He passed out samples to attendees: a steel nut that acquired the color of copper and was reduced in size; magnetic stainless steel turned non-magnetic, asbestos which became like ceramic. No radioactivity had been observed in any of his experiments and he is convinced that radioactive wastes can be stabilized. [19]

These observations, originating from various domains of scientific research form a solid case of low-level advanced transmutation -- with minuscule power and signal strength and sometimes without any, i.e. in nature alone.

advanced transmutation: **disposing of nuclear waste**

Experimental results obtained by advanced transmutation have direct bearing on the problem of disposal of nuclear wastes.

The first relies on the interaction of nuclear wastes with ionic hydrogen and ionic oxygen gas known as Brown's Gas. Brown's Gas has been developed by a Bulgarian-born Australian national, Prof. **Yull Brown**. In his process, water is separated into its two constituents, hydrogen and oxygen in a way that allows them to be mixed under pressure and then burned simultaneously and safely in a 2:1 proportion. The process results in a gas containing hydrogen and oxygen in the required proportions that can be generated economically and safely and be compressed up to 0.45 MPa. [1, 3, 4]

At this time, Brown's Gas generators are mass-produced in the Bautou, a major research city in the People's Republic of China by the **NORINCO** factory which also manufacturers locomotives and ordinances -- and services the nation's nuclear industry complex. Most of these generators (producing up to 4,000 litres/hour/2.4 litres of water at 0.45 MPa with power requirements ranging from 0.66 kW/hr up to 13.2 kW/hr) are marketed for their superior welding and brazing qualities, costing between $ 2,000 and $ 17,000. Other models, usually near the 1,000 litres/hour range are being manufactured in smaller quantities in several countries. Some units have been used for the decontamination of radioactive materials since 1991. Brown's Gas generators produce between 300 and 340 litres of Brown's Gas per 1 kW/hr energy DC current approximately and one litre of water produces about 1,866.6 litres of gas. A generator that produces 10,000 litres per hour has been built specifically for the reduction of nuclear waste. Prof. Brown first successfully reduced radioactivity radionuclides of Cobalt 60 in his laboratory in Sydney, Australia with initial experimental results of about 50%. [25]

On August 24, 1991, Baotou's **Nuclear Institute # 202** released a report, ***The results of experiments to dispose of radiation materials by Brown's Gas*** which establishes that experimentation on Cobalt 60 radiation source decreased radiation by about 50%. [2] The treatment involved exposures to Brown's Gas flame, *lasting only a few minutes,* as in the samples described in the table below:

	First Experiment	**Second Experiment**
Original Source Intensity	580 *millirads/hour*	115 - 120 *millirads/hour*
After Treatment	220 - 240 *millirads/hour*	42 *millirads/hour*

Table 2. **Reduction of radioactivity of Cobalt 60 by exposure to Brown's Gas flame for less than 10 minutes. 1991 experiments conducted by Baotou Nuclear Institute # 220, People's Republic of China.**

In another test conducted by Yull Brown before a public audience including U.S. Congressman Hon. **Berkeley Bedell** with committee responsibilities in this area of concern, the experiment ran as follows (as reported by the press):

> *Using a slice of radioactive Americium ... Brown melted it together on a brick with small chunks of steel and Aluminum ... After a couple of minutes under the flame, the molten metals sent up an instant flash in what Brown says is the reaction that destroys the radioactivity. Before the heating and mixing with the other metals, the Americium, made by the decay of an isotope of Plutonium, registered 16,000 counts per minute of radiation. Measured afterward by the [Geiger Counter], the mass of metals read less than 100 counts per minute, about the same as the background radiation in the laboratory where Brown was working.* [2]

This experiment indicated a reduction of radiation in the order of over 99% (to about 0.00625 of original level) -- in less than 5 minutes, with minimal handling. The improvement in the reduction of radioactivity process from about 50% to nearly 100% has come only with persistent research over the decades by Brown and his colleagues. The Brown's Gas generating units that produced such effects are not expensive -- a far cry from the multi-million processes tabled by atomic energy agencies worldwide. They are powered by low energy requirements and require only small volumes of water, at most a few litres per hour as fuel. Furthermore, the training required for operation is minimal.

The Hon. Bedell has reported, "It has been my good pleasure to witness experiments done by Prof. Yull Brown in which it appeared to me that he significantly reduced the radioactivity in several nuclear materials. Under the circumstances, I believe it is very important for our federal government to completely investigate Dr. Yull Brown's accomplishments in this area." [9]

On August 6, 1992, almost a year after the Chinese nuclear report, Prof. Yull Brown made a special demonstration to a team of 5 San Francisco field office observers from the **United States Department of Energy**, at the request of the Hon. Berkeley Bedell. Cobalt 60 was treated and resulted in a drop of Geiger readings from 1,000 counts to 40 -- resulting in radioactive waste residue of about 0.04 of the original level. Apprehensive that somehow the radioactivity might have been dispersed into the ambient environment, the official requested the **California Department of Health Services** to inspect the premises. The health services crew found no radioactivity in the air resulting neither from this demonstration nor from another repeat demonstration held for their benefit. [9] This sequence of experiments was monitored by the Hon. **Daniel Haley**, the legislator who established the forerunner **New York State Energy Research and Development Agency**.

Other demonstrations, measured with under more sophisticated protocol and instrumentation have been conducted before Japanese nuclear experts, including four scientists from **Toshiba** and **Mitsui**: Cobalt 60 of 24,000 mR/hr reduced with one treatment to 12,000 mR/hr. The Japanese scientists were so excited by what they saw that they immediately purchased a generator and air shipped it to Japan. They sent Prof. Brown a confidential report of some of their results. Subsequently, they tried to obtain additional Brown's Gas generators directly from the People's Republic of China.

In 1999, one of the authors, **Mark Porringa** (responsible for one of the world's largest research reactors) used Brown's Gas to process a 1.0 uCi sample of Am^{241}, a weak alpha emitter with a half-life of 461 years. The radiation levels were reduced from over 70,000 cpm down to less than 6,000 cpm in less than 1 minute without any attempt at optimization. This would normally require thousands of years by natural decay processes. Yull Brown originally developed the proprietary protocol used. The author suspects from his tests and theory that a wide variety of radioactive wastes or undesirable materials such as plutonium would respond in like manner.

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ANNEX C
Peer-reviewed nuclear waste remediation technologies

The Brown's Gas-Metal Matrix Process:

The BG-MMX process utilizes a patented electrolysis cell of the Australian **Prof. Yull Brown**'s design that is said to produce a stoichiometric mixture of monatomic hydrogen and oxygen or possibly a quasi-stable water molecule raised to a high-energy state. This gas has some very peculiar properties including the ability to sublimate Tungsten (6000^{o}C) with an implosive flame that burns cool in air with a temperature of only 130^{o}C. A highly exothermic radiant reaction appears to result in the immediate reduction of radioactivity approaching 95% of the original levels judging from preliminary tests, within seconds of treatment. The process is conjectured to be effective with high level solid wastes and possibly gasses, but probably not liquids. The high temperatures involved may also preclude the processing of more volatile wastes.

Since 1991, this technology has been successfully demonstrated, on a small scale, at least 50 times to US, Chinese, Japanese and United Kingdom officials on a variety of nuclear waste products including Americium, Cobalt, Uranium, and Plutonium. The technique can be applied for the immediate decontamination of stockpiles of nuclear waste materials being held near nuclear power plants. The process is very simple, safe, and inexpensive to develop further into robotics application for on-site treatment with no foreseen environmental effects.

Photoremediation:

This photo remediation process of the American Dr. **Paul Brown** (consultant to **AECL**) is essentially conventional physics, albeit applied in a new and novel way. The process involves the use of a high-energy electron beam impinged on a target which in turn produces a monochromatic gamma radiation that is tuned to induce Photofission and Photoneutron reactions in the target material causing rapid neutralization of radioactive isotopes. The efficiency claimed exceeds 500% due to the high cross-section reactions in the Giant Dipole Resonance region. The 10 MeV electron beam produces typical fission reactions in the 200MeV range effectively turning high level solid wastes such as spent fuel into an energy source. The process is apparently intended for on-site treatment with some waste-partitioning required. While this idea is similar in topology to a system being developed by **Los Alamos National Labs**, Dr. Paul Brown's approach offers several advantages: no need for extensive chemical pre-processing and the energy required to effect transmutation is greatly reduced. No new technology needs to be developed, yet the engineering of such a photon reactor must be completed and it could itself become a practical method for generating power.

ZIPP Fusion:

The ZIPP fusion process, identified by team member **Mark Porringa** formerly chief engineer at **AECL** , induces a wide variety of fusion reactions, resulting from the radial compression of individual diatomic and other simple molecules dissolved or suspended in a light water, carbon arc electrolysis cell. A variety of other cell configurations are envisioned. The process appears to produce only stable isotopes, which should therefore make it capable of stabilizing a wide variety of radioactive waste materials. The theory on the process draws from Condensed Charge phenomena, Brown's Gas implosion, cavitations bubble collapse and sonoluminesence - all variations of the Casimir effect - which is believed to cohere the Zero-point energy of Quantum Vacuum Fluctuations. Transmutations using variations of this basic process may be applicable to a wide variety of nuclear wastes and appears capable of operating with an efficiency exceeding 100%. A major implication of this process is that the Strong force of the nucleus is understood as an ultra close range Casimir effect. **Oakridge Nuclear Laboratories** in the US in conjunction with several international collaborators have just (this month, in fact) announced a deuterium cold fusion process based on the essential elements of the ZIPP Fusion process first reported in 1998. The process is very simple and inexpensive to develop.

RIPPLE Fission:

The RIPPLE Fission process is an adaptation of existing potential technology utilizing a supersonic ionized gas to aerosol a counter flow heat exchanger that envelopes the radioactive waste aerosol in a vacuum induced plasma vortex which

appears to disrupt the matter stabilizing influence of the Quantum Vacuum fluctuations resulting in “gentle” low recoil fission reactions which produce only stable fission products, with excess neutrons being prompt converted to protons via quenched Beta emissions. The process is apparently proven with conventional non-radioactive wastes and is believed applicable to the entire spectrum of Radwaste without the need for waste partitioning. This process is also conjectured to operate with over-unity efficiency.

The LENTEC Processes:

The Low Energy Nuclear Transmutation Electrolytic Cells of the Cincinnati group produce a variety of transmutation reactions using a variety of exotic electrolysis cell designs that generally produce condensed charge clusters composed primarily of up to 1011 electrons each. These electron charge clusters produced with the use of special electrodes can penetrate the nuclei of larger atoms in solution and transmute these atoms into stable elements.

The range of design and operating protocols and potential applications are essentially limitless provided for the waste that is dispersed in the electrolyte. The reported transmutation of thorium to stable titanium and copper by the Cincinnati Group and by the Salt Lake City group is one of the most dramatic examples of this type of treatment process. Application to other high-level liquid transuranic fissionable wastes such as surplus Plutonium seems likely. The glaring absence of normal fission yield energies is perplexing but probably explicable as another form of low recoil fission reaction, similar to RIPPLE fission.

The PIT Processes (also known as HDCC):

Plasma Induced/Injected Transmutation processes run include a gamut from recent achievements dating back to the Oshawa-Kushi cold plasma transmutations reported in 1964. The patented high-density charge cluster process (HDCC) was first discovered by Kenneth Shoulders and added on to by Harold E. Puthoff. Later, the late Stan Gleeson discovered HDCC in properly processed solutions. Still later, Alexander Ilyanok of Belarus discovered HDCC, followed by Vasiliy Baraboskin in Russia.

The production of Condensed Charge Clusters and various plasma glow discharge phenomena in a variety of gaseous atmospheres is again implicated as the underlying cause with what should be by now an obvious connection with the coherence of Zero-point energy from the Quantum or Stochastic vacuum. Desk-top high energy particle accelerators have also been envisioned, based on the “piggy back” principle, in which the clusters permit acceleration of “piggy-backed” heaver +ions to extremely high energies capable of causing fusion and transmutations in target materials including those in solution and the materials of which the electrodes are composed. Brown’s Gas implosion and cavitation bubble collapse reactions are also believed to be prevalent in these types of cells due to the prevalence of electrolysis.

A high-density charge cluster technology was discovered and used by Stan Gleeson to stabilize radioactive liquid wastes and has been developed further in the last 4 years by a group led by S-X Jin and team member Hal Fox. Best results for radioactive liquids have been demonstrated in the processing of thorium for a 30-minute period and achieving a reduction of radioactivity of about 90% from a liquid sample.

Kervran Reactions:

The very compelling evidence compiled by French Nobel Candidate Dr. Louis Kervran has identified a wide range of nuclear transmutations in biological systems that have not been adequately explained. Coherence of Zero-point energy via Casimir effects within the Somatid particles identified by the Canadian Gaston Naessens is implicated as a possible cause. A wide variety of in vitro and in vivo reactions are believed to be possible as proven in nature and numerous experiments typically involving a reaction medium composed of a dielectric fluid such as water. Highly radiation resistant microorganisms have been found thriving in the core of nuclear reactors indicating the possibility of microorganisms being capable of transmuting some bioactive nuclear wastes in the course of the normal metabolism of such organisms.

AmoTerra Process

The process involves confined explosions involving proprietary mixtures of materials that include radioactive waste. Ignition of such mixtures causes nuclear transmutations resulting in reduced radioactivity (to near-background levels) following combustion, gradually over 1 to 4 days. This technique has been confirmed by the Italian ENEA and is supported by the French CEA scientists as a serious candidate for treatment of waste stockpiles. The system, as currently designed, required waste to be inserted into a chamber.

Higher group symmetry electrodynamics:

Extremely weak, non-classical, higher group symmetry electromagnetic fields were found during a 1991 experiment made by team member Glen Rein to alter significantly the level of radioactivity in materials, even those in the environment. The experiments suggest that higher group symmetry electrodynamics modulate the quantitative and /or qualitatitive properties of radioactive species. If the non-classical fields directly affect the radioactive species, it is likely that the appropriate field parameters will be discovered to neutralize radioactive emissions. In 1999, a theoretical basis for the phenomenon was developed by the Welsh physicist, M. W. Evans, with the participation of team member Lt. Col. (retired) Thomas E. Bearden.

The technology is extremely simple and could be applied with minimum logistics for treating massive structures, in-toto outdoors, such as the Chernobyl disaster site.