

14th March 2018

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

W. A. Scientific Inquiry into Hydraulic Fracture Stimulation

Health and Environmental Impacts.

When bore holes are drilled the operators have no idea as to the radioactivity of the material into which they are drilling. It may be an inert stable mineral or element or more radioactive Uranium or Thorium. Both these elements decay into Radium, Radon gas and Polonium which is vastly more radioactive and carcinogenic than the original Uranium.

Radon is a colourless, odourless, radioactive gas. It is easily inhaled and living tissue is directly exposed to the radiation. Density: 0.00973 grams per cc $\frac{1}{2}$ life 3.8 days

In nature the radiation is virtually trapped underground; exposures are only possible if contaminated groundwater, that is circulating through the deposit, is used for drinking. Radon is of no concern for deep deposits, though it can travel through underground fissures, since it decays before it can reach the surface.

The situation changes completely, when the deposit is mined: **Radon** gas can escape into the air, through created fractures in the rock, from gas leaks, waste water evaporation ponds, slurry and ore dust and Radon gas can be blown by the wind, and contaminants can be leached and seep into surface water bodies and groundwater. Radon gas is the heaviest gas and so stays close to the surface of the atmosphere. It has a half life of 3.8 days or 91 hours. In a 10 km/ hr wind it will travel 912 km and there will still be half of it left to travel further. As it travels the radon gas decays into Lead210 and Polonium which is more radioactive than Plutonium 239 used in nuclear reactors and weapons. The Polonium 210 coats grass, leaves, soil and water and is absorbed by plants and animals alike thus transferring to the food chain and often being further concentrated along the way.

Lead with the isotope signature of the Broken Hill deposits has been found across the entire continent of Antarctica, in ice cores dating back to the late nineteenth century.^[6] Lead weighs 8 times more than sand or dust. The wind did not blow it to Antarctica. Radon gas was blown to Antarctica and then decayed into lead and Polonium.

During processing of the solution, large amounts of the **radon** contained escape into the atmosphere, while the other decay products are transferred to the waste solutions. Those solutions are evaporated in ponds, resulting in a concentrated waste slurry. This practice allows the Radon to enter the atmosphere. Once released it cannot be recovered. The genie is out of the bottle!

In undersea gas wells it is easy to detect leaks of gas from well heads and piping by observing the trail of bubbles. It is much more difficult to detect natural and/or radon gas leaks from on land gas wells.

Fracking will increase the release of radon gas by many orders of magnitude and vastly increase the distribution of radioactive and carcinogenic materials in the biosphere and the food chain.

The [United States Environmental Protection Agency](#) (EPA) says that radon is the number one cause of lung cancer among non-smokers.^[78]

The [Surgeon General of the United States](#) has reported that over 20,000 Americans die each year of radon-related lung cancer.^[81]

Polonium 210

A milligram of ^{210}Po emits as many alpha particles per second as 5 grams of Radium ^{226}Ra .^[1]

A single gram of ^{210}Po generates 140 watts of power.^[2]

^{210}Po is extremely toxic, with one milligram being enough to kill the average adult (250,000 times more toxic than hydrogen cyanide by weight). $\frac{1}{2}$ life 138.376 Days. $\times 10 = 1383$ days (3.78 years) for 99% of it to have decayed into stable lead 206.

It should not be thought that after 3.78 years that is the end of the story. That applies only to the Polonium210 created today. Polonium210 created tomorrow or this day next year will again last for 3.78 years and so on for as long as Uranium and Thorium exist on the surface of the planet.

Every last gram of Uranium in the earth's crust will go through this decay process. The question is whether this will happen securely sequestered under- ground or on the surface of the planet?

So Called NORM radioactive materials are not normal radiation as it has been removed from its secure location under-ground.

Alpha particles emitted by polonium will damage organic tissue easily if polonium is ingested, inhaled, or absorbed, Wearing chemically resistant and intact gloves is a mandatory precaution to avoid transcutaneous [diffusion](#) of polonium through the [skin](#)

An interesting fact is that 98% of the radiation emitted from some Uranium ores is actually coming from the tiny (less than 1%) Radium impurity in the ore, not from the Uranium not as you would expect. This is why Uranium ore is much more radioactive than pure Uranium metal

[Uranium SubDirectory](#)

http://ccnr.org/radon_chart.html

In the chart on page 1 showing Radon progeny note that the Polonium progeny emit alpha particles at between 5.36 and 7.69 Mev. That is Million electron volts!

Plutonium239 which is used in atomic bombs emits alpha particles at 5.244 Mev. Which makes Polonium even more dangerous in so far as the damage that the 5.36 or greater Mev emission can do to living cells causing genetic mutation, leukaemia and cancer .

Polonium-210 has a *half-life** of 138 days, and it decays to stable lead-206 by emitting an *alpha particle* (an alpha particle has two protons and two neutrons). With a specific activity of 166 TBq/g, one microgram of ingested polonium would deliver a *committed effective dose equivalent* of approximately 40 Sv (4,000 rem). This value is based on human and animal studies conducted in the 1950s that showed that approximately 10 percent of ingested polonium is absorbed by blood (Harrison et al. 2007).

Based on studies carried out by the [National Academy of Sciences](#) in the United States, radon would thus be the second leading cause of [lung cancer](#) after [smoking](#), and accounts for 15,000 to 22,000 cancer deaths per year in the US alone.^[77]

The [United States Environmental Protection Agency](#) (EPA) says that radon is the number one cause of lung cancer among non-smokers.^[78]

Note that it says nothing about radon progeny or daughters such as Polonium which have been consumed by humans eating contaminated meat, fish, vegetables, fruit and dairy products.

The Union of Concerned Scientists states:

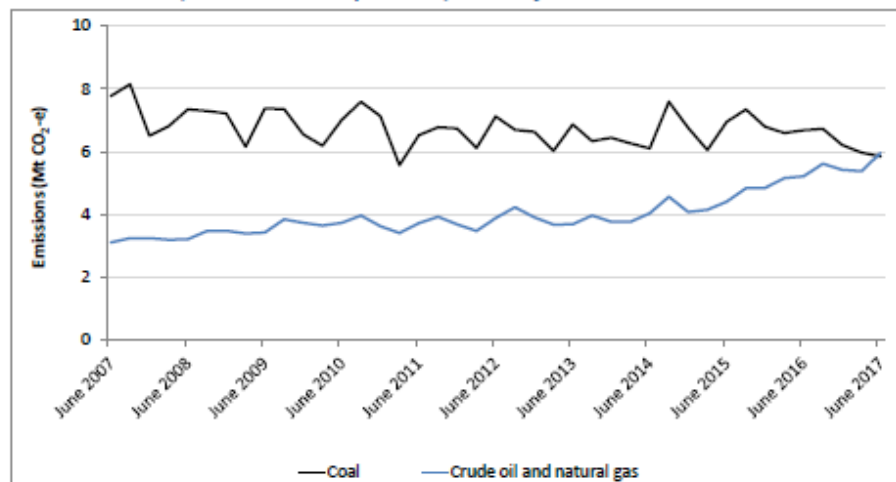
“The drilling and extraction of natural gas from wells and its transportation in pipelines results in the leakage of methane, primary component of natural gas that is 34 times stronger than CO₂ at trapping heat over a 100-year period and 86 times stronger over 20 years [3]. Preliminary studies and field measurements show that these so-called “fugitive” methane emissions range from **1 to 9 percent** of total life cycle emissions [4].”

Union of Concerned Scientists <https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas#.WpptfWZL3Jy>

Pennsylvania

<https://stateimpact.npr.org/pennsylvania/2015/04/09/new-study-raises-possible-link-between-gas-drilling-and-radon-levels/>

Figure 16: Fugitive emissions by sub-sector, quarterly, ‘unadjusted’ emissions, June 2007 to 2017



Source: Department of the Environment and Energy

Fugitive emissions:

Emissions, other than those attributable to energy use, from:

- Solid fuels: CO₂ and CH₄ from coal mining activities, post-mining and decommissioned mines. CO₂, CH₄ and N₂O from flaring associated with coal mining; and
- Oil and natural gas: exploration, extraction, production, processing and transportation of natural gas and oil. Includes leakage, evaporation and storage losses, flaring and venting of CO₂, CH₄ and N₂O.

Ref: Australian 2017 National Greenhouse Gas Inventory, Australian Dept of Environment and Energy

Renowned US environmental advocate Bill McKibben raised serious methane emissions issues from US gas fracking in March 2016. Following are excerpts from his reference:

- *The EPA's old chemistry and 100-year time frame assigned methane a heating value of 28 to 36 times that of carbon dioxide; a more accurate figure, says Howarth, is between 86 and 105 times the potency of CO₂ over the next decade or two.*

<https://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwi4o4T3juTYAhWCXrwKHUpZA4IQFggnMAA&url=https%3A%2F%2Fwww.thenation.com%2Farticle%2Fglobal-warming-terrifying-new-chemistry%2F&usg=AOvVaw08h35KO4cSHqA5i2LTLjxA>

- *In February, Harvard researchers published [a paper in Geophysical Research Letters](#). Using satellite data and ground observations, they concluded that the USA as a whole is leaking methane in massive quantities. Between 2002 and 2014, the data showed that US methane emissions increased by more than 30 percent, accounting for 30 to 60 percent of an enormous spike in methane in the entire planet's atmosphere. ...Howarth and Ingraffea began producing a series of papers claiming that if even a small percentage of the methane leaked—maybe as little as 3 percent—then fracked gas would do more climate damage than coal. And their preliminary data showed that leak rates could be at least that high: that somewhere between **3.6 and 7.9 percent** of methane gas from shale-drilling operations actually escapes into the atmosphere.*
- *The EPA had been insisting throughout that period that methane emissions were actually falling, but it was clearly wrong—on a massive scale. In fact, emissions “are substantially higher than we’ve understood,” EPA Administrator Gina McCarthy admitted in early March.*

The Canning Basin is estimated to contain 225 trillion cubic feet of gas =6.37 trillion cubic meters. If 5% of it leaks into the atmosphere that would amount to 318 billion cubic meters of methane greenhouse gas.

Radon in Natural Gas from Marcellus Shale Page 1 Marvin Resnikoff, Ph.D.

Marcellus Shale is 8 to 32 times background. This compares to an average radium-226 in surface soil in New York State of 0.81 picoCuries per gram (pCi/g)⁵ Using this range of radium concentrations and a simple Fortran program that simulates the production of radon in the well bore, and transit to the wellhead, we calculate a range of radon concentrations at the wellhead between 36.9 picoCuries per liter (pCi/L) to 2576 pCi/L. These wellhead concentrations in Marcellus shale are up to 70 times the average in natural gas wells throughout the U.S. The average was calculated by R.H.Johnson of the US Environmental Protection Agency in 1973 (pre-fracking) to be 37 pCi/L⁶ to a maximum of 1450 pCi/L.

37 pCi = 1.369 Bq/L. 2576 = 95.3Bq/L 1450 =53.65Bq/L (disintegrations per second)

http://www.radonleaders.org/sites/default/files/Marcellus_Radon.pdf

Now 318 billion M³ containing 1369 Becquerel's/M³ of alpha particles = 435 trillion potentially cancer causing bullets and 70 times more if the gas emits 95.3 Bq/litre .

Fracking Increases Radon Gas Hazard, US Study Finds

Levels of the carcinogenic gas rising in Pennsylvanian homes near industry sites.

By **Andrew Nikiforuk** 13 Apr 2015 | TheTyee.ca

In 2013, Douglas Tait, Isaac Santos and Damien Maher reported that the radon air levels above the heavily fracked Surat Basin in Queensland, Australia were three times greater than those observed in a non-fracking region. (A separate and earlier study also showed that methane and carbon dioxide levels in the air were three times higher in the mined landscape.)

The connection between radon migration and hydraulic fracking has been documented in other regions, too. A 2013 [study](#) by the University of Colorado-Colorado Springs found radon levels at fracking sites so high that they recommended better air monitoring.

<https://thetyee.ca/News/2015/04/13/Fracking-Radon-Gas-Hazard/>

In addition, the well-known textbook by Leonid Khilyuk and George Chilingar also notes that seismic activity, such as industrial fracking or earthquakes, can greatly accelerate upward gas migration by creating new faults and fractures, or by increasing the sponginess of the rock formation.

<http://www.resilience.org/stories/2015-04-14/fracking-increases-radon-gas-hazard-us-study-finds/>

Princeton University

Abandoned wells can be 'super-emitters' of greenhouse gas

by **John Sullivan, Office of Engineering Communications**

Dec. 9, 2014 11:15 a.m.

Read more at <https://www.princeton.edu/news/2014/12/09/abandoned-wells-can-be-super-emitters-greenhouse-gas>

Unlike the gaseous radon itself, radon daughters are solids and stick to surfaces, such as dust particles in the air. If such contaminated dust is inhaled, these particles can stick to the airways of the lung and increase the risk of developing lung cancer.^[4]

Radon gas in US; radioactivity often regarded as 37 Becquerel's per Cubic meter

Isotope	1/2-Life	Spec Activity (TBq/g)	Decay Mode	Alpha (α) Energy (MeV)
Polonium-208	2.9 yr	21.8	α	5.1
Polonium-209	103 yr	0.63	α	4.9
Polonium-210	138 days	166	α	5.3

g = gram and MeV = million electron volts

Bq or Becquerel. The unit of radioactive decay equal to one disintegration per second

So 1 millionth of a gram of Polonium 210 will have a specific activity of 166 million decays per second and each decay will produce 5,300,000 electron volts.

Most people have heard of Cesium137 and fear it greatly because of its ability to cause genetic mutation, leukemia and cancer. Radioactivity of Caesium 137 is 34TBq per gram =34,000 GBq per gram which is 3,400 times more than 50 year old High level nuclear waste.

Polonium 210 at 166 TBq per gram is 4.88 times more dangerous than Caesium 137.

Health consequences

Embryos 50 times more vulnerable to genetic mutation than adults

Children; 10 times more vulnerable to genetic mutation than adults

Latency period for tumour formation and leukaemia shorter in children than in adults. And shorter still in embryos.

Genetic mutations passed on to succeeding generations.

Permissible releases of radioactive material and decay products or progeny cumulative on grass, leaf vegetables, grain, fruit, berries, tobacco leaves, soil and water.

Bio accumulation and concentration by animals in milk and flesh.

Bio accumulation and concentration in fish, crustaceans and mammals.

Bio accumulation and concentration in plants.

Hayfleck limit and Telomere shortening. Average cell replication = 52 times

Average life expectancy in Ukraine and Belarus has REDUCED 4 yrs to age 68.

Each year 6000 babies are born with “Chernobyl Heart” Half of them die!

Alpha particles can rip through 2000 DNA Helixes, 200 nerve cells & 39 sperm cells.

Beta particles can rip through 43 Human egg cells, 838 sperm cells, 4,300 nerve cells and 43,000 DNA helixes!

Gamma Radiation is worse still.

Additional cases of cancer, leukaemia and genetically induced disease.

Treatment paid for by Taxpayers or additional private health premiums.

Sickness benefit paid for by Taxpayers or increased insurance premiums.

Carer benefit paid for by Taxpayers.

Hormesis. Kerala India; Natural background radiation 80mSv. Indigenous people.

Coronary heart disease 3 to 6 times higher than Japanese or rural Chinese.

See full text “Nuclear Why Not” attached

(f) Age an important factor

No factor is of greater importance in considering the implications of delivery of radiation to humans than is age. Direct evidence has been provided by Dr. Alice Stewart of Oxford, England that developing embryos are vastly more sensitive to the cancer and leukaemia producing effects of radiation than are adults. In fact, a given amount of radiation increases the risk of future cancer or leukaemia 50 times more if delivered to the embryo during gestation than if delivered to adults. Next to the sensitivity of the fetus in utero are children, and then come adults. Unfortunately, even the sensitivity of adults to cancer production by radiation is 10 to 30 times more than "expert" bodies of scientists thought up until the last few years.

The embryo presents other special problems too. Radiation, received at a time where the various organs are being formed, can cause a whole organ system to be deformed. For example, early radiation can lead to serious brain injury with resultant mental infirmities. This was seen in Hiroshima.

"Hot" particles are very small dust-like particles that are made up of alpha-emitting substances. One of the prominent ones, plutonium-239, is widely heralded as the "nuclear fuel of the future." Fine particles of pure plutonium-239 oxide (formed when plutonium burns) are very intense sources of alpha particles.

Geesaman and Tamplin have shown that such fine particles, referred to as "hot" particles because of their extremely high alpha particle emission in a localized region, may be 10 to 1000 times more effective in producing cancer than would be expected if the same number of rads were delivered in a more diffuse manner to an organ, such as the lung.

It is this "hot" particle problem associated with plutonium-239 that makes the contemplated, future, widespread use of this radionuclide as a fuel in the nuclear-electricity-generation plants such an unmitigated nightmare for mankind. Not only may the hot particles of plutonium oxide be super-cancer producers, but with a half-life for plutonium-239 of 24,000 years, such plutonium oxide can be spread about the earth, re-suspended in air, and produce lung cancers in generations of humans for 100,000 to 200,000 years.

Manufacture of plutonium-239 and its widespread use in nuclear electric power may represent man's most immoral act.

<https://ratical.org/radiation/CNR/PP/chp2.html>

The release of Radon and subsequent Polonium into the biosphere should be regarded as equally immoral.

Radon gas: The silent killer in the countryside | The Independent

- JEREMY LAURANCE
- @jeremylaurance
- Monday 9 August 2010 23:00 BST

Professor Sir Richard Peto, the renowned cancer epidemiologist, once remarked: "If only it were blue and people could see it they would take it seriously, but unfortunately it isn't."

The largest and most rigorous study of radon, published in 2004, showed that the gas causes 20,000 deaths from lung cancer in the European Union each year. The research combined the results from 13 studies and showed that smokers were at greatest risk. Worldwide, radon causes a million deaths every decade.

However, it is important to keep these risks in proportion. True, radon kills more people than cervical cancer, for which there is a national screening programme, and more than melanoma, the lethal skin cancer caused by sunburn, about which there are widespread warnings. So, if you live in an area with high levels it is not wise to bury your head in the sand.

<http://www.independent.co.uk/life-style/health-and-families/features/radon-gas-the-silent-killer-in-the-countryside-2047987.html>

RADIOACTIVE MATERIALS COULD POSE PROBLEMS FOR THE GAS INDUSTRY

06/25/199

Some radon undoubtedly was removed with the NGL's prior to 1971. However, the development of deep extraction techniques to remove more ethane from the gas resulted in the extraction of significantly greater concentrations of radon as well. This problem was discovered when the radon contamination in propylene became sufficiently high to interfere with liquid level sensors detecting slurry levels in a polypropylene plant.

As long as it is contained and controlled within vessels, equipment, and piping, radon is not generally a health hazard to employees and the public.

<https://www.ogj.com/articles/print/volume-88/issue-26/in-this-issue/production/radioactive-materials-could-pose-problems-for-the-gas-industry.html>

Contained is the operative word. It cannot be done with unconventional fracking

Time

It is vitally important to appreciate that it took 170 years for humanity to start to realize that we could not add Co₂ from sequestered fossil fuels to the natural and normal carbon cycle with impunity. Fortunately we can desist from this practice. If the world stopped burning fossil fuel today then in 100 years time it would be recovering quite well from our misadventure with burning fossil fuels and increasing Co₂ in the atmosphere.

Similarly, it will take 22 years + 3.8 days for half of the Radon and daughter Lead 210 to decay into Polonium 210. We will then start to realize that we cannot increase the background radiation and radioactivity on the surface of the planet with impunity.

In 100,000 years time the planet would still not have recovered from Mayak, Chernobyl, Doenreagh, Hanford, Rocky flats, Marshall Islands, Montebello, Maralinga and Fukushima; to name a few.

In addition there is all the Radon gas from mine tailings and oil and gas extraction which is leaking into the atmosphere and blown by the wind and depositing progeny or daughters such as Lead 210 and Polonium 210 which contaminates grass, leaves, berries, fruit, soil and water. Every last gram of Uranium in the earth's crust will decay into Radon and Polonium at some stage. If it is deep underground, fine. In the biosphere and the food chain it will undoubtedly cause an increased amount of genetic mutation, leukaemia and cancer with increased cost to our healthcare system.

As shown below our health has already been impacted by the release of radioactive materials into the atmosphere and onto the land and water.

The collective radioactivity resulting from all coal burning worldwide between 1937 and 2040 is estimated to be 2,700,000 curies or 0.101 EBq.^[22]

Burden of disease

- Between 1982 and 2010, the number of new cancer cases in Australia more than doubled (from 47,388 to 116,580 cases).¹
- While cancer incidence rates have increased (from 382.8 to 487.7 cases per 100,000 between 1982 and 2010), cancer mortality rates have fallen (from 209.0 to 172.5 deaths per 100,000 between 1982 and 2011).¹
- In 2010, the five most commonly diagnosed cancers in Australia were prostate cancer (19,821 cases), bowel cancer (14,860 cases), breast cancer (14,308 cases), melanoma (11,405 cases) and lung cancer (10,296 cases).^{1,4}
- In 2010, prostate cancer was the most commonly diagnosed cancer among men and breast cancer was the most commonly diagnosed cancer among women.^{1,4}

Variations between population groups

In the 5 years from 2004 to 2008, the age-standardised incidence rate of all cancers combined was:

- significantly higher for Aboriginal and Torres Strait Islander Australians than their non-Indigenous counterparts (461 and 434 per 100,000 respectively) (New South Wales, Queensland, Western Australia and the Northern Territory).^{3,5}
- higher for people living in lower than those in higher socioeconomic status areas.³
- significantly higher in *Inner regional* (504 per 100,000) than other remoteness areas.³

Burden of disease

- In 2012, cancer was estimated to be the leading cause of burden of disease in Australia, accounting for approximately 19 per cent of the total disease burden.³
- |

- In 2012, cancer was estimated to account to 551,300 disability adjusted life years (DALYs*) in Australia; of these, 457,400 were years lost due to premature death and 93,900 were years of healthy life lost due to disease, disability or injury.³

*DALYs are years of healthy life lost, either through premature death or through living with disability due to illness or injury. This is the basis unit used in burden of disease or injury estimates.³

Chernobyl

Children

- Today in Ukraine, 6,000 children are born every year with genetic heart defects. More than 3,000 will die for lack of medical attention.
- Children born since 1986 are affected by a 200 percent increase in birth defects and a 250 percent increase in congenital birth deformities.
- 85 percent of Belarusian children are deemed to be Chernobyl victims: they carry “genetic markers” that could affect their health at any time and can be passed on to the next generation.
 - UNICEF found increases in children’s disease rates, including 38 percent increase in malignant tumors’, 43 percent in blood circulatory illnesses and 63 percent in disorders of the bone, muscle and connective tissue system.

Health

- Seven million people living in the affected areas received the highest known exposure to radiation in the history of the atomic age.

10

- Belarusian doctors have identified increases in a number of cancers, including: a 200 percent increase in breast cancer, a 100 percent increase in the incidence of cancer and leukemia, and a 2,400 percent increase in the incidence of thyroid cancer.
 - The mortality rates among the population already outstrip their birth rates.

If we had 1% of the above quoted figures for Chernobyl would it impact on our health care budget and by how much? Not to ignore the pain, suffering and anguish to victims and their family’s.

Over the last 70 years we have been digging up radioactive Uranium and more recently gas with the result that it’s radioactivity is added to the natural background radiation. Sound familiar?

Every week on the news we hear of another rare genetic disease. Where does that come from?

Well maybe it was caused by natural background radiation or radioactivity released by mining, oil and gas extraction.

What will future generations be able to do about increased background radiation?

They will not be able to gather up lead 210 and Polonium 210 spread over our vast land by the wind and put it back underground.

The main driving force behind evolution is radiation resulting in genetic mutation.

Further information on Radioactivity from Uranium and its progeny may be found here in my submissions to the SA Nuclear Royal Commission on all four issues plus a response to their initial findings.

<http://nuclearrc.sa.gov.au/app/uploads/2016/03/Ivan-Quail-24-07-2015.pdf>

and

<http://nuclearrc.sa.gov.au/app/uploads/2016/03/Ivan-Quail-25-07-2015.pdf>

I thank you for affording me the opportunity to make a submission to you.

Yours Sincerely,

Ivan Quail

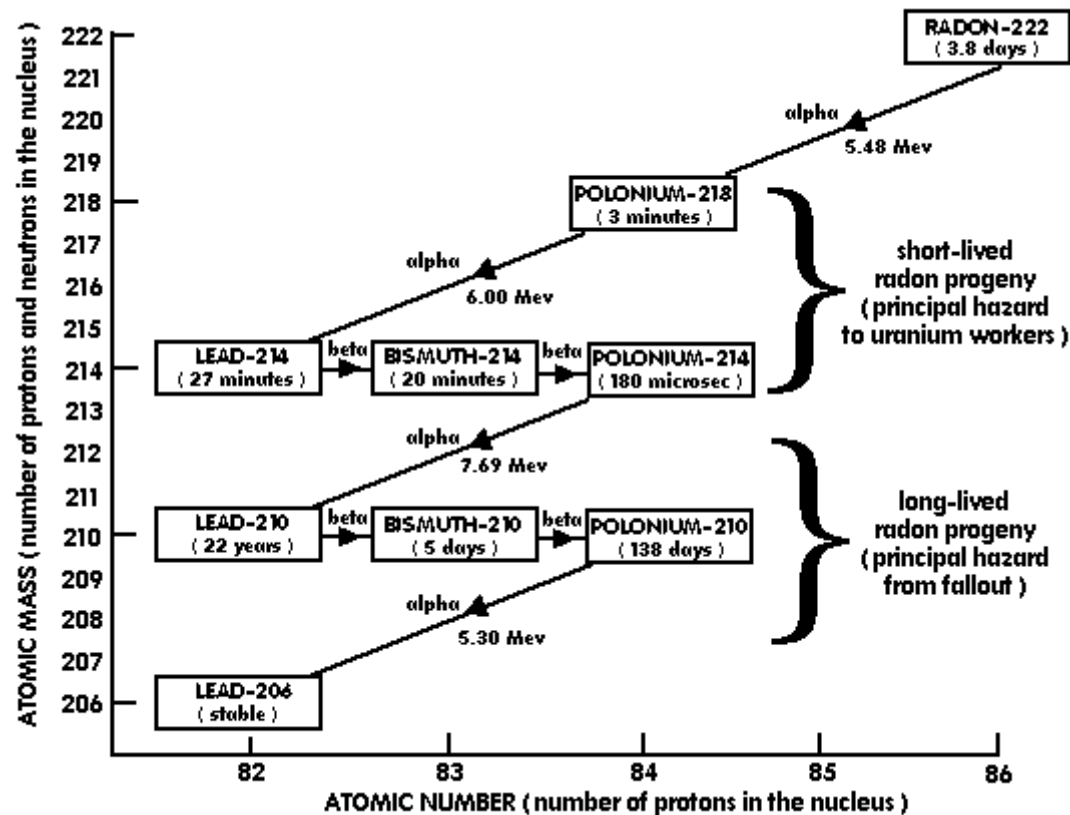
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Introducing the Radon Progeny (formerly called Radon Daughters)

[[pour la version française](#)]

The chart below lists all of the decay products of radon gas (radon-222) in their order of appearance. They are called the "radon progeny" (formerly "radon daughters"). Each radioactive element on the list gives off either [alpha radiation](#) or beta radiation -- and sometimes gamma radiation too -- thereby transforming itself into the next element on the list. Lead-206, the last element on the list, is not radioactive. It does not decay, and therefore has no half-life.

When radon gas is allowed to build up in an enclosed space, such as a mine shaft or basement, the radioactive hazard increases enormously because of the build-up of radon progeny. Conversely, when radon gas migrates through the atmosphere, the solid radon progeny are deposited on the soil and water below, entering into the food chain and hence the bodies of birds, animals, fish and insects.



NOTES ON THE CHART

The vertical axis measures the **MASS NUMBER**, while the horizontal axis measures the **ATOMIC NUMBER**.

DIAGONAL ARROWS indicate alpha decay while **HORIZONTAL ARROWS** indicate beta decay.

MeV = MILLION ELECTRON-VOLTS.

It is a measure of the **ENERGY** of the alpha radiation.

The more energetic it is, the more damaging it is.

What are the Mass Number and the Atomic Number?

All the atoms of a given element are identical. Each atom has a tiny core called a "nucleus", containing even smaller particles called "protons" and "neutrons". The number of protons in the nucleus is the "atomic number", while the number of protons and neutrons together is the "mass number". These numbers are characteristics of the particular element.


Elements having the same atomic number are chemically indistinguishable, even if the mass numbers are different. They are called "isotopes". For example, polonium-218, polonium-214, and polonium-210 are three isotopes of polonium. They have different mass numbers -- as indicated by their names -- but they share the same chemical properties because they all have the same atomic number, 84.

During "alpha decay", the nucleus gives off an alpha particle, which is made up of two protons and two neutrons. Thus the atomic number goes down by two and the mass number goes down by four.

During "beta decay", one of the neutrons in the nucleus spontaneously turns into a proton giving off a high-velocity electron in the process. Thus the atomic number increases by one (as there is now an extra proton) and the mass number is unchanged. The escaping electron is called a beta particle.

[[Uranium Sub-Directory](#)] [[Picture Gallery](#)]
[[COMPLETE DIRECTORY](#)]



Since March 27th 1996, there have been over
100,000 outside visits to the CCNR web site, plus

(counter reset June 3rd 1998 at midnight)

24th June 2017

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Uranium and Nuclear; Why not?

If the world stopped burning fossil fuel today then in 100 years time it would be recovering quite well from our misadventure with burning fossil fuels. In 100,000 years time the planet would still not have recovered from Mayak, Chernobyl, Doenreagh, Hanford, Rocky flats, Marshall Islands, Montebello, Maralinga and Fukushima; to name a few. In addition there is all the Radon gas from mine tailings and oil and gas extraction which is leaking into the atmosphere and depositing progeny or daughters such as Polonium210 which contaminates grass, leaves, berries, fruit, soil and water. Every last gram of Uranium in the earth's crust will decay into Radon and Polonium at some stage. If it is deep underground, fine. In the biosphere definitely not good.

Swapping Co2 for more Radioactivity is jumping from the frying pan into the fire. Eighty six percent of the potential radioactivity contained in Uranium ore is still present in the tailings dumps after extraction of the yellowcake. (Mainly Thorium and Radium,) This decays into Radon gas which is blown far and wide for thousands of Kilo meters and decays into lead and Polonium 210 which is highly radioactive and a well known carcinogen.

What is the current problem with Co2? It is this. We have dug up carbon sequestered in wood, oil and gas millions of years ago and added it through burning to the natural every year carbon cycle.

Over the last 70 years we have been digging up radioactive Uranium and more recently gas with the result that it's radioactivity is added to the natural background radiation. Sound familiar?

Every week on the news we hear of another rare genetic disease. Where does that come from?

Well maybe it was caused by natural background radiation or radioactivity released by mining, oil and gas extraction.

Maximum permissible dose	worker 20mSv pa
Public	1mSv pa
Fertile female worker 8AM to 4PM	20mSv
4PM to 8AM + Sat-Sun(member of public)	1mSv
3 weeks pregnant & at work	20mSv
Exposure to embryo (Mum at work-legal)	20mSv
Children age 0 to 10	1mSv

Embryos 50 times more vulnerable to genetic mutation than adults

Children; 10 times more vulnerable to genetic mutation than adults

Latency period for tumour formation and leukaemia shorter in children than in adults.
And shorter still in embryos.

Genetic mutations passed on to succeeding generations.

Permissible releases of radioactive material and decay products or progeny cumulative
on grass, leaf vegetables, grain, fruit, berries, tobacco leaves, soil and water.

Bio accumulation and concentration by animals in milk and flesh.

Bio accumulation and concentration in fish, crustaceans and mammals.

Bio accumulation and concentration in plants.

Hayfleck limit and Telomere shortening. Average cell replication = 52 times

Average life expectancy in Ukraine and Belarus has REDUCED 4 yrs to age 68.

Each year 6000 babies are born with “Chernobyl Heart” Half of them die!

Alpha particles can rip through 2000 DNA Helixes, 200 nerve cells & 39 sperm cells.

Beta particles can rip through 43 Human egg cells, 838 sperm cells, 4,300 nerve cells and
43,000 DNA helixes!

Gamma Radiation is worse still.

Additional cases of cancer, leukaemia and genetically induced disease.

Treatment paid for by Taxpayers or additional private health premiums.

Sickness benefit paid for by Taxpayers or increased insurance premiums.

Carer benefit paid for by Taxpayers.

Hormesis. Kerala India; Natural background radiation 80mSv. Indigenous people.

Coronary heart disease 3 to 6 times higher than Japanese or rural Chinese.

Legal and accidental releases of radioactive material

to air

IRRETRIEVABLE

to water

IRRETRIEVABLE

to land

Some partially recoverable

Duration of contamination from legal and accidental releases of radioactive material

to land, air and water (biosphere)

2.5 years to Millions of years!

Scientist publishes paper

Subject to peer review

Engineers design nuclear facility

NOT subject to peer review

Deliberately kept secret.

Public must TRUST.

Operation of nuclear facility self monitored.

Nuclear industry protected by official secrets act

Nuclear facility must have a government approved and sanctioned liability cap.

The taxpayers of Japan are paying the \$200 Billion cost to date for Fukushima!

Yours Sincerely

Ivan Quail