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Submission from Ivan Quail

Nuclear Fuel Cycle Royal Commission-- South Australia

Issue 4

**MANAGEMENT, STORAGE AND DISPOSAL OF WASTE**

It is unclear as to whether this refers to management, storage and disposal of waste produced in Australia by Australians or to waste produced elsewhere and imported into Australia for the purpose of storage and disposal.

For waste produced in Australia. That which is of our creation and our responsibility.

Early in 2015 the government said there were 4248 m$^3$ of LLW awaiting disposal and 656 m$^3$ of ILW awaiting better storage.

So a suitably lined pit 20M x 20M x 11M deep = 4400M$^3$ for LLW and 8M x 8 x 11M deep = 704 M$^3$ for the ILW.

As a result of the British nuclear weapons testing program in the 50s and 60s at Maralinga we already have a somewhat contaminated site at Maralinga where a fair amount of radioactive material is already stored in presumably lined underground pits.

It therefore makes little sense to expose yet another uncontaminated and relatively pristine area of Australia to the possibility of leakage and contamination. Furthermore the Maralinga site belongs to the Dept of Defense. To locate a site elsewhere would entail significant expenditure of taxpayer funds to acquire a new site and create new infrastructure such as roads etc.

In 1992, with the full cooperation of all state and territory governments, the Commonwealth government initiated an Australia-wide survey to site a low level waste repository. In May 2003 a final site for the national repository near Woomera in South Australia was decided. The disposal area of the repository would be about 100 metres square, with long trenches up to 20 metres deep. It would be set in a 2.25 square kilometre buffer zone.

In 2001 the government decided to locate the ILW store on the same site as the LLW repository. For this, a secure building with concrete vaults for the category S wastes would occupy a similar area at Woomera.


It would be much more secure and more easily guarded and protected if the secure building was replaced with underground storage. Capital expenditure may be a little
higher but this would soon be offset by lower operating and maintenance costs in the long term. Stored below ground it will also be a more difficult target for any terrorist action. Once radioactive material escapes from an above ground building it is subject to being blown around by the wind and dispersed by rain water. It is very difficult if not impossible to retrieve it. If we are going to do it do it right the first time.

With regard to the idea of South Australia and Australia becoming a nuclear waste dump for the world.

**High-level waste**
High-level waste (HLW) arises from the 'burning' of uranium fuel in a nuclear reactor. HLW contains the fission products and transuranic elements generated in the reactor core. It is highly radioactive and hot due to decay heat, so requires cooling and shielding. It has thermal power above about 2 kW/m$^3$ and can be considered as the 'ash' from 'burning' uranium. HLW accounts for over 95% of the total radioactivity produced in the process of electricity generation. There are two distinct kinds of HLW:

- Used fuel itself.
- Separated waste from reprocessing the used fuel (as described in section on [Managing HLW from used fuel](#) below).

HLW has both long-lived and short-lived components, depending on the length of time it will take for the radioactivity of particular radionuclides to decrease to levels that are considered no longer hazardous for people and the surrounding environment. If generally short-lived fission products can be separated from long-lived actinides, this distinction becomes important in management and disposal of HLW.

**TABLE 3. STATUS OF OPERATING NUCLEAR POWER PLANTS (1.1.2000) AND ANNUAL LILW ARISINGS** (low and intermediate level waste (LILW);
Total volume = 153,780 M$^3$ per annum with Radioactivity = (TBq/y) 102,300

2.2.2. Spent nuclear fuel and high level waste
Spent fuel and HLW contain by far the largest activity of the radioactive substances produced by nuclear fission.
Due to their very high concentrations of radionuclide’s and high heat generation rate, spent fuel and HLW require to be managed with the greatest care.
Up to the year 1988, the Hanford reprocessing operations generated about two million m$^3$ of liquid HLW that contained $1.5 \times 10^7$ TBq. This volume of waste, placed in storage tanks, was later reduced by evaporation, treatment, and disposal and leakage to ground. By the year 2002, about 200 000 m$^3$ of HLW were remaining in the Hanford tanks [27].

“and leakage to ground” with consequent contamination of underground water and aquifer’s is totally unacceptable.

ANNEX III
ENVIRONMENTAL INVENTORIES OF RADIOACTIVE MATERIAL III-1.
RELEASES TO THE ENVIRONMENT FROM PAST OPERATIONS
In some cases liquid radioactive waste has been discharged in surface water bodies or pumped in wells at various depths and at sites characterized by extremely different geological conditions. Examples of environmental contamination caused by the discharge of liquid radioactive waste in surface water bodies are the Techa River basin and the Karachai Lake in the area near the Mayak PA plant in the Ural region [III-1]. During the years 1949-1956, about 76 million m$^3$ of liquid waste were discharged in the Techa River with a radioactive content of $1.0 \times 10^5$ TBq (both 90Sr and 137Cs amounted to 11-12% of the total). As a result of the discharge in the river, downstream populations were exposed to radiation doses that were considered unacceptable. Consequently various remediation measures were enforced, including reduction of waste discharges and resettlement of a number of downstream villages [III-1]. One of the measures enforced to limit the contamination of the Techa River was to discharge the waste in storage ponds. Karachai Lake was used as a storage pond for liquid ILW.

Contaminated sediments from the banks of the lake were then scattered by wind and caused the contamination of an area of 1800 km$^2$ [III-1]. The total activity discharged in the Karachai Lake is estimated to be about 22 TBq consisting mainly of 137Cs and 90Sr (activity ratio of the two radionuclide’s about 2.8).

Deep well injection of high level liquid radioactive waste was carried out by the former Soviet Union at three sites. The intention was to remove the radioactive material from the near surface environment and to rely on the isolation capacity of confined deep aquifers to allow decay of the radionuclides. The volumes and activities of liquid waste injected into deep wells at the sites of two Russian reprocessing plants are shown in Table 8 (Section 2.4.3.2 of main report). Low level waste was also injected into wells in the USA. They were not quite as deep as the Russian wells and relied upon the length of travel between injection and discharge and on the retention by geological materials to allow decay of the radioactive contaminants. The latter approach has been used, inter alia, at some DOE sites such as Hanford and INEEL (Idaho).

A disposal approach used in an experimental way at the Oak Ridge National Laboratories in the years from 1959 to 1984 involved mixing liquid radioactive waste with cement to form a sludge that was then injected in a shale formation at depths as great as 300 m. The intention was to retain the radionuclides in the hardened cementitious material, counting on the low permeability of the shales to limit leaching and subsequent migration of the radionuclides. A total of 46 injections were carried out, injecting 19 000 m$^3$ of waste grout mix with an activity of $5.2 \times 10^4$ TBq [III-2]. The disposal options described in the preceding paragraphs can be considered geological disposal options in which containment is provided exclusively, or mainly (as in hydraulic fracturing), by the geological barriers.

Due to questions, at least in the mind of some stakeholders, about the long term reliability of the different isolation systems, such disposal methods were abandoned in the USA.
Any such contamination of ground water precludes it from use as water for live stock, human consumption or agriculture for many thousands of years.

III-2.
SITES CONTAMINATED BY ACCIDENTAL RELEASES
A limited number of nuclear accidents causing significant environmental contamination has occurred over the years. The most serious nuclear accidents were an explosion affecting a HLW tank at an Ural site in 1957 and the accident of 1986 at the Chernobyl NPP. The 1957 chemical explosion of a HLW tank in Kyshtym in the Chelyabinsk region caused the dispersal in the environment of about 7.3 E4 TBq of radioactivity containing about 2 E3 TBq of 90Sr and 250 TBq of 137Cs. The accident caused the contamination of an area of about 20 thousand km2 [III-1]. On 26 April 1986, the core of Unit 4 of the Chernobyl NPP contained an estimated 7.4 E7 TBq of radioactivity. During the accident about 15% of the radioactive inventory, that is 1.1 E7 TBq, was released to the environment [III-6]. A fraction of the released activity was dispersed widely but a large part was deposited in the relative proximity of the plant. As a result, significant environmental contamination was caused in the surrounding area. As far as longer lived radionuclides are concerned, it has been estimated that about 5% of the inventory of 90Sr and between 20% and 40% of the inventory of 137Cs were released by the accident. Consequently the amounts of the two radionuclides dispersed in the environment were 1.0 E4 TBq (90Sr) and 8.5 E4 TBq (137Cs) [III-6]. The largest fraction of the core inventory is still associated with the remains of the reactor and is within the shelter that was built after the accident to contain the radioactive rubble.


This is an interesting article worth reading. However accuracy may be dubious.

Risks Posed by High Level Wastes

Nuclear reactors produce high level radioactive wastes which present a variety of problems that must be considered for safe disposal. [4] Some waste products will generate considerable heat as they decay while others will remain intensely radioactive for very long time periods. Because of these hazards, disposal regulations require isolation of the wastes from the public and the environment for tens of thousands of years. Some of the most concerning by-products from spent fuel are Plutonium-239 (half-life 24,000 years), Technetium-99 (half-life 220,000 years), and Iodine-129 (half-life 15.7 million years). [4] Without a permanently safe location for these by-products, society will have to carry the burden of storing and guarding nuclear wastes for many centuries.

This turns the nuclear energy process into a moral issue involving sustainability and the fact that the power consumed today will leave radioactive garbage for
future generations. [5] While the nuclear fuel cycle hardly exacerbates global warming, nuclear power still poses globally significant risks. Two that dominate the discussion are the vulnerability of spent nuclear fuel in storage pools to terrorist attack and leakage from geologic repositories that are designed to isolate high level waste from the natural environment. [3] The biggest problem is how to keep radioactive waste in storage when there is nothing that could be built that would be definitively safe until the waste becomes benign after hundreds of thousands of years. A final high level waste deposit must be absolutely reliable, because the quantities of poison are tremendous, and it must be permanently guarded which requires a society with stability that has not yet been demonstrated by humankind. [5]

**Conclusions**

Nuclear materials generate high level waste that is extremely hazardous and capable of harming living organisms and the environment. While low and intermediate level radioactive wastes are being appropriately disposed, high level radioactive waste is still stored at temporary locations awaiting disposal at permanent facilities. [8] And still, there are no permanent facilities, even though approximately 270,000 metric tons of high level radioactive waste has accumulated in 30 countries and an additional 9,000 metric tons are being added annually. [8] Despite being in the title of this paper, high level nuclear waste "disposal" is a misnomer. [5] Even the strongest promoters of nuclear energy will not claim that ultimate disposal methods are yet achievable. Any idea conceived will have to solve problems regarding storage, guardianship, and management of the waste. [5] Without a known solution to the nuclear energy waste problem, and with continued electricity production from reactors, high level waste will continue to build up around the world. And as debates over this controversial issue continue, the waste will patiently decay as its gets passed from generation to generation for hundreds of thousands of years.

http://tinyurl.com/ntfgnnw

large.stanford.edu/courses/2011/ph241/madres1/

What are the health effects and medical consequences and dangers to humans and other animals from ionising radiation?

In 1963 The Concerned Union of Scientists which included scientists from both sides of the cold war and Prof Linus Pauling (Nobel Laureate x2) and Prof Joshua Lederberg (Nobel Laureate Genetics) pushed for and got the Limited Nuclear Test Ban Treaty agreed to by most nations and respected by almost all ever since. This was done because the dangers to all life forms including to humans of radioactive materials including Pu and other radioactive
fission products (Cesium137, Strontium 90 etc) in the biosphere were recognised and greatly feared.

http://tinyurl.com/qaoxcxp

The US Atomic Energy Commission were not very happy with the nuclear test ban treaty as part of their job was to promote nuclear energy. Accordingly they employed Dr’s Gofman and Tamplin to do a thorough in depth and exhaustive study complete with laboratory animal experiments over a period of eight years to determine the biological effects of ionising radiation on living cells in humans and animals. “In assigning this study mission to us Chairman Glen Seaborg (AEC) assured us that he wanted favourable or unfavourable finding made available to the public. “All we want is the truth.” he said.

When they delivered their final report which confirmed the concerns of the hundreds of scientists from both sides of the cold war which led to the NTBT it was swept under the carpet (locked in the AEC vaults) as it was not what the AEC was hoping for. The AEC was both the regulator and promoter of the nuclear industry. A conflict of interest. Dr’s Gofman and Tamplin were so incensed that they wrote the book Poisoned Power to bring their findings to the attention of the public.

John Gofman graduated from Oberlin College with a bachelor's in chemistry in 1939, and received a doctorate in nuclear and physical chemistry from Berkeley in 1943, where he worked as a graduate student under Glenn T. Seaborg, the discoverer of plutonium and later a chairman of the US Atomic Energy Commission. In his PhD dissertation, Gofman described the discovery of radioisotopes protactinium-232, uranium-232, protactinium-233, as well as uranium-233 and the characterization of its fissionability.[1] Seaborg had a very high opinion of Gofman: he called Gofman one of his "most brilliant students" when, in 1963, he appointed him to head the Biomedical Research Division at the Lawrence Livermore Laboratory;[6] he wrote that his PhD dissertation was "very brilliant".[7]

Gofman shared three patents with collaborators on their discoveries:

- n° 3,123,535 (Glenn T. Seaborg, John W. Gofman, Raymond W. Stoughton): The slow and fast neutron fissionability of uranium-233, with its application to production of nuclear power or nuclear weapons.

Medical research[edit]

Dr. Gofman earned his medical degree from the University of California, San Francisco, in 1946. After that, he and his collaborators investigated the body’s lipoproteins, which contain both proteins and fats, and their circulation within the bloodstream. The researchers described low-density and high-density lipoproteins and their roles in metabolic disorders and coronary disease. This work continued throughout the late 1940s and early 1950s.[9]

At Livermore[edit]

At the request of Ernest Lawrence, Gofman established the Medical Department at the Lawrence Livermore National Laboratory (LLNL) in early 1954 and acted as the Medical Director until 1957 roughly two days a week while teaching at Berkeley the rest of the time.[10]
In 1962, the US had resumed atmospheric tests of nuclear weapons at the Nevada test site in 1962. The State of Utah had set up its own network of monitoring facilities to test milk for radioiodine, since "data pertaining to the safety of the citizens of Utah was not forthcoming from the AEC", and the levels of radioactivity were found to be close to the limits prescribed by the Federal Radiation Council. The Commissioners of the AEC were "on the hot seat" and announced "a comprehensive, long-range program" to explore the effects of man-made radioactivity "upon plants, animals and human beings". At the request of the US Atomic Energy Commission and of LLNL's director John Foster, Gofman reluctantly accepted to establish the Biomedical Research Division for the LLNL in 1963. He served as the first director of the LLNL biomedical research division from 1963 to 1965 and as on the nine associate directors of the entire lab until 1969.

In 1964, he raised questions about a lack of data on low-level radiation and also proposed a wide-ranging study of exposure in medicine and the workplace at a symposium for nuclear scientists and engineers. This helped start a national inquiry into the safety of atomic power. With his colleague Dr. Arthur R. Tamplin, Dr. Gofman then looked at health studies of the survivors of Hiroshima and Nagasaki, as well as other epidemiological studies, and conducted research on radiation's influences on human chromosomes. The two scientists suggested that federal safety guidelines for low-level exposures be reduced by 90 percent in 1969. The Atomic Energy Commission contested the findings, and "the furore made Dr. Gofman a reluctant figurehead of the anti-nuclear movement" according to The New York Times. In 1970, he testified in favour of a bill to ban commercial nuclear reactors in New York City and told the City Council that a reactor in an urban environment would be "equal in the opposite direction to all the medical advances put together in the last 25 years."

It is important to note that Gofman and Tamplin were employed by the US Atomic Energy Commission for eight years. So their study and research was paid for by the AEC.

I would strongly urge the Commissioners to read Poisoned Power by Drs Gofman and Tamplin. Available online at http://tinyurl.com/q3av3ox

www.ratical.org/radiation/CNR/PP/

From Ch 2
(c) The role of chemical similarity between elements

Potassium is a prominent, vital constituent of the interior of every living human cell. Fish living in fresh water, where the concentration of potassium is very low, may be forced to concentrate the potassium 1000-fold, in order to maintain the concentration necessary to sustain life. Because cesium is chemically quite similar to potassium, the same mechanism also concentrates cesium from such a fresh water source approximately 1000 times. If the cesium in the fresh water happens to be radioactive cesium-137, from a
nuclear reactor or other source, then the fish will contain 1000 times more cesium-137 than the fresh water itself, on a weight-for-weight basis.

Apparently Dr Gofman was too conservative in his estimation.

Tokyo Electric Power Co. said Friday it detected a record 740,000 Becquerel’s per kilogram of radioactive cesium in a fish caught in waters near the crippled Fukushima Daiichi Nuclear Power Station, equivalent to 7,400 times the state-set limit deemed safe for human consumption.

http://tinyurl.com/pcv2utx

and

One of the samples of the 37 black sea bream specimens caught some 37 kilometers south of the crippled power plant tested at 12,400 Becquerel’s per kilogram of radioactive cesium, making it 124 times deadlier than the threshold considered safe for human consumption, Japan’s Fisheries Research Agency announced.

http://tinyurl.com/qe6h7j8

Similarly, radioactive materials can and are concentrated in the milk and flesh of animals, birds and plants which form part of the human diet and our food chain.

From Poisoned Power Introduction

THE POISON

One year of operation of a single, large nuclear power plant, generates as much of long-persisting radioactive poisons as one thousand Hiroshima-type atomic bombs. There is no way the electric power can be generated in nuclear plants without generating the radioactive poisons. Once any of these radioactive poisons are released to the environment, and this we believe is likely to occur, the pollution of our environment is irreversible. They will be with us for centuries. It is important that people learn how they are likely to be exposed to such poisons and how death-dealing injury is thereby produced in the individual and in all future generations.

Chapter 2 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 foetus in utero are children, and then come adults. 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.

Both from the point of view of injuring whole organ systems during pregnancy and that of producing massive increases in the risk of future cancer and leukaemia, irradiation early in pregnancy is an extremely serious matter. This would be true for any source of radiation—medical x-rays, nuclear electricity or other activities. Since a woman often does not realize she is pregnant during these critical early stages, it seems extremely unwise for women of child-bearing age to be associated, in any way, with the nuclear power industry or
other activities where the chance of radiation exposure is high. In the case of the male and female reproductive organs, however, the damage done during reproductive years guarantees great harm.

Since the gene-containing cells for future generations of humans reside in these organs, irradiation here will cause the genetic (inherited) alterations which can produce mental and physical deformities, and a host of serious diseases in future generations.

(g) Other radiations: Alpha particles, "Hot" particles, Plutonium
But one type of radioactivity associated with nuclear electricity deserves special consideration; alpha radioactivity. Alpha particles, electrically charged nuclei of helium atoms, affect material (including human tissues) in their paths so extensively that they travel only short distances before they have expended all their energy. In the process they provide intense radiation to the tissue in their path.

Much confusion has been generated by some so-called authorities (in AEC) concerning alpha particle radiation. These "authorities" have stated repeatedly that, since alpha particles transfer so much of their energy in such a short distance and are then stopped, it follows that alpha particles are not serious. This assumption is false. It is true that a radionuclide (emitting alpha particles) lodged on the skin cannot irradiate internal tissues, simply because no alpha particles get any deeper than the skin. But they can provoke skin cancer.

Much much worse is the inhalation of nuclides which emit alpha particles. Once inhaled, the radionuclide can be distributed along the lining of the respiratory tract and there irradiate those cells especially prone to develop cancer. Indeed, this is the source of lung cancer induced by radioactive exposure of uranium miners, one of the truly unnecessary tragedies that has already occurred in the nuclear electricity industry.

"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 (or Becquerel’s) were delivered in a more diffuse manner to an organ, such as the lung.

http://tinyurl.com/q3av3ox

www.ratical.org/radiation/CNR/PP/

See also Salem News

http://tinyurl.com/gh2q5sp
Radioactivity in some natural and other materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Activity (Bq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 adult human (100 Bq/kg)</td>
<td>7000 Bq</td>
</tr>
<tr>
<td>1 kg of coffee</td>
<td>1000 Bq</td>
</tr>
<tr>
<td>1 kg superphosphate fertiliser</td>
<td>5000 Bq</td>
</tr>
<tr>
<td>The air in a 100 sq metre Australian home (radon)</td>
<td>3000 Bq</td>
</tr>
<tr>
<td>The air in many 100 sq metre European homes (radon)</td>
<td>up to 30 000 Bq</td>
</tr>
<tr>
<td>1 household smoke detector (with americium)</td>
<td>30 000 Bq</td>
</tr>
<tr>
<td>Radioisotope for medical diagnosis</td>
<td>70 million Bq</td>
</tr>
<tr>
<td>Radioisotope source for medical therapy</td>
<td>100 000 000 million Bq (100 TBq)</td>
</tr>
<tr>
<td>1 kg 50-year old vitrified high-level nuclear waste</td>
<td>10 000 000 million Bq (10 TBq)</td>
</tr>
<tr>
<td>1 luminous Exit sign (1970s)</td>
<td>1 000 000 million Bq (1 TBq)</td>
</tr>
<tr>
<td>1 kg uranium</td>
<td>25 million Bq</td>
</tr>
<tr>
<td>1 kg uranium ore (Canadian, 15%)</td>
<td>26 million Bq</td>
</tr>
<tr>
<td>1 kg uranium ore (Australian, 0.3%)</td>
<td>500 000 Bq</td>
</tr>
<tr>
<td>1 kg low level radioactive waste</td>
<td>1 million Bq</td>
</tr>
<tr>
<td>1 kg of coal ash</td>
<td>2000 Bq</td>
</tr>
<tr>
<td>1 kg of granite</td>
<td>1000 Bq</td>
</tr>
</tbody>
</table>

N.B. Though the intrinsic radioactivity is the same, the radiation dose received by someone handling a kilogram of high-grade uranium ore will be much greater than for the same exposure to a kilogram of separated uranium, since the ore contains a number of short-lived decay products (see section on Radioactive Decay), while the uranium has a very long half-life.

http://tinyurl.com/nmzhp8g

When people dismiss the effects of Cesium-137 by comparing it to the radioactive Potassium-40 in a banana, they fail to account for the strength of the radioactivity. It is like saying a single stick of dynamite and the bomb dropped at Hiroshima amount to the same thing.

Potassium-40 = 71 ten millonths Curies per gram (=262700 Becquerel)
Cesium-137 = 88 Curies per gram (=3256,000,000,000 Becquerel’s =3256 GBq )
Strontium-90 = 140 Curies per gram (=5180 GBq)
So the effects of Cesium-137 are about 10 million times more radioactive (and damaging) than Potassium-40.

http://tinyurl.com/qdwzett

Conversion factors:

- $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq} = 37 \text{ GBq}$
- $1 \mu\text{Ci} = 37,000 \text{ Bq} = 37 \text{ kBq}$
- $1 \text{ Bq} = 2.7 \times 10^{-11} \text{ Ci} = 2.7 \times 10^{-5} \mu\text{Ci}$
- $1 \text{ GBq} = 0.027 \text{ Ci}$

Dr Karl gives this further explanation:

There’s a boxer throwing punches — in all directions. Most of them miss you. Only some of the punches land on you. Some might be hard and land like a sledgehammer, while others might be as soft as a feather. Moving on, think about where the punches land. If you suffer 50 little punches on your arms and legs, you would not incur any permanent damage. But if those 50 little punches were all to your left eyeball, you might well end up permanently blind.

In terms of radiation landing on your body, your bone marrow is much more sensitive to radiation than your big toe.

Premature aging

Hayflick demonstrated that a population of normal human fetal cells in a cell culture will divide between 40 and 60 times. So let us take 100 cells of a particular organ. You lose 5% due to exposure to ionizing radiation. You have effectively lost 5% of that organs life expectancy.

In humans this occurs on average, after 52 divisions, known as the Hayflick limit. The cell is then referred to as senescent. Cells stop dividing because the telomeres, protective bits of DNA on the end of a chromosome required for replication, shorten with each copy, eventually being consumed, as described in the article on telomere shortening. Cancer cells, on the other hand, are not thought to degrade in this way, if at all. An enzyme called telomerase, present in large quantities in cancerous cells, rebuilds the telomeres, allowing division to continue indefinitely.

Tissues that have limited ability to regenerate include bone, cartilage, and smooth muscle (such as the muscles around the intestines) and heart muscle. Tissues that rarely or never regenerate include the nerves, skeletal muscle, heart muscle, and the lens of the eye. When injured, these tissues are replaced with scar tissue.

I would suggest the Commissioners consult Dr Elizabeth Blackburn (Australian Nobel Laureate) on telomere shortening or Prof Susan Cory

Chernobyl Heart is an example of the damage that can and has been caused to children.

The heart is one of the organs most vulnerable to the effects of radiation, and every year, 6,000 children in the Ukraine are born with genetic heart diseases and defects. One of these defects is the deadly condition known as “Chernobyl Heart.” This is a defect in the heart of children caused by radiation from Chernobyl, and it causes physical holes in the heart of the child, along with a host of other issues.
Over 68% of all deaths in Ukraine are due to cardiovascular disease alone and more than 50% of children are not operated on because of lack of facilities and training. Ukraine has an under-five mortality rate of 15%, by comparison to 5% in the UK, and this has been attributed mainly to congenital heart diseases.

Only half of affected children will receive the surgeries that they need to survive: the rest will die within three to five years.

CCI manages and delivers a world-recognised Cardiac Programme that has saved the lives of thousands of children. In collaboration with the American cardiac surgeon Dr. William Novick, CCI has reduced a waiting list for cardiac surgeries in Belarus from 7,000 to less than 2,500 children in just five years. Volunteer surgical teams travel throughout the Ukraine and Belarus to perform surgeries that save lives.

- See more at: http://www.chernobyl-international.com/programmes/medical-programmes-projects/cardiac-mission#sthash.sOmZLO3T.dpuf

Chernobyl 20 years on

The 40% increase in all malignancies between 1990 and 2000 correlates with radioactive fallout levels. The list of cancer sites includes retinoblastoma, lung, intestines, colon, kidneys, female breast, bladder, respiratory organs, nervous system, pancreas, all cancers in children.

There is accelerated ageing among the people in radioactively polluted territories in the Ukraine: their biological age exceeds their actual age by 7 - 9 years. In highly polluted territories in Belarus the mean age of men and women who died from heart attacks was 8 years younger than the average across Belarus.

For a full list see: http://tinyurl.com/ocj5f9d

The Chernobyl Forum will attempt to down play and minimise the consequences and health effects of the disaster.

However:

The IAEA, in its 5 September 2005 press release “Chernobyl: The True Scale of the Accident” stated: “A total of up to four thousand people could eventually die of radiation exposure from the Chernobyl nuclear power plant (NPP) accident nearly 20 years ago, an international team of more than 100 scientists has concluded.” The figure of 4,000 fatalities has been quoted extensively by the world media. However the statement is misleading, as the figure calculated in the IAEA/WHO report is nearly 9,000 excess cancer deaths.

http://tinyurl.com/nnqnxzd

WHO

http://tinyurl.com/owleo77

However
Dr. I. Fairlie, a radiation biologist, was a scientific secretary to UK Government’s Committee Examining Radiation Risks from Internal Emitters

Depending on the risk factor used (ie the risk of fatal cancer per person sievert), the TORCH Report estimates that the worldwide collective dose of 600,000 person sieverts will result in 30,000 to 60,000 excess cancer deaths. That is 7.5 to 15 times the figure released in the IAEA’s press statement.

Assessment of Radiological and Health Impacts 2002 Update of Chernobyl: Ten Years On (2) In addition, because caesium and strontium are taken up by plants by the same mechanism as potassium and calcium respectively, the extent of their uptake depends on the availability of these elements. Thus, high levels of potassium fertilisation can reduce caesium uptake and liming can reduce strontium uptake. The releases during the Chernobyl accident contaminated about 125 000 km² of land in Belarus, Ukraine and Russia with radiocaesium levels greater than 37 kBq/m², and about 30 000 km² with radiostrontium greater than 10 kBq/m². About 52 000 km² of this total were in agricultural use; the remainder was forest, water bodies and urban centres (Ri95)... In Ukraine, 8.4 million hectares of agricultural soil are contaminated with 137Cs, and are subject to countermeasures, mostly the use of fertilisers:

- The 54 900 hectares in the exclusion zone and the 35 600 ha contaminated with more than 555 kBq/m² are exclude from agricultural farming.
- 130 800 ha are contaminated between 185 and 555 KBq/m², including 15 000 ha of peat bog where the transfer of caesium to plants is the highest.
- 1.1 million ha contaminated between 37 and 185 kBq/m², including 99 500 ha of peat bog.
- 7 238 millions ha contaminated between 3.7 and 37 kBq/m². An exclusion zone of about 4 000 km² has been defined, including a circular area with a radius of 30 km around the reactor. The areas affected are 2 100 km² in Belarus, 2 040 km² in Ukraine and 170 km² in the Russian Federation. All agricultural activities are forbidden, as is transfer of products. In early 2001, 2 217 cities are still under radiological control in the Ukraine. In fact, only 1 316 need permanent controls. At present drinking water is not a problem. Contamination of groundwater, especially with 90Sr, could be a problem for the future in the catchment basins downstream of the Chernobyl area.
- Contaminated fish from lakes may be a long-term problem in some countries.

TORCH
Extensive surveying of Chernobyl’s caesium-137 contamination was carried out in the 1990s under the auspices of the European Commission. The results indicate that about 3,900,000 km² of Europe was contaminated by caesium-137 (above 4,000 Bq/m²) which is 40% of the surface area of Europe.

Curiously, this latter figure does not appear to have been published and, certainly has never reached the public’s consciousness in Europe.

Of the total contaminated area, 218,000 km² or about 2.3% of Europe’s surface area has been contaminated to higher levels (greater than 40,000 Bq/m² caesium-137). This is the area cited by IAEA/WHO and UNSCEAR, which shows that they have been remarkably selective in their reporting.
In Germany, caesium-137 levels in wild boar muscle reached 40,000 Bq/kg. The average level is 6,800 Bq/kg, more than ten times the EU limit of 600 Bq/kg. The European Commission does not expect any change soon. It has stated7: “The restrictions on certain foodstuffs from certain Member States must therefore continue to be maintained for many years to come.” (emphases added)

http://tinyurl.com/pcy2n4u

UK radiation scientists Dr Ian Fairlie and Dr David Sumner estimate 30,000 to 60,000 deaths.10 Dr Fairlie notes that statements by UNSCEAR indicate that it believes the whole body collective dose across Europe from Chernobyl was 320,000 to 480,000 Sv, from which an estimate of 32,000 to 48,000 fatal cancers can be deduced (using the LNT risk estimate of 0.10).11

UN reports in 2005-06 estimated up to 4,000 eventual deaths among the higher-exposed Chernobyl populations (emergency workers from 1986–1987, evacuees and residents of the most contaminated areas) and an additional 5,000 deaths among populations exposed to lower doses in Belarus, the Russian Federation and Ukraine.7

The estimated death toll rises further when populations beyond those three countries are included. For example, a study by Cardis et al reported in the

International Journal of Cancer estimates 16,000 deaths.8 Dr Elisabeth Cardis, head of the Radiation Group at the World Health Organization's International Agency for Research on Cancer, said: "By 2065 (i.e. in the eighty years following the accident), predictions based on these models indicate that about 16,000 cases of thyroid cancer and 25,000 cases of other cancers may be expected due to radiation from the accident and that about 16,000 deaths from these cancers may occur. About two-thirds of the thyroid cancer cases and at least one half of the other cancers are expected to occur in Belarus, Ukraine and the most contaminated territories of the Russian Federation."9

http://tinyurl.com/nqeij492

Three months after the Chernobyl disaster, Gofman predicted that Chernobyl would cause "475,000 fatal cancers plus about an equal number of additional non-fatal cases, occurring over time both inside and outside the ex-Soviet Union".25 In contrast, even some 19 years later in September 2005, an official UN IAEA report claimed 4,000 deaths as the final estimated toll from Chernobyl.26 In their 2006 book Alexey V. Yablokov and other Russian and East European researchers estimated that Chernobyl caused a million deaths through 2004, nearly 170,000 of them in North America. The book's English translation Chernobyl: Consequences of the Catastrophe for People and the Environment was published by the New York Academy of Sciences in 2009. The book cites "5,000 mainly Slavic-language scientific papers the IAEA overlooked",27
As early as 1970, Gofman predicted that ionizing radiation, which can break chromosomes--causing deletions, translocations and double strand DNA breaks--would cause increased suffering from fatal diseases and birth defects from that chromosome damage, in the exposed population. (See his 1992 paper at [www.ratical.org/radiation/CNR/RICI.html](http://www.ratical.org/radiation/CNR/RICI.html).)

Gofman’s 1981 Radiation and Human Health (pp. 788-791) indicates that ionizing radiation causes 6 to 100 times more heart disease, cancer, diabetes, anaemia, schizophrenia, ulcers and many other killers (referred to as “Irregularly Inherited Diseases”) than assumed by the self-appointed radiation committees. His 1993 paper, “Asleep at the Wheel” ([www.ratical.org/radiation/CNR/Asleep@Wheel.html](http://www.ratical.org/radiation/CNR/Asleep@Wheel.html)), explains how the Hiroshima and Nagasaki follow-up studies were not designed to find genetic health effects in future generations. Thus, claims of no genetic effects from radiation are not valid.

CHERNOBYL RISKS AND ROUTINE RELEASES UNACCEPTABLE: Gofman calculated that there would be in the range of 1,000,000 cancers caused from the cesium-137 released from the Chernobyl nuclear power reactor meltdown in 1986. This is not counting other health effects or exposure to other radioactivity also released.

He then calculated that without an accident, with 99.9% containment, 4 times as much cesium-137 is routinely released from 100 (1000 megawatt) nuclear reactors operating for 25 years. He said, “This assault on human health could occur without blowing the roof off any single plant.” Now that’s something to consider as new reactors are proposed.

Stanford Colin Wessel

During the Chernobyl explosion, about 27 kg of cesium-137 were expelled into the atmosphere. [2] After the rapid decay of iodine-131, cesium-137 was the predominant source of radiation in fallout from the Chernobyl explosion. Particles of the reactor fuel settled densely within about 100 km of their release, and within a 30 km radius of the facility, cesium radioactivity due to ground deposition of fallout particles was over $1.5 \times 10^6$ Bq/m$^2$. [2] Fallout hotspots to the northeast in Belarus, much farther from the disaster site, were found to have cesium-137 radioactivities of up to $5 \times 10^6$ Bq/m$^2$. In comparison, measurements in southern Sweden, several hundred kilometers northwest (and upwind) of the disaster found that the ground surface radioactivity due to cesium-137 was only $8 \times 10^4$Bq/m$^2$ and total radiation doses peaked at only about twice the typical background rate. [7] In 2002, sixteen years (about one half of a cesium 137 half life) after the Chernobyl disaster, a 4,000 km$^2$ area still contained too much cesium-137 to be inhabited or used for agricultural purposes. [2] Much of this area must remain unpopulated for decades to come, until several more half-lives of the released cesium-137 have elapsed.

Less than two grams of Cesium-137, a piece smaller than an American dime, if made into microparticles and evenly distributed as a radioactive gas over an area of one square mile,
will turn that square mile into an uninhabitable radioactive exclusion zone. Central Park in New York City (315 Hectares) can be made uninhabitable by 2 grams of microparticles of Cesium-137. Hard to believe, isn’t it?

Remember, these nuclear poisons are lethal at the atomic level. There are as many atoms in one gram of Cesium-137 as there are grains of sand in all the beaches of the world. That’s 1021 atoms—10 to the 21st power. 1480 trillion of them or 1.48 times 10 to the 12th power are disintegrating every second, releasing invisible nuclear energy. So this works out to about one and a half million disintegrations per second per square meter.

4500 square miles (or earlier today we heard 7700 square miles)—which is an area larger than the size of Connecticut—was found to have radiation levels that exceeded Japan’s previously allowable exposure rate of 1 millisievert per year.

Rather than evacuate this area, Japan chose to raise its acceptable radiation-exposure rate by 20 times, from 1 millisievert to 20 millisieverts per year.

World Health Organisation—WHO It is important to recognise that the WHO does much good work in many fields. However we should also be aware of the fact that:

The World Health Organization cannot make any comment or decision regarding nuclear energy without deferring to the International Atomic Energy Agency which actively promotes nuclear power. On Friday, Dr. Alexey Yablokov, a Russian expert on Chernobyl, referred to this conflict in pointing out why his book -- which found likely one million deaths as a result of the Chernobyl accident -- has been met with silence by agencies like the WHO.

As Oliver Tickell wrote in The Guardian: the 1959 agreement gave "the IAEA an effective veto on any actions by the WHO that relate in any way to nuclear power -- and so prevent the WHO from playing its proper role in investigating and warning of the dangers of nuclear radiation on human health." The WHO vigil is now entering its 204th consecutive week.

"The subordination of the WHO to IAEA is a key part of the systematic falsification of nuclear risk which has been under way ever since Hiroshima, the agreement creates an unacceptable conflict of interest in which the UN organisation concerned with promoting our health has been made subservient to those whose main interest is the expansion of nuclear power. Dissolving the WHO-IAEA agreement is a necessary first step to restoring the WHO's independence to research the true health impacts of ionising radiation and publish its findings." Some birthdays deserve celebration – but not this one. After five decades, it is time the WHO regained the freedom to impart independent, objective advice on the health risks of radiation.

http://www.guardian.co.uk/commentisfree/2009/may/28/who-nuclear-power-chernobyl/print
From The Conversation

Shirley Birney

The World Health Organisation (WHO) and the International Atomic Energy Agency (IAEA) signed the Agreement “WHA 12-40” on 28th May 1959.

"The International Atomic Energy Agency and the World Health Organization recognize that they may find it necessary to apply certain limitations for the safeguarding of confidential information furnished to them …

Paul Richards from The Conversation explains it thus

'The UN agencies are saying what they believe to be true, about Chernobyl... As these groups respect the nuclear chain of command function. Just as those above them all governments within the UN have also respected the same hierarchical command since the Security Council first ruled on nuclear issues officially from 24/10/1945. So once again to be perfectly clear all the information disseminated about nuclear issues is framed by the UN Security Council and made available to the 71 groups in your list. This is in plain sight, as it is how national and international nuclear issues are dealt with. What many people supporting the nuclear industry are wilfully blind to is; the whole industry has been militarized and all information on nuclear issues are vetted by - the People's Republic of China, France, the Russian Federation, the United Kingdom and the United States.

It is important to be mindful all the information used in support of the nuclear industry has been vetted by the Security council since 1945. Ergo; all scientific references to industrial, medical, and weapons nuclear activity has been influenced by the Security Council since 1945.

Pre 1940 we had a certain amount of radioactive material in the biosphere. Then we started digging it up, milling it, refining it and dispersing it far and wide with nuclear weapons, reactors, accidents and leakages through the biosphere and the food chain. It defies logic that there could not be significantly more radioactive material in the biosphere than there was pre 1940.

From: Radiation Therapy for Cancer Item (9)

Some types of systemic radiation therapy may temporarily make a patient's bodily fluids (such as saliva, urine, sweat, or stool) emit a low level of radiation. Patients receiving systemic radiation therapy may need to limit their contact with other people during this time, and especially avoid contact with children younger than 18 and pregnant women.

http://tinyurl.com/no6hf39

The very reason the medical profession use radiotherapy and radioactive chemotherapy to kill cancer is because radiation is so very, very good at killing and maiming living cells, indeed it is the big gun in the Oncologists arsenal. They want the killing but not the maiming and go to extraordinary lengths to very specifically target cancer tumours and avoid maiming healthy cells which damage could itself create further tumours.

Some people think that the inhalation or ingestion of radioactive material is no more dangerous than having an X ray. The difference is that the X ray is switched off after a few seconds whereas if you inhale or ingest radioactive material you are stuck with it and your cells continue to receive radiation for months and years on an ongoing basis until the radioactive material leaves your body or decays away. Plutonium has a biological half life of 200 years and a physical half life of 24,000 years. Once inside you it will never stop irradiating your cells and tissue.
Some training texts call it a biological damage conversion factor but what it truly represents is the ratio of biological damage done by radiation types to the biological damage done by gamma radiation. For gamma, x-ray and beta radiation, this factor is 1. For alpha, it is 20. What this implies is that a rad or Gray of alpha energy absorbed by soft human tissue does 20 times more damage than a rad or Gray of gamma, x-ray or beta energy absorbed.

Rad Pro Calc [www.radprocalculator.com/FAQ.aspx](http://www.radprocalculator.com/FAQ.aspx)

Alpha decay, the release of a high-energy helium nucleus, is the most common form of radioactive decay for plutonium. A 5 kg mass of $^{239}$Pu contains about $12.5 \times 10^{24}$ atoms. With a half-life of 24,100 years, about $11.5 \times 10^{12}$ of its atoms decay each second by emitting a 5.157 MeV alpha particle. This amounts to 9.68 watts of power. Heat produced by the deceleration of these alpha particles makes it warm to the touch.

Los Alamos Science Number 26 2000

At Los Alamos, some 100 men and women work with plutonium routinely. Tunneled out of a nucleus with a kinetic energy of about 5 million electron volts (MeV), the alpha particles from plutonium-$^{239}$ move at a speed of about $1.5 \times 10^7$ meters per second (5 percent of the speed of light).--- they collide with molecules, break those molecules apart through electrical forces, and leave a trail of ion pairs in their wake. In air, alphas travel only 3 to 5 centimeters and in living tissue only about 30 micrometers (which is equal to 3 to 5 cell diameters) before they expend their energy and come to rest.

Radiation primarily affects systems that contain rapidly dividing cells, such as the blood-forming system (whose cells originate from the bone marrow) or the gastrointestinal system (the cells that line the small intestine). It also affects the central nervous system. For example, bone-marrow stem cells can die when they are irradiated. Their death diminishes or stops the resupply of circulating red and white blood cells and other blood constituents. After about three weeks, the reduction in blood cell supply leads to immune deficiencies, infections, fever, bleeding, and even death unless the bone marrow starts to regenerate.

At lower doses, acute radiation effects become less noticeable, and below certain levels of exposure, effects cannot be predicted. It is at these low levels of exposure that stochastic, or probabilistic, effects become apparent. Cancer is best known among them. Ionizing radiation of any kind can lead to alterations of a living cell’s genetic makeup, and sometimes those alterations trigger the uncontrolled growth and multiplication of that cell’s progeny, more commonly known as cancer. Stochastic effects occur randomly and are assumed to have no threshold dose.

Plutonium Toxicity. It is important to remember that, because their power of penetration is limited, alpha emitters are hazardous to human health only when they have found their way into the body. When inhaled, ingested, or passed into the blood stream through a wound, plutonium deposits in the lung, liver, or bones. Only about 10 percent of it is distributed to other organs. The plutonium atoms remain in the body for many decades, a fraction of them emitting alpha ionizing radiation and damaging the surrounding cells. The long radioactive half-lives of the plutonium isotopes and the amounts retained in the body make plutonium a long-term source of radiation to nearby cells and thus a biological hazard.
No humans have ever died from acute toxicity due to plutonium uptake. Nevertheless, lethal doses have been estimated from research on dogs, rats, and mice. Animal studies indicate that a few milligrams of plutonium per kilogram of tissue is a lethal dose. For example, the LD50(30) for dogs after intravenous injection of plutonium is about 0.32 milligram per kilogram of tissue. Assuming this animal dose also applies to humans, an LD50(30) by intravenous injection for an average human of 70 kilograms would be about 22 milligrams.

(And .96 milligrams for a 3Kg baby. A speck of dust so small it is invisible to the naked eye)

Pharmaceutical companies are obliged to do extensive testing of their new drugs before releasing them on the market and then they are only given to an individual with a demonstrable need for them on the recommendation of a qualified and registered Medical Doctor and WITH THE CONSENT of the patient.

What right does the nuclear industry have to administer doses of carcinogenic radioactive materials by a shotgun approach as opposed to carefully targeted medical treatment to all life forms including homo-saps not only to current generations but to future generations as well without their specific consent?

In 2012 there were 18,560 cases of prostate cancer and 14,560 cases of breast cancer in Australia. (to name but two).

As there were so many cases is it ok if the numbers were increased by 10% due to anthropogenic releases of radioactive materials into the biosphere past and present? Is it ok if our national health care budget for radiation induced disease increases by a minimum of 10%?

For society to go nuclear or not based on economic factors alone would at very least constitute reckless endangerment. It would be saying that we are going to have nuclear power at any societal cost. Those homosapiens (and other life forms) who are not equipped with 1st class DNA repair mechanisms and succumb to increased doses of anthropogenic radiation are obviously untermench and deserve to be culled from the species. Now I can’t speak for others but my father’s generation fought a long hard bitter war to stop another bloke who had the same idea and attitude.

UNSCEAR
Background Radiation

Re UNSCEAR wiki
In about 2009 I looked up Background Radiation on Wiki. From memory it stated that background radiation from nuclear testing was 10% of the total. It also stated that background radiation was a total of 18% higher than before the nuclear age. The additional 8% coming from industrial and medical uses and accidents and leaks. Now since then the whole Wiki article has been re-written. Imagine my surprise when I opened and read the new un-verified article.

The figure .005 millisievert for atmospheric nuclear testing is the average for the whole world’s surface area. Now, land surface area where people and land animals live is 30% of total surface area. In addition, entire continents such as Antarctica, S. America and Africa + the Arctic received relatively small amounts of the fallout. The same cannot be said for N. America, Asia and Australia.

Secondly, in a nuclear weapon only about 30% of the fissile material Pu239 or U235 actually fissions. The other 70% (un-fissioned and enriched) goes into the biosphere + fission products such as I 129, Cs 137, Sr 90 etc. The vast bulk of the fallout from atmospheric testing is dispersed over an area of some tens of thousands of sq. Kilo meters on the land area of the US, former USSR and Australia. If
you scroll down the page on the wiki link background radiation by UNSCEAR you will find a map showing fallout over the US from their tests.

The continental US had 119,008 Ktons of bombs dropped on it. Japan had a miniscule 32Ktons dropped on it but it still has a measurable .01ms. See what I mean about cover-ups and not telling the whole truth or is that info protected by the official secrets act. Why should anybody trust the so-called experts on matters nuclear? There are still many tons of Plutonium and Uranium+ radioactive fission products in the biosphere. The background radiation from atmospheric nuclear testing in Japan is shown as .01mS. No figure is given for the US. Why?

*I do not believe that the un-fissioned 70% has been collected up by the fairies and taken off planet.*

So I don’t accept UNSCEAR’s statement as being of any relevance at all. Another propaganda exercise in misinformation.

Natural background radiation over the whole planet is not comparable with total radiation over the Fukushima exclusion zone (20 Km radius) 628 sq km of land or Chernobyl 2826 sq Km. Exposure to X rays is for a few seconds and they are external X rays which is not the same as alpha emitting particles ingested or inhaled.

http://tinyurl.com/ohxdwpz

Risk.
Risk of injury to people and the whole animal kingdom needs to be clearly understood. A 60 year old person has lived ¾ or 75% of their life. If exposed to low level ionising radiation, most particularly internal radiation from inhalation or ingestion it could take 15 to 20 years for them to develop cancer or leukaemia and a further 5 years to kill them by which time they would normally and on average be past their use by date or average life expectancy. A 40 year old person will have lived half their lives and as their cells are now dividing and replicating much more slowly it may take 15 years for them to develop cancer or leukaemia and a further 5 years to kill them. They will have lost a not insignificant 25% of their life. A 20 year old in the prime of life could have cancer or leukaemia at 30 and be dead at 35. They will have lost a significant 45 years or 56% of their life. Furthermore as the 20 to 40 year old period is the prime time for reproduction they could have passed on genetic deformities to genes and chromosomes caused by ionising radiation to their children who in turn could lose some of their life expectancy as well as themselves suffering from congenital heart, circulatory or other disease such as cancer or leukaemia. As 10 year old children are 10 times more vulnerable to chromosomal and genetic damage from ionising radiation there suffering and life expectancy will be even more severely impacted. Embryos are 50 times more vulnerable to chromosomal and genetic damage than adults as shown earlier.

Dr John Gofman

ii. By any reasonable standard of proof, the combination of human epidemiology and track-analysis demonstrates that there is no threshold dose or dose-rate below which "repair" invariably prevents *health* harm.
**Conclusion:** It is factually wrong to believe or to claim that no harm has ever been proven from very low-dose radiation. On the contrary. Existing human evidence shows cancer-induction by radiation at and near the lowest possible dose and dose-rate with respect to cell-nuclei. By any reasonable standard of scientific proof, such evidence demonstrates that there is no safe dose or dose-rate below which dangers disappear. No threshold-dose. Serious, lethal effects from minimal radiation doses are not "hypothetical," "just theoretical," or "imaginary." They are real.

"It is highly unlikely that a dose threshold exists for the initial molecular damage to DNA, because a single track from any ionizing radiation has a finite probability of producing a sizable cluster of atomic damage directly in or near, the DNA. Only if the resulting molecular damage, plus any additional associated damage from the same track, were always repaired with total efficiency could there be any possibility of a dose threshold for consequent cellular effects."

UNSCER 1993 Report, p.636, para.84.

http://tinyurl.com/pplgern

Prof Brian Cox demonstrates very well in episode 3 of Wonders of Life in a cloud chamber. 30 min in http://tinyurl.com/nok65ns

Adelaide University

3.30 RADIATION SAFETY MANAGEMENT : GENERAL RADIATION INFORMATION

Downloaded on 27.2.15

Under medical effects states:
- **Deterministic effects**

  The severity of the effect increases with the dose and there is a threshold dose below which no detrimental effects are seen. These are produced by relatively high doses.

So, they reject the widely accepted Linear No Threshold LNT model which has been used and accepted for decades and the UNSCEAR report of 1993 (above). What research have they done and over what period of time to prove that Dr John Gofman was wrong? It is way too easy to not look properly and then say “no observed effect”

**Dose Limits**

- **Pregnant Workers** 1 mSv per year = 0.75 mSv during pregnancy

  Most women will not know they are pregnant for 3 to 4 weeks after conception. So the time at which the embryo is the most vulnerable (50 times more so than an adult) it may be legally exposed to the full adult dose for a worker of 20mSv! What effects will higher doses have on the embryo or foetus?

**Equivalent Dose**
Different kinds of radiation have different biological effects. Neutrons cause 10 to 20 times as much damage per Gray as 1 MeV gammas.

**Radiation Weighting Factor $w_R$**

This depends on the radiation, and is 1 for $\beta$ and $\gamma$ radiation and X-rays, and larger (10) for neutrons.

Why is this not (20)? From Radpro calculator above:
For alpha, it is 20 What this implies is that a rad or Gray of alpha energy absorbed by soft human tissue does 20 times more damage than a rad or Gray of gamma, x-ray or beta energy absorbed.(in an adult)

**Cooling**

High Level Waste will in all likelihood require cooling. Where will the water for this come from? How much energy will be required to pump the water to site? What is the risk of cooling water being contaminated? How will cooling water be disposed of?

**Insurance**

Who is going to insure the operators and owners of such management, storage and disposal facility?

Will the insurance have uncapped or unlimited liability?

Who will pick up any costs in excess of the insured amount? Will it be the State of South Australia ie the taxpayers of S. Australia or will it be the Federal government ie the tax payers of Australia?

Who will pay for any and all medical costs of injured or contaminated people and livestock in the event of accidental or other escape of radioactive materials in to the populace and environment?

Who will pay for cleanup costs and compensation to land holders and fishers whose livelihood may be damaged or destroyed?

The Exxon Valdeze, BP, Mayak, Doenray and Rockey flats accidents are cases in point.

Furthermore we in Australia have form on the matter of compensation.

Right now in Australia there are people dying from cancer induced by the Montebello and Maralinga nuclear tests. Of the 103 officers and men aboard HMAS Fremantle 70% died before the age of 60. The fallout was blown by the wind over much of Australia. How many more adverse health effects did this cause? We will never know because no records were kept. If the authorities do know, it is protected by the official secrets act as it is in all nuclear armed states and most if not all states that have a nuclear industry.

Some 21,000 bone samples were collected in S. Australia from cadavers in the 60 and 70’s after the Maralinga test to be assessed for Strontium 90 and other radionuclides . Why can the public not access the results?

The US has paid compensation to it’s nuclear veterans and “down-winders” and Uranium miners, millers and transporters. (Now over $11 Billion) We still have not compensated our nuclear veterans from the Montebello or Maralinga tests!
Payment for management, storage and disposal.

Let us presume that 7 years ago a country like Greece entered into an arrangement with us to manage, store and dispose of their nuclear waste from power reactors and that we have received a few shipments from their stockpile. Do we seriously expect that they would close a school or a hospital ward so as to pay us our annual fee? More likely they would send us an IOU!

OR perhaps it was an arrangement with a public or private company. After the Fukushima accident the question of compensation was raised.

Tepco, the owners of Fukushima were quick to state that if they had to pay compensation they would have to declare bankruptcy. The result is that the Japanese tax payers have so far paid up US$ 105 Billion!

How long would such undertakings and contracts be for? Fission products need safe storage for at least 300 years. Plutonium needs safe storage for 240,000 years.

How could we enforce an obligation of payment? Can we get blood out of a stone?

It is after all pointless to make or have a law that you cannot enforce.

By Ivan Quail