

# FOREVER DEADLY RADIOACTIVE WASTES

Submission to the Parliamentary Inquiry into nuclear power generation in Australia.

by Kenneth N Higgs.

*" it would be irresponsible and morally wrong to commit future generations to the consequences of fission power on a massive scale unless it has been demonstrated beyond reasonable doubt that at least one method exists for the safe isolation of these wastes for the indefinite future".*

*(Sir Brian Flowers, UK Royal Commission, 1976) <sup>i</sup>*

## HUNDREDS OF SYNTHETIC RADIOISOTOPES.

Nuclear reactors use "nuclear fission" to boil water, to drive a steam turbine, to generate electricity.

Fission involves bombarding Uranium-235 atoms with neutrons, causing them to split into lighter "fission products", releasing intense heat energy to drive the steam turbine.

The uranium fuel inside a nuclear reactor contains a mix of "fissile" Uranium-235 and non-fissile Uranium-238. When a Uranium-235 atom is hit by a neutron, it can split into unstable "radioactive isotopes" (radioisotopes) like Strontium-90 and Caesium-137, as well as releasing 2 or 3 more neutrons. Nuclear fission generates more than 200 different synthetic radioisotopes that normally don't exist in nature.

When Uranium-238 is hit by neutrons, it "captures" 1 or 2 and absorbs them into its nucleus. This reaction gives rise to heavier radioisotopes called "actinides", such as Neptunium-239 and Plutonium-239. Most of these actinides never existed before in nature.

Uranium fuel, fission products and actinides are unstable "radionuclides" which continually disintegrate and radiate atomic energy in the form of gamma rays, alpha particles, beta particles and neutrons, as they gradually decay and transmute into other elements. Generally, radionuclides take 10 to 20 "half-lives" to transmute entirely into another element.

Some radionuclides have very short half-lives of seconds or hours; but many have much longer half-lives of years, centuries or millennia. All radionuclides emit hazardous radioactivity until they finally transmute into stable non-radioactive isotopes such as Lead 208 or Thallium 205.

Gamma radiation from short-lived fission products in spent nuclear fuel (SNF) decreases over the first 500 to 1,000 years. However, long-lived radioisotopes, especially actinides, remain very toxic and poisonous to humans, if absorbed, inhaled or ingested.

## THE REAL PRODUCT IS LONG TERM WASTE.

Thus, long after a nuclear reactor is shutdown and electricity generation ceases, the resulting highly irradiated SNF waste will remain lethal to humans and all life for several millennia.

Almost fifty years ago, the Flowers Report on "Nuclear Power and the Environment" dispelled any notion that the nuclear industry was "clean" or "non-polluting". Their 1976 Royal Commission report noted that:

"The highly active waste which arises from fuel reprocessing contains the fission products and actinides created by nuclear fission. The waste must be isolated until the various radioisotopes have decayed to insignificant levels. For the fission products this requires a period of perhaps a thousand years, but some of the actinides have half-lives of thousands or tens of thousands of years or longer. ...

"We must assume that these wastes will remain dangerous, and will need to be isolated from the biosphere, for hundreds of thousands of years." (*Flowers, p80 / para 178*)

The longevity of spent nuclear fuel (SNF) was confirmed in 2008 by the United States Environmental Protection Authority, which recognised that SNF waste would last one million years. <sup>ii</sup>

## INTERGENERATIONAL EQUITY

Surely it is a violation of intergenerational equity to be building and operating nuclear plants and creating thousands of tonnes of forever hazardous radioactive waste?

These long-lived radioactive wastes will be a dangerous and costly burden on 300,000 future generations of our children. Yet they did not consent to it, and nor will they receive any "benefit" from reactors, which will shutdown after only 2 or 3 human generations.

Obviously, this is not morally acceptable. "It would be irresponsible and morally wrong" (*Flowers, p81, para 181*).

## DANGER TO HUMAN HEALTH AND SAFETY

Humans cannot see, feel, taste, smell or hear ionizing radiation, yet it is very hazardous to human health and safety. If ingested, inhaled or absorbed through our skin, radionuclides can cause harm as they travel through our cells, tissues, and organs. The radiation tears apart DNA molecules, rips away electrons from atoms inside your cells, and disrupts cell structures, causing mutations and disease.

Fallout or leakages from nuclear plants can scatter hazardous radionuclides into the air, water, soil, plants, milk, fish, and other food sources. This can lead to people receiving dangerous internal exposures to carcinogenic radiation, as they inhale or ingest radionuclides like Strontium-90, Iodine-131, Caesium-137, Carbon-14 and Tritium.

Strontium-90 replaces the body's stable calcium and lodges permanently in bones and teeth, where it continually irradiates surrounding tissue for many years, leading to bone cancer and leukaemia.

Iodine-131 replaces stable iodine and concentrates in thyroid glands and lymphatic systems, leading to thyroid cancer and other problems.

Caesium-137 replaces the body's stable potassium, lodges in muscles and continually irradiates nearby tissues and organs, leading to various cancers and cardiovascular problems.

Carbon-14 replaces stable carbon in various chemical compounds absorbed by a person's body, exposing cells and organs to damaging radiation energy. It could be responsible for gross physical or mental defects, stillbirths and childhood deaths, embryonic and neonatal deaths, leukemia, bone and other cancers.

Tritium is radioactive hydrogen ( $^3\text{H}$ ) which replaces stable hydrogen in drinking water and numerous other chemical compounds. Tritium increases the risk of cancer if taken into the body by inhalation, skin absorption, ingestion of tritiated water, or ingestion of contaminated fish and seafood.

## RADIOACTIVE RELEASES FROM NUCLEAR PLANTS

The radioactive waste and discharges from nuclear plants are especially hazardous. If unshielded, irradiated nuclear fuel just removed from a reactor core could deliver a lethal dose of beta, gamma and neutron radiation to a person standing 1 metre away in just seconds. Even after decades of radioactive decay, a few minutes unshielded exposure time would be enough to deliver a lethal dose.

There is the added danger that fissile materials still present in highly radioactive wastes will form a "critical mass," causing an inadvertent nuclear chain reaction that could radiate a deadly beam of neutrons and possibly even generate enough heat to melt through the storage container.

The British Medical Journal reported in 2022: "Anecdotal evidence within communities around nuclear facilities suggests an association between radiation exposure and increases in birth defects, miscarriages and childhood cancers." <sup>iii</sup>

"Children, women and particularly pregnant women living near nuclear production facilities appear to be at disproportionately higher risk of harm from exposure to these (radiation) releases."

"Nuclear power plants routinely release radioactivity as part of daily operation. In 2008, a landmark case-control study was published in Germany, known as the KiKK study."

"It revealed an unsettling 1.6-fold increase in all cancers and a 2.2-fold increase in leukaemias among children under 5years old living within 5km of operating nuclear power plants."

"In general, the incidences were higher the closer the children lived to the nuclear plant. The KiKK findings were backed up by other studies and a meta-analysis."

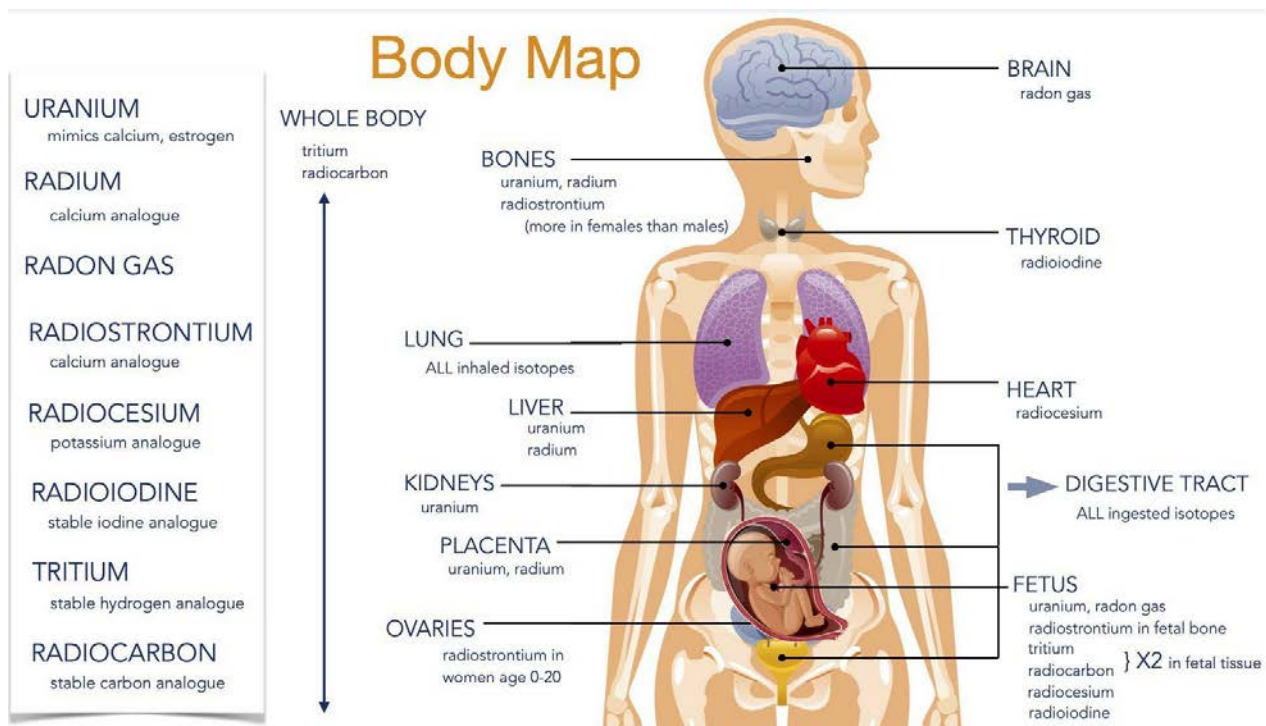


Figure 1 - Selected radioisotopes: where they travel and primarily collect in the body.

(Image courtesy of British Medical Journal <sup>iv</sup>)

## NO PROVEN SAFE LONG-TERM STORAGE

The global inventory of nuclear waste is likely more than 400,000 tonnes of SNF waste, plus a few million tonnes of other activated materials from dismantled nuclear facilities, including pipes, cables, concrete and steel structures, fluids, clothing and so on. The entire nuclear plant eventually becomes contaminated by neutron leakage and neutron bombardment.

We cannot just toss all these hazardous radioactive waste materials down a deep hole and forget about them. Nuclear wastes must be responsibly managed and securely stored for at least a million years, as noted above. Regular oversight is necessary to check for any disruption, interference or leakage from nuclear waste caskets.

NO ONE CAN GUARANTEE that there will never be:

- accidents;
- earthquakes;
- groundwater seepage;
- corrosion or cracking of waste containers;
- criminal or sanctioned theft and interference;
- wars and insurrection;
- terrorist or criminal attacks,
- or accidental interference by uninformed intruders.

There is no known geology anywhere in the world guaranteed to safely isolate hazardous radioactive waste for a million years. Furthermore, excavation and construction of any geological repository will disturb the surrounding rocks and geological strata and water tables, opening up cracks and fissures which then allow radioactive gases and liquids to seep out and contaminate nearby waterways, ground and air. Underground salt layers can also react with underground water and air, leading to oxidation and corrosion of steel cladding and other metals.

## ESCALATING NUCLEAR WASTE COSTS

Storage and management of 20th century nuclear reactor waste is already enormously expensive and will only get worse the longer nuclear reactors are allowed to operate. Any nuclear power reactors built in Australia would also incur exorbitant nuclear waste management costs, not unlike the costs burden experienced overseas.

In the UK, the cost of decommissioning and clean-up of radioactive waste is forecast to grow to £260 billion (AU \$501 billion).<sup>v</sup>

In the USA, the Department of Energy (DOE) holds a massive 91,000 tonnes of SNF and reprocessing waste, stored on-site at both operating and closed nuclear power plants. They have already spent over US \$215 billion (AU \$326 billion) since 1989 to clean up hazardous and radioactive waste. The remaining work is estimated to cost about US \$675 billion (AU \$1,025 billion) more. <sup>vi</sup>

In Canada, the Nuclear Waste Management Organisation (NWMO) reports that Canada has 3.3 million spent nuclear fuel bundles (62,830 tonnes), projected to be 5.6 million bundles (106,900 tonnes) by 2050. NWMO expects that the cumulative cost of storage and management of Canada's nuclear waste will be more CA \$26 billion (AU \$29 billion). <sup>vii</sup>

How much will taxpayers have to pay to store and manage Mr Dutton's nuclear waste?

## CONCLUSION

Nuclear fission is a complicated and dangerous way to boil water for generating electricity.

Every nuclear reactor is a repository of the most pernicious industrial waste ever known; waste so radioactive that it spontaneously melts down if not continually cooled; waste that, when targeted by terrorists or saboteurs, or by conventional warfare, will render large portions of the earth uninhabitable for centuries; waste that contains material that can be used as a nuclear explosive at any time in the future, for thousands of years to come.

Half a century ago, various governments and the nuclear industry already knew about the dangers and longevity of nuclear waste. Almost fifty years later, in 2024, there is still no proven safe site anywhere on Earth for the long-term secure storage of "the fission products and actinides created by nuclear fission".

Consequently, every nuclear plant becomes a de-facto radioactive waste dump:

(i) because the irradiated spent nuclear fuel is searing hot and too dangerous to move for at least 30 years after it is removed from reactor core; and

(ii) because there is no other secure repository for permanent long-term storage.

Australia does not need such hazardous, risky, expensive radioactive-waste-generating nuclear plants. Our country has far safer, better, renewable energy sources which are already contributing massive amounts of electricity into the national power grid.

## RECOMMENDATION

I strongly oppose any nuclear reactors or uranium enrichment or nuclear waste dumps in Australia.

I urge the Australian Parliament to reject nuclear power plants and to maintain the current prohibitions on nuclear-powered electricity production, as per the Environment Protection and Biodiversity Conservation Act 1999 (Cth) and the Australian Radiation Protection and Nuclear Safety Act 1998 (Cth).

Sincerely,

Kenneth N Higgs,

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## REFERENCES

<sup>i</sup> Flowers, Sir Brian (September 1976). Nuclear Power and the Environment (PDF) (6th ed.). London: Royal Commission on Environmental Pollution. p81, para181.  
<http://www.davidsmythe.org/nuclear/flowers%20commission%201976.pdf>

<sup>ii</sup> United States. Environmental Protection Agency. "40 CFR Part 197: Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada: Proposed Rule." Federal Register, v.73, no. 200, October 15, 2008, pages 61256-61287.  
<https://www.ecfr.gov/current/title-40/chapter-I/subchapter-F/part-197#197.13>

<sup>iii</sup> "Radioactive releases from the nuclear power sector and implications for child health" - British Medical Journal article by Cindy Folkers and Linda Pentz Gunter, 2022.  
<https://bmjpaedsopen.bmj.com/content/6/1/e001326>

<sup>iv</sup> Image courtesy of British Medical Journal - BMJ Paediatr Open. 2022 Oct 7;6(1):e001326. doi: 10.1136/bmjpo-2021-001326  
<https://pmc.ncbi.nlm.nih.gov/articles/PMC9557777/figure/F2/>

<sup>v</sup> Guardian article by Sandra Laville: "UK's nuclear waste cleanup operation could cost £260bn"  
<https://www.theguardian.com/environment/2022/sep/23/uk-nuclear-waste-cleanup-decommissioning-power-stations>

<sup>vi</sup> USA: General Accounting Office (GAO)  
<https://www.gao.gov/products/gao-24-105975>

<https://www.pnnl.gov/publications/spent-nuclear-fuel-and-reprocessing-waste-inventory-spent-fuel-and-waste-disposition>

<sup>vii</sup> Canada: Nuclear Waste Management Organisation (NWMO)  
<https://www.nwmo.ca/Who-we-are/Funding/Project-costs>

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