Nuclear For Climate Australia

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Submission to:

Victorian Parliament – Environment and Planning Committee

Inquiry into the Nuclear Activities (Prohibitions) Act 1983

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Health Impacts on Workers within the Nuclear Power Industry and Health Risks from Low Dose Radiation

This response provides references for the health impacts on workers operating nuclear power plants. Concerns regarding leukaemia in children living near nuclear power plants are also addressed. Throughout these references and in this document the measurement of radiation is the Sievert (Sv) or millisievert (mSv). Its impact upon us is shown in the following two images.

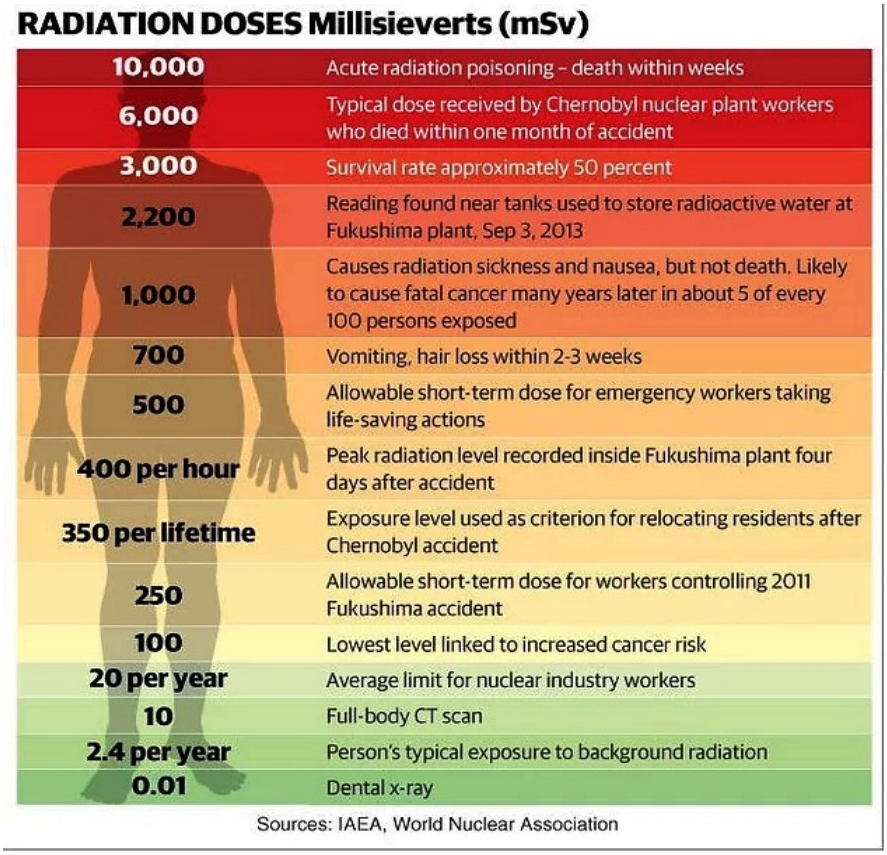

Figure 1 - Comparison of the effects of varying levels of ionising radiation in mSv

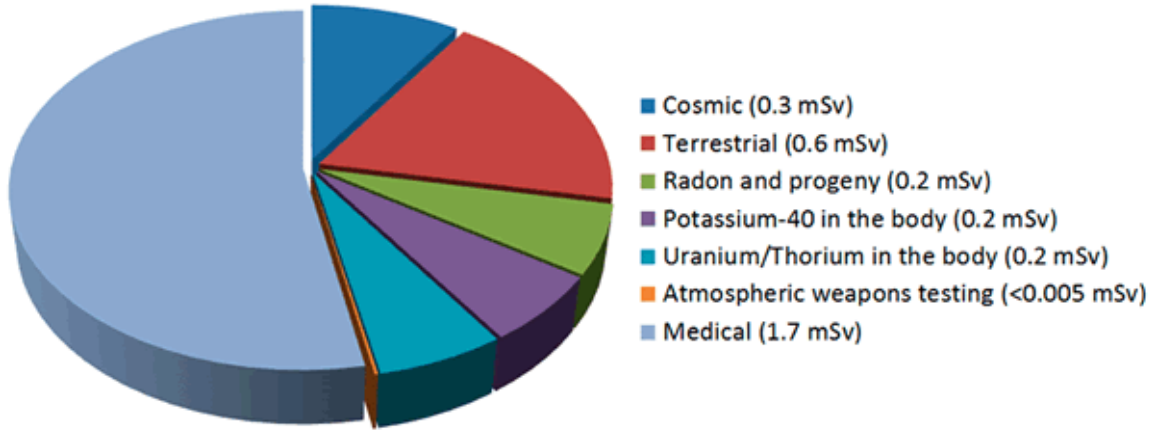

Figure 2 - Average background radiation dose per year in Australia 1.5mSv excluding medical.

1. No link between level of background radiation and rates of cancer

Life would have been impossible without protection of the genetic material by efficient systems. The species which have successfully evolved over the 3.5 billion years since life began are those which are successfully protected against cancer and dangerous mutations.

Life has developed in a bath of ultraviolet and ionizing radiation. It should therefore be expected that living organisms have particularly efficient systems within the dose range which was delivered during evolution (2–20 mSv/year). This reasoning does not attempt to argue in favour of a practical threshold but underlines that its existence could be a consequence of the logic of life.[1]

Possibly the strongest evidence supporting our ability to tolerate low dose radiation is the absence of health impacts to populations living in High Natural Background Radiation Areas (HNBRA). On average, Australians are exposed to about 1.5 mSv each year from natural sources[2]. Internationally some areas are much higher. Examples are[3] Yangjiang, China with average annual internal effective doses of 4.27mSv, parts of Kerala in India with 15mSv, Brazil with 3.5 to 15mSv and Ramsar in Iran with 2.4 to 71.74mSv. A number of epidemiological studies have been conducted to analyse the risk of cancer incidence in the world's HNBRAs. Most of these studies have concluded that there is no link between exposure to high background natural radiation and an increased rate of cancer or mortality.[3,4]

2. Current models for radiation dose response are challenged by many scientists

BEIR VII[5] is the latest reference from the National Research Council in the US which addresses the effects of exposure to low dose LET (Linear Energy Transfer) ionizing radiation on human health. It sets the policy for the US EPA and radiation guidelines for the nuclear industry. Central to its policy is that of the LNT model which holds that all radiation carries a risk in a linear proportion to its intensity – See Figure 3.

Many scientists are calling for a review of the Linear No Threshold (LNT) model. Levels of this support are shown in Table 1. In their publications many advocates such as Calabrese and

O'Connor[6], Sacks, Meyerson and Siegel[7,8], Cardarelli and Ulsh[9] and Tubiana, Aurengo, Averbeck and Masse[10] have outlined their cases in detail.

A variety of plausible dose-response models exist and are shown in Figure 3. The vertical axis shows risk to health with harm occurring above the horizontal axis and benefits existing below the axis.

These response models are:

1. A **Linear Threshold Model** where below a recognised Threshold dose of say, 100mSv no damage occurs or,
2. An **Hormesis Model** where benefits such as cancer protection and improved immune responses actually exist at low radiation levels – below the horizontal axis or,
3. **Supra-linear** and **linear quadratic** relationships exist which do not have significant support.

The initial data upon which the LNT concept was based was limited to a few studies of an acute nature[11] and at very high doses such as the high end of the atomic bomb survivors at the end of World War 11. In the fullness of time its been established that the Japanese survivors who received low doses of radiation had fewer cancers than unirradiated populations.[12]

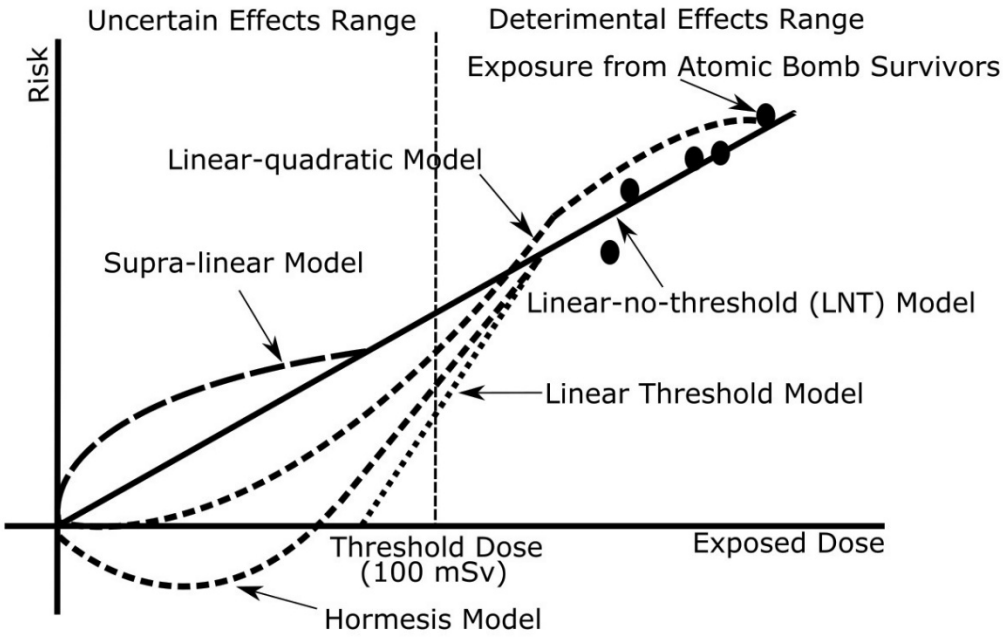

Figure 3 - Dose-response models to estimate the risk of low-dose radiation from medical imaging based on high-dose radiation exposure.[13]

Table 1 – Survey of Scientists Regarding the Most Accurate Radiation Dose–Response Model for Cancer.[14,15]

Surveys	Respondents	Percent Supporting LNT Model	Percent Supporting Threshold Model	Other
United States	National Labs	12	70	18[a]
	Union of Concerned Scientists	21	48	31[a]
Subscribers to Science	United States	19	75	6[b]
	Britain	21	71	8[b]
	France	18	70	13[b]
	Germany	22	64	13[b]
	Other European Union	23	69	8[b]

Abbreviation: LNT, Liner No-Threshold

[a] The "other" category includes "supralinear" and "don't know" responses.

[b] The "other" category includes "supralinear" responses.

3. No Impact on Nuclear Power Plant Workers from Low Level Radiation – in fact their health is probably improved.

3.1.France

A French study was carried out on 22,393 workers employed over a 42 year period at EDF's 58 nuclear power plants.[16] They received an average cumulative occupational dose of 21.5mSv. With an average age of 49 years, their background radiation from non-occupational sources would be approximately 2-4mSv/yr or 98-196mSv cumulative. This significantly dominates the workplace dose and calls into doubt the accuracy of studies which focus solely on the occupational dose.

The French study found no increase in death relative to radiation dose except for an excess of 2 deaths out of 22 linked to cerebrovascular disease. Relative risks of cancer for these nuclear workers was lower than the general population.

3.2.Canada

Review[17] by the Canadian Government's Nuclear Safety Commission has found approximately 42,200 Nuclear Energy Workers (NEWs) from Hydro-Québec, New Brunswick Power Corporation, Ontario Hydro, and AECL, first employed since 1965, had no increase in risk of solid cancer mortality due to their occupational radiation exposures.

3.3.INWORKS

The International Nuclear Workers Study (INWORKS)[18] study examined risks in worker cohorts from the United States, France, and the United Kingdom (a subset of the larger cohort

included in the 15-country study). It claimed analysis demonstrated a significant association between red bone marrow low dose radiation and the risk of leukaemia (excluding chronic lymphocytic leukaemia) and between colon dose and the risk of solid cancers.

It came under criticism from Cardarelli, Ulsh[9], Pennington, Sacks, Siegel and Meyerson[7,12], Calabrese and O'Connor[6] and Scott[19] for significant methodological errors including:

1. failure to account for natural background radiation exposure, the differences in which potentially dwarf the occupational exposures of the study cohort;
2. failure to account for medical exposures experienced by the public;
3. failure to account for dose–rate effects;
4. the a priori assumption of an LNT dose response;
5. mischaracterization of the y-intercept as 0 total dose when in fact it was 0 occupational dose;
6. arbitrary exclusion of all dose responses except LNT and linear-quadratic

3.4. Nuclear shipyard worker study (1980–1988): A large cohort exposed to low-dose-rate gamma radiation

The 1991 Final Report of the Nuclear Shipyard Worker Study (NSWS)[20] was a very comprehensive study of occupational radiation exposure in the US. The NSWS compared three cohorts: a high-dose cohort of 27,872 nuclear workers, a low dose cohort of 10,348 workers, and a control cohort of 32,510 unexposed shipyard workers. The cohorts were matched by ages and job categories. Although the NSWS was designed to search for adverse effects of occupational low dose-rate gamma radiation, few risks were found. The high-dose workers demonstrated significantly lower circulatory, respiratory, and all-cause mortality than did unexposed workers. Mortality from all cancers combined was also lower in the exposed cohort.

<u>The workers exposed to radiation had a 24% lower standardised mortality ratios (SMR) than the unexposed workers which implies a 2.8-year increase in average lifespan.</u>

4. No evidence that radiation causes childhood leukaemia clusters.

Mention is now made of Submission 34 received from the Medical Association for Prevention of War (Australia). Figure 1 in that report makes claim of an increase in lifetime cancer risk of an additional 10mSv. This claim is not based upon any measurable evidence but is an extension of the LNT hypothesis.

> *Collective effective dose is an instrument for optimisation, for comparing radiological technologies and protection procedures. Collective effective dose is not intended as a tool for epidemiological studies, and it is inappropriate to use it in risk projections. This is because the assumptions implicit in the calculation of collective effective dose (e.g., when applying the LNT model) conceal large biological and statistical uncertainties.*
>
> *"Specifically, the computation of cancer deaths based on collective effective doses involving trivial exposures to large populations is not reasonable and should be avoided. Such computations based on collective effective dose were never intended,*

are biologically and statistically very uncertain, presuppose a number of caveats that tend not to be repeated when estimates are quoted out of context, and are an incorrect use of this protection quantity".[21]

The claim has been made in Submission 34 that childhood leukaemia clusters near some nuclear power plants are caused by radiation on the grounds that "no possible cause other than radiation has been identified". Further, it is claimed that errors in radiation measurement are also a cause.

These claims are challenged. A review of the German KiKK report by COMARE[22] and reviewers from Oxford found the effective doses from discharges of between 0.0001 mSv and 0.02 mSv per year for individual NPPs, are totally dominated by doses from medical diagnostic radiation exposure per person of 1.9 mSv per year and natural background radiation exposure of 2.1 mSv per year.

A comprehensive summary of childhood leukaemia clusters in France, Germany, the UK and Finland exists in the Oxford Martin[23] "Health effects of low-level ionizing radiation" and a detailed discussion by Janiak[24].

From these studies possible explanations for the German KiKK results include:

- statistical problems with the study or
- possible causes of childhood leukaemia such as virus infection from population mixing.

For the time being, no cause for the German cancer clusters has been identified but radiation has been rejected on the basis that the amounts are too low.

It is also noteworthy that based on data from the United Nations Scientific Committee on the Effects of Atomic Radiation on the Effects of Atomic Radiation 2016 Report[25], nuclear power plants emit less radiation than coal fired power plants, especially of the brown coal variety in use in the Latrobe Valley. This is shown in the following image of Table 48 from Annex B, Radiation Exposures from Electricity Generation.

Table 48. Comparison of collective doses to the public, and collective doses normalized to electricity generation in 2010, integrated to 100 years, to the world-average population within a 1,500 km radius of each source for the electricity-generating technologies based on the coal cycle and the nuclear fuel cycle

Coal			*Nuclear*		
Source	*Collective dose (man Sv)*	*Normalized collective dose (man Sv/(Gw a))*	*Source*	*Collective dose (man Sv)*	*Normalized collective dose (man Sv/(Gw a))*
Coal mining	370	0.4	Uranium mining[a] and milling	53	0.2
Older coal plants	780	0.8	NPP generation	68	0.2
Modern coal plants	60	0.1			
From coal ash deposits	240	0.2	Reprocessing	7.6	0.03

[a] Of the 53 man Sv for uranium mining and milling, 40 man Sv is from mining only.

5. Nuclear Power Protects Lives and Our Environment

This final group of references addresses the benefits of nuclear energy in terms of reduced mortality per unit of output compared to other generating sources and also a reduction in carbon emissions.

Pushker Kharecha and James Hansen outlined in their paper Prevented Mortality and Greenhouse Gas Emissions[26] that global nuclear power has prevented an average of 1.84 million air pollution-related deaths and 64 gigatonnes of CO2-equivalent (GtCO2-eq) greenhouse gas (GHG) emissions that would have resulted from fossil fuel burning.

They calculate that nuclear power could additionally prevent an average of 420 000−7.04 million deaths and 80−240 GtCO2-eq emissions due to fossil fuels by mid-century, depending on which fuel it replaces.

The following table from Electricity Generation and Health[27] by Anil Markandya, Paul Wilkinson outlines the very low mortality of nuclear energy compared to fossil fuel use. References included[28], Power generation and the environment—a UK perspective, vol 1.[29] and European Commission report EUR 16524, Vol 5. Brussels: EC,1995[30].

	Deaths from accidents		Air pollution-related effects		
	Among the public	Occupational	Deaths*	Serious illness†	Minor illness‡
Lignite[30]	0·02 (0·005–0·08)	0·10 (0·025–0·4)	32·6 (8·2–130)	298 (74·6–1193)	17 676 (4419–70 704)
Coal[31]	0·02 (0·005–0·08)	0·10 (0·025–0·4)	24·5 (6·1–98·0)	225 (56·2–899)	13 288 (3322–53 150)
Gas[31]	0·02 (0·005–0·08)	0·001 (0·0003–0·004)	2·8 (0·70–11·2)	30 (7·48–120)	703 (176–2813)
Oil[31]	0·03 (0·008–0·12)	..	18·4 (4·6–73·6)	161 (40·4–645·6)	9551 (2388–38 204)
Biomass[31]	..	..	4·63 (1·16–18·5)	43 (10·8–172·6)	2276 (569–9104)
Nuclear[31,32]	0·003	0·019	0·052	0·22	..

Data are mean estimate (95% CI). *Includes acute and chronic effects. Chronic effect deaths are between 88% and 99% of total. For nuclear power, they include all cancer-related deaths. †Includes respiratory and cerebrovascular hospital admissions, congestive heart failure, and chronic bronchitis. For nuclear power, they include all non-fatal cancers and hereditary effects. ‡Includes restricted activity days, bronchodilator use cases, cough, and lower-respiratory symptom days in patients with asthma, and chronic cough episodes. TWh=10^{12} Watt hours.

Table 2: **Health effects of electricity generation in Europe by primary energy source (deaths/cases per TWh)**

The benefits of nuclear energy were outlined in an Economic Analysis of Various Options of Electricity Generation - Taking into Account Health and Environmental Effects by Nils Starfelt Carl-Erik Wikdahl[31]

Final Comment

Thirty-one references have been provided which give a snapshot of the contested issues surrounding the safety of nuclear energy. Many hundreds of additional papers and studies no doubt exist. From the body of evidence that we have examined the introduction of nuclear energy to the State of Victoria would provide improved health outcomes, increased community wealth and stability and a greatly improved environment.

Robert Parker

Founder of Nuclear For Climate Australia and

Vice President, Australian Nuclear Association

https://nuclearforclimate.com.au/

www.nuclearaustralia.org.au

Appendix 1 – List of references

Reference	Title	Website	Paywall	Comment
1	Recent reports on the effect of low doses of ionizing radiation and its dose–effect relationship	https://pubmed.ncbi.nlm.nih.gov/16468064/	Yes	French article contrasts BEIR VII with French research favours low dose threshold and c0mplex cell repair mechanisms
2	Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)	https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/ionising-radiation-and-health	No	The Australian Government's primary authority on radiation protection and nuclear safety
3	The world's high background natural radiation areas (HBNRAs) revisited: A broad overview of the dosimetric, epidemiological and radiobiological issues.	https://www.sciencedirect.com/science/article/abs/pii/S1350448715000086	Yes	Challenges LNT hypothesis and looks at regions of high background radiation.
4	Cancer Mortality Among People Living in Areas With Various Levels of Natural Background Radiation	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4674188/	No	Favours the Threshold or hormesis models over LNT
5	Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2006)	http://nap.edu/11340	No	Generally outlines support for LNT model

6	Estimating Risk of Low Radiation Doses - A Critical Review of the BEIR Report and its Use of the Linear No-Threshold (LNT) Hypothesis	http://www.jstor.com/stable/24545417	Yes	Outlines defects in LNT model and advocates for low dose threshold
7	Epidemiology Without Biology: False Paradigms, Unfounded: Assumptions, and Specious Statistics in Radiation Science	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4917595/	No	Highly critical of BEIR VII and calls for more work on biological mechanisms
8	LINEAR NO-THRESHOLD (LNT) VS. HORMESIS: PARADIGMS, ASSUMPTIONS, AND MATHEMATICAL CONVENTIONS THAT BIAS THE CONCLUSIONS IN FAVOR OF LNTAND AGAINST HORMESIS	https://pubmed.ncbi.nlm.nih.gov/30768437/	Yes	The LNT assumption misunderstands the complex multiphasic biological response to ionizing radiation, focusing solely on the initial physical radiogenic damage.
9	It Is Time to Move Beyond the Linear No-Threshold Theory for Low-Dose Radiation Protection	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6043938/	No	
10	Recent reports on the effect of low doses of ionizing radiation and its dose–effect relationship.	https://pubmed.ncbi.nlm.nih.gov/16468064/	Yes	French study challenges BEIR VII and calls for review of LNT
11	Origin of the linearity no threshold (LNT) dose-response concept	https://pubmed.ncbi.nlm.nih.gov/23887208/	Yes	Critique of origins of LNT hypothesis

12	The Linear No-Threshold Model of Low-Dose Radiogenic Cancer: A Failed Fiction	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6376521/	No	Critique of origins of LNT hypothesis and addresses low doses to Japanese atom bomb survivors
13	Is the linear no-threshold dose-response paradigm still necessary for the assessment of health effects of low dose radiation?	https://epos.myesr.org/poster/esr/eurosafeimaging2020/ESI-10315	No	Image of Various radiation dose response models
14	Beliefs about radiation scientists, the public and public policy	https://pubmed.ncbi.nlm.nih.gov/19820463/	Yes	
15	Reconciling scientists' beliefs about radiation risks and social norms	https://pubmed.ncbi.nlm.nih.gov/17640221/	Yes	
16	Relationship between occupational exposure to ionizing radiation and mortality at the French electricity company, period 1961–2003,	https://pubmed.ncbi.nlm.nih.gov/20148259/	Yes	French study of EDF workers in 58 nuclear power plants with no health impacts from radiation
17	Verifying Canadian Nuclear Energy Worker Radiation Risk: A Reanalysis of Cancer Mortality in Canadian Nuclear Energy Workers	https://nuclearsafety.gc.ca/eng/resources/health/health-studies/iarc-reanalysis.cfm	No	Canadian Nuclear safety Commission report verifying no cancer and health risks to nuclear plant workers

	(1957-1994) Summary Report,			
18	THE INTERNATIONAL NUCLEAR WORKERS STUDY (INWORKS): A COLLABORATIVE EPIDEMIOLOGICAL STUDY TO IMPROVE KNOWLEDGE ABOUT HEALTH EFFECTS OF PROTRACTED LOW-DOSE EXPOSURE	https://academic.oup.com/rpd/article/173/1-3/21/2558799	No	
19	A Critique of Recent Epidemiologic Studies of Cancer Mortality Among Nuclear Workers,	https://pubmed.ncbi.nlm.nih.gov/29872372/	Yes	Methodological critiques of INWORKS study.
21	ICRP Publication 103: the 2007 recommendations of the International Commission on Radiological Protection	http://www.icrp.org/publication.asp?id=ICRP%20Publication%20103	No	INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION
20	Nuclear Shipyard Worker Study (1980-1988): a large cohort exposed to low-dose-rate gamma radiation;	https://nuclearforclimate.com.au/wp-content/uploads/2020/07/Sponsler-and-Cameron-2005-Shipyard-Worker-Study.pdf	No	Although the NSWS was designed to search for adverse effects of occupational low dose-rate gamma radiation,

				few risks were found. The high-dose workers demonstrated significantly lower circulatory, respiratory, and all-cause mortality than did unexposed workers.
22	Committee on Medical Aspects of Radiation in the Environment (COMARE) 14th Report	https://www.gov.uk/government/publications/comare-14th-report	No	Committee undertook further review of the incidence of childhood leukaemia in the vicinity of nuclear power plants (NPPs) in Great Britain, and German KiKK study and studies from other countries
23	Oxford Martin Restatement 5:A restatement of the natural science evidence base concerning the health effects of low-level ionizing radiation	https://royalsocietypublishing.org/doi/10.1098/rspb.2017.1070	No	Excellent summary of contending issues surrounding low level ionising radiation
24	EPIDEMIOLOGICAL EVIDENCE OF CHILDHOOD LEUKAEMIA AROUND NUCLEAR POWER PLANTS	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4146329/	No	Review of evidence of Childhood leukaemia around nuclear power plants finds no health risk

25	United Nations Scientific Committee on the Effects of Atomic Radiation on the Effects of Atomic Radiation 2016 Report;	https://www.unscear.org/unscear/en/publications/2016.html	No	
26	Prevented Mortality and Greenhouse Gas Emissions	https://pubs.acs.org/doi/abs/10.1021/es3051197	No	Nuclear power has saved 1.8 million lives by preventing air pollution
27	Electricity generation and health Anil Markandya, Paul Wilkinson	https://www.sciencedirect.com/science/article/abs/pii/S0140673607612537	Yes	Benefits of nuclear in terms of lives saved per unit of energy
28	ExternE National Implementation; Germany.	http://externe.jrc.es/ger.pdf	No	
29	Berry JE, Holland MR, Watkiss PR, Boyd R, Stephenson W. Power generation and the environment—a UK perspective, vol 1.	http://externe.jrc.es/uk.pdf	No	
30	Dreicer M, Tort V. ExternE—Externalities of Energy: nuclear. European Commission report EUR 16524, Vol 5. Brussels: EC,1995.	Dreicer M, Tort V. ExternE—Externalities of Energy: nuclear. European Commission report EUR 16524, Vol 5. Brussels: EC, 1995.	NA	

31	Economic Analysis of Various Options of Electricity Generation - Taking into Account Health and Environmental Effects Nils Starfelt Carl-Erik Wikdahl	http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.180.4490	No	

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[1] Recent reports on the effect of low doses of ionizing radiation and its dose–effect relationship. https://pubmed.ncbi.nlm.nih.gov/16468064/

[2] ARPANSA, https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/ionising-radiation-and-health

[3] The world's high background natural radiation areas (HBNRAs) revisited: A broad overview of the dosimetric, epidemiological and radiobiological issues. https://www.sciencedirect.com/science/article/abs/pii/S1350448715000086

[4] Cancer Mortality Among People Living in Areas With Various Levels of Natural Background Radiation. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4674188/

[5] Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2006), http://www.jstor.com/stable/24545417

[6] Estimating Risk of Low Radiation Doses - A Critical Review of the BEIR Report and its Use of the Linear No-Threshold (LNT) Hypothesis. http://www.jstor.com/stable/24545417

[7] Epidemiology Without Biology: False Paradigms, Unfounded: Assumptions, and Specious Statistics in Radiation Science, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4917595/

[8] LINEAR NO-THRESHOLD (LNT) VS. HORMESIS: PARADIGMS, ASSUMPTIONS, AND MATHEMATICAL CONVENTIONS THAT BIAS THE CONCLUSIONS IN FAVOR OF LNT AND AGAINST HORMESIS; https://pubmed.ncbi.nlm.nih.gov/30768437/

[9] It Is Time to Move Beyond the Linear No-Threshold Theory for Low-Dose Radiation Protection. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6043938/

[10] Recent reports on the effect of low doses of ionizing radiation and its dose–effect relationship. https://pubmed.ncbi.nlm.nih.gov/16468064/

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[12] The Linear No-Threshold Model of Low-Dose Radiogenic Cancer: A Failed Fiction, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6376521/

[13] Ref Seong KM, Songwon S, Dalnim L, Min-Jeong K, Seung-Sook L, Sunhoo P, and Young WJ. (2016) Is the linear no-threshold dose-response paradigm still necessary for the assessment of health effects of low dose radiation? Journal of Korean Medical Science. 31(1): 10-23. https://epos.myesr.org/poster/esr/eurosafeimaging2020/ESI-10315

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[15] Silva CL, Jenkins-Smith HC, Barke RP. Reconciling scientists' beliefs about radiation risks and social norms: explaining preferred radiation protection standards. Risk Anal. 2007;27(3): 755-773.

[16] Relationship between occupational exposure to ionizing radiation and mortality at the French electricity company, period 1961–2003, https://pubmed.ncbi.nlm.nih.gov/20148259/

[17] Verifying Canadian Nuclear Energy Worker Radiation Risk: A Reanalysis of Cancer Mortality in Canadian Nuclear Energy Workers (1957-1994) Summary Report,

[18] THE INTERNATIONAL NUCLEAR WORKERS STUDY (INWORKS): A COLLABORATIVE EPIDEMIOLOGICAL STUDY TO IMPROVE KNOWLEDGE ABOUT HEALTH EFFECTS OF PROTRACTED LOW-DOSE EXPOSURE. https://academic.oup.com/rpd/article/173/1-3/21/2558799

[19] A Critique of Recent Epidemiologic Studies of Cancer Mortality Among Nuclear Workers, https://pubmed.ncbi.nlm.nih.gov/29872372/

[20] Nuclear Shipyard Worker Study (1980-1988): a large cohort exposed to low-dose-rate gamma radiation; https://nuclearforclimate.com.au/wp-content/uploads/2020/07/Sponsler-and-Cameron-2005-Shipyard-Worker-Study.pdf

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[22] Committee on Medical Aspects of Radiation in the Environment (COMARE) 14th Report, https://www.gov.uk/government/publications/comare-14th-report

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[24] EPIDEMIOLOGICAL EVIDENCE OF CHILDHOOD LEUKAEMIA AROUND NUCLEAR POWER PLANTS, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4146329/

[25] United Nations Scientific Committee on the Effects of Atomic Radiation on the Effects of Atomic Radiation 2016 Report; https://www.unscear.org/unscear/en/publications/2016.html

[26] Prevented Mortality and Greenhouse Gas Emissions, https://pubs.acs.org/doi/abs/10.1021/es3051197

[27] Electricity generation and health:Anil Markandya, Paul Wilkinson. https://www.sciencedirect.com/science/article/abs/pii/S0140673607612537

[28] ExternE National Implementation; Germany, http://externe.jrc.es/ger.pdf

[29] Power generation and the environment—a UK perspective, vol 1., http://externe.jrc.es/uk.pdf

[30] European Commission report EUR 16524, Vol 5. Brussels: EC,1995.

[31] Economic Analysis of Various Options of Electricity Generation - Taking into Account Health and Environmental Effects, Nils Starfelt Carl-Erik Wikdahl; http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.180.4490