



To Esprit Readers,

Here, as promised, is a letter to our Fellowship's journal from Dr. Mark Diesendorf, Associate Professor and Deputy Director of the Institute of Environmental Studies, UNSW.

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This letter is occasioned by, but not in its entirety a response to, our Esprit Special Issue from 2013 in which Dr David Blair critiqued the soundness of the Linear No Threshold theory of nuclear radiation. Part of the present article responds to that critique. We are lucky to have two such highly qualified physicists write for us.

Jan Tendys

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**Nuclear Energy is Not a Solution to Climate Change**

**Mark Diesendorf**

Your editor, Jan Tendys, has kindly invited me to reply to David Blair's pro-nuclear 'letter'. However, his contribution is so long that it is almost a small book. No doubt it took at least several weeks to prepare. It would take at least as long to prepare a reply refuting systematically and in detail each of David's points. Unfortunately, as someone who is still working full-time, I don't have that luxury of time. So I've written a more concise article and refer readers to Chapter 6 of my new book, **Sustainable Energy Solutions for Climate Change (UNSW Press, 2014)** for a detailed, referenced critique of nuclear energy.

David's article focuses on the health impacts of low doses of ionizing radiation, which is the least of the short-term potential impacts of nuclear energy. It is a straw person. However, even in that case I think he has misinterpreted the evidence, as outlined later in this article.

The principal case against nuclear energy is that it is too dangerous, too expensive, too slow a technology to be disseminated and, in the long term, a significant emitter of greenhouse gas emissions. Furthermore, it is unnecessary, because we could now transition to an energy system that is run entirely on scaled-up commercially available renewable energy technologies. This ecologically sustainable energy system would be as reliable as the existing fossil fuelled system and affordable. Let me expand on some of these points.

### **Nuclear energy is too dangerous**

The principal hazard of nuclear energy, in terms of short-term deaths and destruction, is that nuclear energy enables countries to covertly develop the capacity and explosives for nuclear weapons. In recent decades South Africa, India, Pakistan and North Korea have all done this. There is also evidence that the UK and France supplemented their military production of the nuclear explosive plutonium by means of civil nuclear power. In addition, the governments of many other countries commenced nuclear weapons programs under the cloak of developing 'peaceful' nuclear energy, but fortunately terminated them for various reasons. These included Argentina, Australia, Brazil, Libya, South Korea, Taiwan and possibly Algeria.

The point is that the risk of nuclear war increases with the number of countries that have nuclear weapons, or the capacity to produce them quickly. The application of climate models to even a 'small' nuclear war, such as between (let's say) India and Pakistan, reveals that the soot released into the atmosphere could screen sunshine for several years, to the extent that most agriculture would collapse on a global scale and billions would starve. This is on top of the more localised devastation caused by the blasts, firestorms and ionising radiation.

David's dismissal of the risks of major nuclear accidents fails to take account of the potentially huge consequences of such accidents. It was a matter of sheer luck that during early days and weeks of the Fukushima disaster the wind was blowing mostly off-shore. If the wind had been blowing towards Tokyo, millions would have been exposed to medium-level radiation, not low-level. It would have been impossible to evacuate Tokyo in the short time available and thousands of cancers would have been induced.

Concerning the Chernobyl nuclear accident, reputable unbiased studies of the cancers likely to be induced over a period of several decades range from 16,000 by the International Agency for Research on Cancer to 93,000 by a team of expert medical researchers from Russia, Ukraine and elsewhere. The statement quoted by David from the UNSCEAR (2000) report, that 'apart from 1800 cases of thyroid cancer in children exposed at the time of the accident, there is no evidence of increased overall cancer incidence or mortality 14 years later' has no significance, because an increase in cancer deaths of even 100,000 over a 50 year period across the huge region exposed to fallout would be undetectable, given the level of accuracy of medical statistics and the fact that radiation-induced cancers do not have little flags identifying their causes.

David's comparison of the hazards of coal and nuclear energy is flawed because it ignores the huge potential impacts of nuclear war, nuclear accidents and nuclear terrorism. The impacts of coal are continuous, while the most severe potential impacts of nuclear energy are from discrete events of rare occurrence (we hope), but huge impacts. David ignores such events, although they should be treated in terms of risk. Risk is the probability of occurrence multiplied by magnitude of impact. Rare events with massive impacts must be taken seriously.

No permanent repository for high-level nuclear waste is operating anywhere in the world,

although underground repositories are under construction in Finland and Sweden. The challenge is to create an institution to manage and guard such repositories for 100,000 years or more. This seems impossible, because so far no human institution has lasted for more than a few thousand years. With the high-level wastes from nuclear energy and nuclear weapons production, we have already imposed a terrible burden on future generations.

### **Nuclear energy is too expensive**

Not a single nuclear power station has ever been built without massive subsidies. These subsidies include:

- government funding for research and development, uranium enrichment, decommissioning of retired reactors and waste management;

- loan guarantees backed by governments (that is, taxpayers);

- stranded assets, such as failed nuclear power stations, paid for by taxpayers and electricity ratepayers;

- limited liabilities (including inadequate insurance) paid for by taxpayers and by the victims of accidents, proliferation and terrorism.

These subsidies continue today after 60 years of civil nuclear energy. For instance, the British government recently announced that electricity from the proposed new Hinckley C nuclear power station would receive a guaranteed price of 9.25 British pence per kilowatt-hour (about 17 cents per kilowatt-hour), which is about double the average wholesale price of electricity in the UK and over three times the wholesale price of electricity in Australia. This guaranteed price would be increased with inflation and would continue for at least 35 years. In addition the power station would receive a loan guarantee covering two-thirds of its huge capital cost and would be granted operating priority over wind, even though wind farms are much cheaper to operate.

Estimates of the partial cost of the Fukushima disaster are as high as US\$250 billion. Yet the reactors were only insured for US\$1.5 billion. The 180,000 people who were evacuated from the region and the local agriculture and fishing industries that were destroyed will never be adequately compensated.

These gigantic subsidies are far greater than the small and declining subsidies to renewable energy.

### **Nuclear energy is too slow to develop**

It has been estimated that, if a nuclear power station were ever built in Australia, the planning, construction and associated infrastructure would take about 15 years. In that time, we could be obtaining more than half our electricity from the wind and sunshine, given the political will. Within 20–25 years, all our electricity could be renewable. Denmark is already well on the way towards achieving its target of 100 per cent renewable electricity and heat by 2035.

### **Nuclear energy will soon have medium-level CO<sub>2</sub> emissions**

Apart from the operation of nuclear power stations, all stages in the nuclear life-cycle – mining, milling and enrichment of uranium; construction and decommissioning of reactors; and waste management – use fossil fuels and hence emit carbon dioxide (CO<sub>2</sub>). Total life-cycle CO<sub>2</sub> emissions are much greater than from those of wind and most solar technologies. Furthermore, CO<sub>2</sub> emissions from mining and milling uranium will increase substantially over the next

few decades as high-grade uranium ore is used up and low-grade ore has to be used. For example, with low-grade ore, at least 10 tonnes of rock has to be mined and milled using diesel fuel to obtain just 1 kg of yellowcake (uranium oxide).

Although this fundamental problem could be overcome by building fast breeder reactors that produce more nuclear fuel than they use, these reactors are not commercially available. Because of their complexity, additional dangers and additional costs, they have been stuck at the demonstration stage for decades and are likely to remain so. If they eventually become available in 2040 onwards as David suggests, they will be too late and too expensive to compete with renewable energy systems.

### **Even low-level ionizing radiation is likely to be harmful**

The arguments, quoted by David, that low-level may be harmless or even beneficial have been around for decades and have been considered and rejected, on the balance of probabilities, by committees of leading international and national experts, such as the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and Committee on the Biological Effects of Ionizing Radiation (BEIR) of the National Research Council of the USA. The experts on these committees are not environmentalists – they are members of the radiation establishment and are generally very supportive of radiation uses.

The evidence for a threshold is sparse and mostly of poor quality. For instance, David's statement that 'no correlation has been found between background radiation level and the incidence of cancers' carries little scientific weight, because the studies claiming such conclusions fail to control for the other differences, additional to background radiation, between the regions compared. These differences include income, diet, occupations, tobacco use, weather and the presence or absence of other carcinogens in the environment.

On the other hand there is direct evidence from a particular group of the population that low-level induces cancer and that the rate of cancers is proportional to the radiation dose. Before ultrasound, pregnant women were often x-rayed to examine the foetus. The Oxford Childhood Cancer Study led by Alice Stewart showed that children who had been x-rayed prenatally had a much higher relative risk of childhood cancer than those who were not x-rayed. This conclusion was initially fiercely opposed by the radiation establishment, however it was confirmed by independent studies such as by Brian MacMahon in the USA. The conclusion that the link between prenatal x-ray exposure and childhood cancer was causal and linear was based on research by Alice Stewart and George Kneale, who showed that the childhood cancer rate was proportional to the number of prenatal x-rays taken.

Given the mainstream scientific view that low-level radiation is likely to be carcinogenic, there are implications for nuclear energy. For instance, at most uranium mines there are huge uncovered waste dumps, blowing in the wind, that will continue to spread low-level radiation over vast areas for 100,000 years or more. In particular, the uranium and copper mine at Olympic Dam in South Australia has an uncovered low-level radioactive waste mountain of about 150 million tonnes and growing. Even if it only induces a few cancers per year, this could add several hundred thousand cancers in the long run. If we care for future generations, then surely the waste mountains should be covered? To do this would add significantly to the price of uranium and, more importantly, to CO<sub>2</sub> emissions from the nuclear fuel life-cycle, lifting emissions to a level that is comparable with those of gas-fired power stations.

### **Sustainable energy can solve the climate crisis and energy insecurity**

The case for ecologically sustainable energy is made in my new book, **Sustainable Energy Solutions for Climate Change**, which also demolishes the false myths being disseminated about

renewable energy by the fossil fuel and nuclear industries and their supporters. For a small sample, see the transcript of my talk on ABC national radio Ockham's Razor program <<http://www.abc.net.au/radionational/programs/ockhamsrazor/renewing-renewables/5282500#transcript>>.

## Conclusion

Nuclear energy is too dangerous, too expensive, too slow and, in the long term, too greenhouse-intensive to be a credible part of the solution to global climate change. Investing in nuclear energy in Australia would be an expensive and futile diversion from realistic energy solutions to global climate change. Even crazier than investing in the current generation of nuclear power stations would be investing in Generation IV nuclear reactors, fast breeders, which are not even commercially available and may never be. Nuclear energy is unnecessary, because we can now transition to a safe, everlasting, ecologically sustainable and affordable energy system that is based entirely on scaled-up commercially available renewable energy technologies together with the efficient use of energy.

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Membership is open to all adults and includes this newsletter. *Full membership \$50 concession \$20* . If you would like to join us as an active member of Spirit of Life, please ring **0466 940 461** or consult our website www.sydneyunitarians.org . Please note that all membership applications are subject to approval at a meeting of the Committee. Ask Rev. Geoff Usher or Ginna Hastings for an application form at the Sunday service.

If you have a news item or written article you believe would be of interest to the congregation, we invite you to submit it for Esprit.

It would be helpful if items for publication, including articles and talk topics with themes could reach Esprit editor by the 15th of each month: jtendys@bigpond.com or hand to Jan Tendys at the Sunday service.

Do you have a topic of a spiritual / ethical nature that you would like to share with the congregation? As Unitarians, we support an “Open Pulpit” and invite members of the congregation to lead the service if they so wish. *Please see Caz Donnelly at the Sunday service*

Fellowship contact 0466 940 461