Case study: The strategic importance of Australia's uranium resources

Inquiry into developing Australia's non-fossil fuel energy industry

House of Representatives

Submission from Medical Association for Prevention of War (Australia), Victorian Branch

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Terms of reference

The Medical Association for the Prevention of War (Victorian Branch) (Annex 1) is seriously concerned about the nature of the current inquiry and its terms of reference. The reality of global warming and its profound consequences, some already inevitable, are undeniably upon us. At this time, it is overdue for all countries, particularly wealthy and technically sophisticated countries like Australia with high per capita greenhouse gas emissions, to be implementing coordinated and serious measures to increase energy efficiency, reduce consumption, and take decisive steps towards renewable and sustainable energy sources.

The first priority for a national parliamentary inquiry into the non-fossil fuel energy industry should be shifting Australia towards a benign, sustainable, renewable energy future. That the Standing Committee on Industry and Resources should open such an inquiry with a case study into the strategic importance of Australia's uranium resources indicates at best a regrettably misplaced sense of priorities, and at worst a clear indication that the inquiry is a sham and is being used to advance a dangerous and short-sighted decision already made by the government to hasten and encourage the expansion of uranium mining in Australia. The 17 March 2005 media release from the Committee Chair announcing the inquiry, and at the same time

heavily promoting the expansion of uranium mining, suggests that the situation lies towards the latter.

Dangers of proliferation of nuclear weapons

Much of the Association's efforts are based on the abiding truths embodied in resolutions of the World Health Assembly, the global body of Ministers of Health and their representatives which governs the World Health Organisation:

- '... nuclear weapons constitute the greatest immediate threat to the health and welfare of mankind;' (Resolution WHA 36.28 16 May 1983); and
- 'The role of physicians and other health workers in the preservation and promotion of peace as the most significant factor for the attainment of health for all.' (Resolution WHA 34.38 22 May 1981)

Health professionals have individual and collective professional, ethical responsibilities to do no harm; to act with scientific rigour on the basis of the best available evidence to treat illness, alleviate suffering, and promote health, and act to remove or reduce threats to life and health.

Almost two decades ago, following thorough examination of the available evidence, the Association concluded (Annex 2) that nuclear power posed an unacceptable threat to human health, primarily because of the inextricable nexus between the expertise, technology and materials required to fuel nuclear power reactors and those required to produce nuclear bombs. Uranium mining underpins both nuclear reactors and nuclear bombs.

While quite limited progress has been made to reduce US and Russian nuclear arsenals, all nuclear weapons states have affirmed the central role into the indefinite future which nuclear weapons continue to play in their national security policies. Around 28,000 nuclear weapons are still deployed, including thousands on hair-trigger, 'launch on warning' alert; new, including politically unstable countries have acquired nuclear weapons beyond the states possessing them when the nuclear Non-Proliferation Treaty was concluded (Israel, India, Pakistan, probably North Korea); yet others raise serious proliferation concerns; widespread including clandestine dissemination of nuclear technology and weapons designs has occurred; interest by terrorist groups in acquiring nuclear weapons is evident; states have publicly confirmed 20 cases of nuclear material diversion and more than 200 incidents of illicit trafficking in nuclear materials have been documented over the past decade[1]; numerous instances of technical failures and human error have resulted in situations risking nuclear war, including where the judgement of one person has been the only barrier to launch of multiple nuclear weapons; the global non-proliferation regime is currently in crisis; and the US has explicitly abandoned negative security assurances and adopted policies of pre-emptive attack, including use of nuclear weapons against non-nuclear armed states. Earlier limited nuclear disarmament gains are being

[1] Secretary-General's High-level Panel on Threats, Challenges and Change. A more secure world: our shared responsibility. New York, United Nations, A/59/565, 1 Dec 2004:39. www.un.org/secureworld.

eroded: the US abandoned the Anti-Ballistic Missile Treaty – the first time a nuclear weapons state has withdrawn from a major nuclear arms control treaty; the long-awaited entry into force of the Comprehensive Test Ban Treaty, languishes, primarily because of US failure to ratify it. The Non-Proliferation Treaty, the cornerstone of international efforts to limit nuclear proliferation, is under serious threat. No nuclear disarmament negotiations are currently underway. The major nuclear powers continue to develop new and more 'usable' nuclear weapons, and the US is at the same time committed to the de-stabilising development of missile defence. It has not proven possible to restrict the spread of nuclear technologies.

These circumstances do not constitute a decisive change in a benign direction from those which prompted the WHA 1983 assessment of nuclear weapons as the greatest immediate threat to the health and welfare of humankind. Indeed, the overall global risks of nuclear weapons use have arguably increased. Thus the 1983 assessment is still valid. Urgently reducing this threat should receive the highest priority and uncompromising commitment of governments worldwide. That the Australian government is but one of many failing in this regard provides little comfort.

The Australian government requires that countries purchasing Australian uranium enter into bilateral safeguards agreements, and asserts that these provide reliable assurance that Australian uranium does not end up in weapons. This is not borne out by the evidence:

- In some countries where Australian uranium is exported, such as France, some nuclear facilities serve both the nuclear power industry and military purposes
- Movement of Australian-sourced uranium between countries occurs, such as in Europe, both before and after it has been used in reactors
- Accounting procedures for nuclear materials involve uncertainties and margins of error which, on the industrial scale involved, means that it cannot be excluded that material sufficient to produce one or more nuclear weapons could be diverted
- At any stage of enrichment, processing or fabrication, it is impossible to distinguish by any means uranium from one source from uranium from any other source. Accounting is 'virtual' – so-called 'flag-swapping' has been shown to be routine
- Even if atoms of Australian uranium were not used for weapons, Australian uranium contributes to the total pool of uranium used for the intersecting purposes of electricity generation and weapons and the inseparable associated risks, including of accidents, proliferation, targeting of nuclear facilities by terrorist, and waste disposal
- It is widely acknowledged that IAEA safeguards, even with the Additional Protocol, are inadequate. This is demonstrated by the presumed development of nuclear weapons by North Korea; for most of the period that this was occurring, the country was a signatory to the NPT; and current concerns about Iran. Iraq's previous (prior to 1991) substantial progress in nuclear weapons development occurred while it was a member in good standing of the NPT. The Proliferation Security Initiative, and the US administration's current desire to deny access to uranium enrichment to selected states, even those party to the NPT, both supported by the Australian government, are a de facto acknowledgement that current barriers to horizontal proliferation of nuclear weapons are inadequate.

- There are few obstacles to a country going a considerable distance towards nuclear weapons development while a signatory to the NPT, with access to enrichment and reactor technology and technical support for 'peaceful' nuclear activities, and then withdrawing from the Treaty when they are ready to proceed with weaponisation.
- A number of countries have developed nuclear weapons via essentially clandestine programs largely utilising 'research' and civilian reactors – examples include Israel, South Africa, India and Pakistan.
- Current horizontal nuclear proliferation risks and the critical state of the global non-proliferation regime were recently highlighted by the UN High-level Panel, which 'calls urgent attention to the precarious state of the nuclear non-proliferation regime and warns of the risk of a possible cascade of proliferation in the future.' It elaborates:

> 'The first and most immediate concern is that some countries, under cover of their current Treaty on the Non-Proliferation of Nuclear Weapons membership, will covertly and illegally develop full-scale weapons programs, or that ... they will acquire all the materials and expertise needed for weapons programmes with the option of withdrawing from the Treaty at the point when they are ready to proceed with weaponisation.
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> The second longer-term, concern is about the erosion and possible collapse of the whole Treaty regime. Almost 60 states currently operate or are constructing nuclear power or research reactors, and at least 40 possess the industrial and scientific infrastructure which would enable them, if they chose, to build nuclear weapons at relatively short notice ...
>
> Both concerns are now very real ...
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> We are approaching a point at which the erosion of the non-proliferation regime could become irreversible and result in a cascade of proliferation.'[2]

Any activity which has significant potential to increase the number of nuclear weapons, the number of countries or other entities possessing them, and/or the possibilities for their use, or lowers the threshold for their use, therefore magnifies what is already the greatest immediate risk to human health and survival. From this perspective alone, expansion of uranium mining is indefensible.

There are additional factors which reinforce the inadvisability from a long-term human health and security perspective of expansion of uranium mining. However the Association regards the nuclear weapons proliferation dangers associated with the nuclear industry, including nuclear power generation, as a decisive and fatal flaw. Given the unique magnitude of the risks involved, short-term, monetary, political, sectoral or vested interests have no place in decision-making. Committee members need to be very clear that expansion of uranium mining in Australia will inevitably

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[2] Secretary-General's High-level Panel on Threats, Challenges and Change. A more secure world: our shared responsibility. New York, United Nations, A/59/565, 1 Dec 2004:38-9. www.un.org/secureworld.

add to the global danger of nuclear weapons proliferation and use. In an interdependent world on an issue of such great moment, your recommendations and actions should be based on an objective assessment of the best available evidence, including uncertainties, and the long-term interests of the global human population, the global biota, and the global environment. You will need to move beyond the party-political nature and short-term time horizons of parliamentary processes. Your recommendations should be defensible to your great-grandchildren, and their great-grandchildren, and their great-grandchildren, and to children the world over.

The Hippocratic oath has for millennia been accepted as a fundamental statement of the ethical basis for the work of the healing professions; much of it is relevant to others in positions affecting the lives of others, in particular its edict: First, do no harm.

Uranium enrichment

As noted by the High-level Panel:

'In recent years, it has become increasingly clear that the proliferation risks from the enrichment of uranium and from the reprocessing of spent fuel are great and increasing.'[3]

This is because:

> 'The same processes and facilities can be used to enrich uranium to fuel commercial light water reactors – that is, to make LEU [low-enriched uranium] - as well as to make HEU [highly enriched uranium] for nuclear bombs. Therefore, all uranium enrichment technologies are potential sources of nuclear weapons proliferation.'[4]

Two-thirds of the total enrichment process necessary to produce weapons-usable HEU (90% U-235) is undertaken in enriching natural uranium (0.7% U-235) to LEU (around 3.6% U-235) – only one third goes into further enrichment all the way to 90%.(HEU is defined as more than 20% U-235, but in practice at least 90% U-235 has been used to make nuclear weapons).

> 'Thus, stockpiles of low enriched uranium, if maintained in a form suitable for enrichment (ie as uranium hexafluoride), can provide the base material to more easily and more rapidly manufacture HEU for use in nuclear weapons. This is one of the critical proliferation risks regarding the spread of enrichment technologies as part of the spread of nuclear power.'[5]

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[3] Secretary-General's High-level Panel on Threats, Challenges and Change. A more secure world: our shared responsibility. New York, United Nations, A/59/565, 1 Dec 2004:42. www.un.org/secureworld.

[4] Institute for Energy and Environmental Research. Uranium enrichment: just plain facts to fuel an informed debate on nuclear proliferation and nuclear power. Takoma Park, MD, USA, IEER, October 2004. www.ieer.org/reports/uranium/enrichment.pdf

[5] ibid.

In South Africa, the only country to have developed and then to have voluntarily abandoned nuclear weapons, German enrichment technology was used in a facility ostensibly built to supply LEU to South African commercial nuclear power plants, as well as HEU for a research reactor. In reality, the enrichment plant also supplied an estimated 400 kg of HEU (enriched to greater than 80%) used to produce nuclear weapons[6].

The case of India and Pakistan also clearly demonstrate how research and civil nuclear power programs were integral to nuclear weapons acquisition.

In a very real sense then, and at best, nuclear power programs constitute a form of 'latent' nuclear weapons proliferation, and the simultaneous roles of the IAEA in discouraging actual proliferation, while assisting and promoting the spread of know-how, materials and technology relevant to weapons development is inherently contradictory, and ultimately, counterproductive. A similar contradiction is embodied in Australia's position ostensibly opposing nuclear proliferation, while at the same time undertaking and promoting uranium exports.

The Institute for Energy and Environmental Research has highlighted the alarming proliferation dangers associated with substantial expansion of enrichment capacity to serve greatly expanded nuclear power generation in the US in the following assessment:

> '...in order to fuel one thousand 1000 megawatt nuclear plants (a common reference case in many nuclear growth scenarios), a global uranium enrichment capacity roughly nine to ten times greater than that currently operating in the United States would be required. If just 1% of that capacity was used instead to manufacture highly enriched uranium (HEU), then enough HEU could be produced every year to make between 175 and 310 nuclear weapons. With an expanded trade in the specialized materials required to build and operate gas centrifuge and other enrichment plants that would accompany an increase in nuclear power, illicit sales and diversion of supposedly 'peaceful' technologies will become harder to identify.'[7]

A disturbing Australian uranium enrichment program

As documented in a painstaking recent Greenpeace report[8], research into laser enrichment, principally of uranium, has been undertaken at the Lucas Heights facility in Sydney since 1978, initially by the Australian Atomic Energy Commission, later to become the Australian Nuclear Science and Technology Organisation (ANSTO), and since 1990, by a private company known as Silex Systems Ltd. The report convincingly documents a largely secret but close relationship between Silex and

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[6] ibid.
[7] Makhijani A, et al. Uranium enrichment. Science for Democratic Action 2005;13(1):1-11.
[8] Greenpeace. Secrets, lies and uranium enrichment. The classified Silex project at Lucas Heights. Sydney, Greenpeace Australia, Nov 2004. Available at: www.greenpeace.org.au.

ANSTO – Silex leases over 2000 square meters of space in the publicly-owned facility at Lucas Heights, has been provided by ANSTO with contract staff, equipment and radioactive materials, and unspecified access to ANSTO resources. ANSTO and the Australian Safeguards and Non-proliferation Office (ASNO) have assisted Silex with the importation (on multiple occasions during 2001-2) and storage of uranium hexafluoride, a gas used in uranium enrichment. Silex is the only private company in Australia to be regulated by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). While the Silex laser enrichment technology has a number of potential non-radioactive applications for other elements such as carbon and silicon, the focus of Silex appears to be uranium. Laser techniques can also be applied to the separation of other radionuclides, such as plutonium.

The company announced in early 2005 plans for construction of a pilot plant, probably in the US[9]. If further successfully developed and demonstrated, laser enrichment of uranium would significantly add to nuclear weapons proliferation risks, for the very reasons that the company promotes as the benefits of laser enrichment: reduced energy requirements, relatively simple modular design enabling versatility in deployment, and reduced capital costs. Thus in contrast to the massive energy, size and industrial capacity required by current gas centrifuge facilities, making them difficult to conceal; laser enrichment could enable a facility the size of a small warehouse or large garage to produce sufficient HEU for the construction of 1-2 nuclear weapons per year, and would be much easier to conceal. For these reasons, as documented in the Greenpeace report, laser enrichment has been of profound proliferation concern to the US CIA and US Office of Technology Assessment since at least 1978. This concern was formally demonstrated in 1996, when Silex signed an agreement with the United States Enrichment Corporation, resulting in the US Dept of Energy classifying the Silex process as 'Restricted Data', a classification usually relating to the design of nuclear weapons, or the acquisition of nuclear material suitable for their construction. *This is the first time that privately held technology has ever been given this classification.*

Under the IAEA Additional Protocol supported by Australia, laser isotope separation facilities must be declared. South Korea's admitted failure in 2004 to declare a variety of research activities spanning decades, on uranium - including laser - enrichment and plutonium separation, aroused considerable international concern[10]. Iran's laser enrichment program, which escaped detection by the IAEA, is part of the basis for current serious concern, shared by the Australian government, about Iran's nuclear intentions.

In response to the Greenpeace Silex report, defence minister Robert Hill is reported to have acknowledged that dual-use materials from Australia might have been 'innocently' exported and used within an unnamed country's nuclear weapons program[11]. One presumes that he was referring to the US. But whatever country is involved, it is an alarming admission which reinforces the dangers of laser

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[9] Institute for Energy and Environmental Research. Uranium enrichment: just plain facts to fuel an informed debate on nuclear proliferation and nuclear power. Takoma Park, MD, USA, IEER, October 2004. www.ieer.org/reports/uranium/enrichment.pdf

[10] Kang J, et al. South Korea's nuclear surprise. Bull Atomic Scientists 2005; 61(1):40-9.

[11] Boureston J, Ferguson CD. Laser enrichment: Separation anxiety. Bull Atomic Scientists 2005;61(2):14-8.

enrichment research, conducted in Australia in a publicly funded and owned facility, with the main stated purpose of production of isotopes for nuclear medicine, and for industrial uses, with negligible accountability to the Australian parliament or people. This is a gross breach of public trust and the fundamental ethical principle of informed consent. It also reinforces the fundamental reality that all enriched uranium is potentially 'dual use'. Continuing uranium enrichment R&D in Australia very seriously undermines and is utterly inconsistent with the Australian government's credibility and stated commitment to nuclear non-proliferation.

In the 1970s, A Q Khan, a Pakistani metallurgist, while working for the European enrichment consortium URENCO, stole designs for uranium centrifuges, and used this knowledge to build Pakistan's centrifuge enrichment plants. He also distributed the designs and centrifuge components in an international nuclear black market that included multiple countries including Libya and Iran.

All attempts to prevent the spread of nuclear technologies have failed. Even if it became known that laser enrichment had been perfected and proven, but the details could be restricted (for a time), it would give a clear impetus and signal to those interested in accessing similar technology that it can be done, and it would only be a matter of time before others worked out how it can be done.

> '... the further spread of LIS [laser isotope separation] expertise and technologies increases the risk that someday another Khan will peddle these tools to the highest bidder.[12]'

The recent IEER review of uranium enrichment concluded:

> 'All these technologies have been demonstrated on a small scale, whereas some, like AVLIS [Atomic Vapour Laser Isotope Separation], have gone significantly further along in the development process necessary to scale them up to production level facilities. The potential for these alternative technologies to be used for enriching uranium in a clandestine program, however, remain a concern, particularly if the profitability of the plant was not an issue and it was only meant to enrich the reasonably modest quantities of HEU necessary for one or two bombs per year.[13]'

The justification of Silex as assisting in the production of enriched uranium for generation of nuclear power rings particularly hollow as global enrichment capacity is currently more than adequate to meet demands for nuclear power[14], and dismantled nuclear weapons can provide a substantial and more appropriate source of power reactor fuel – over the past decade, about 8000 Russian nuclear warheads have been

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[12] Boureston J, Ferguson CD. Laser enrichment: Separation anxiety. Bull Atomic Scientists 2005;61(2):14-8.
[13] Makhijani A, et al. Uranium enrichment. Science for Democratic Action 2005 (March);13(1):11. Institute for Energy and Environmental Research. Available at: www.ieer.org/sdafiles/13-1.pdf.
[14] Greenpeace. Secrets, lies and uranium enrichment. The classified Silex project at Lucas Heights. Sydney, Greenpeace Australia, Nov 2004. Available at: www.greenpeace.org.au.

dismantled and converted into nuclear fuel, providing half of the uranium needed to run US nuclear power plants[15].

If the Silex process is fully developed, its eventual use for the production of fissile materials for use in nuclear weapons is probably inevitable. Thus in addition to Australian uranium exports fuelling weapons proliferation risks by contributing to the global pool of enriched uranium, successive Australian governments have allowed and supported highly proliferation sensitive enrichment R&D to be conducted in a public Australian facility, while publicly supporting non-proliferation. This is an inconsistent, immoral and indefensible position.

Global warming

The case study's terms of reference include the potential for expanded Australian uranium exports to reduce global greenhouse gas emissions. The framing of this term of reference again demonstrates a clear pre-emptive position supporting a highly questionable justification for expansion of nuclear power. The Association's assessment is that this justification has been seized upon and is being heavily advocated by members and proponents of the nuclear industry largely as an expedient attempt to rationalise a hazardous and unsustainable industry.

Expansion of nuclear power and uranium mining do not represent a feasible or appropriate solution to the momentous challenge of global warming:

- The IPCC has concluded that global CO2 emissions must be reduced by at least 70% over the next 100 years to stabiles atmospheric CO2 concentrations at 450 ppm, 60% higher than pre-industrial levels[16]. Reducing CO2 emissions from electricity generation by itself would be insufficient to achieve this target; thus even massive expansion of nuclear power could not by itself be sufficient.

- Nuclear power is one of the most expensive means of generating electricity, even without accounting for the risks of nuclear accidents, waste and weapons proliferation (eg cost assessment for US and/or Europe of 10.2 – 14.8 US cents per kilowatt hour, the lower estimate being higher than the upper end of the range for costs for wind - 5.3, hydropower – 8.8, and natural gas – 9.5) [17]. Even in France, highly dependent on nuclear power, officials have admitted that combined cycle electricity plants using natural gas are more economical than nuclear power plants[18].

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[15] Assadourian E. Nuclear energy. In: Worldwatch Institute. State of the world 2005. New York, WW Norton & Company, 2005:120-1.

[16] Intergovernmental Panel on Climate Change. Climate change 2001: The scientific basis. Cambridge, UK, Cambridge University Press, 2001:223-34.
[17] Sawin JL. Mainstreaming renewable energy in the 21st century. Worldwatch Paper 169. Washington DC, Worldwatch Institute 2004:12-13.
[18] Makhijani A. Nuclear power: No solution to global climate change. Science for Democratic Action 1998;6(3):1-16.

- Nuclear power is one of the most protected and heavily-subsidised industries in the world, and many cost estimates from proponents fail to take these into account. In the mid-1990s, governments worldwide were subsidizing fossil fuels and nuclear power to the tune of US$250-300 billion per annum. While several transitional and developing country governments have since reduced energy subsidies substantially, global subsidies for conventional (fossil fuel and nuclear) energy remain many magnitudes higher than those for benign alternatives such as efficiency and renewables[19].
- When the entire nuclear fuel cycle is taken into account and indirect greenhouse gas emissions are counted (including those of uranium mining, enrichment, fuel fabrication, transport, reactor construction and operation, decommissioning following an average lifespan of only a few decades, and waste management), nuclear power has been assessed as producing between 1.5 and 3 times as much carbon dioxide (CO2) per kilowatt-hour as wind power[20].
- Renewable energy sources are a feasible and practical alternative, particularly if coupled in a coherent and coordinated strategy with demand reduction and increased energy efficiency.
    - Each year, incoming solar radiation delivers to the Earth more than 10,000 times the energy that humans currently use. According to the International Energy Agency (IEA), buildings in industrialized countries offer enough suitable surfaces for photovoltaics(PV) to generate 15-50 % of current electricity needs. An IEA study concluded that very large scale PV systems installed on 4% of the world's deserts could produce sufficient electricity to meet world electricity demand (while helping to prevent further desertification)[21]. It has been estimated that a massive PV project in the Gobi desert area between western China and Mongolia could generate as much electricity as current world primary energy supply. Diversion of a substantial portion of the gargantuan global resources hemorrhaging away from areas of human and environmental need into global military expenditures - around US$950 billion per year – alone could provide the scale of resources required for major investments in renewable energy sources; at the same time enhancing long-term human security much more effectively.
    - Onshore wind resources could provide more than 4 times global electricity consumption. Substantial offshore wind resources are additional to this[22].
    - Brazil's ethanol program, started in 1975, has created more than 1 million jobs, brought the country's CO2 emissions 20% below what they otherwise would have been[23], displaced about 220,000 barrels of

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[19] Worldwatch Institute. State of the world 2004. Washington DC, WW Norton & Company, 2004:39.
[20] Assadourian E. Nuclear energy. In: Worldwatch Institute. State of the world 2005. New York, WW Norton & Company, 2005:120-1.
[21] Sawin JL. Mainstreaming renewable energy in the 21st century. Worldwatch Paper 169. Washington DC, Worldwatch Institute 2004:26.
[22] Worldwatch Institute. State of the world 2003. New York, WW Norton & Company, 2003:92-3.
[23] Worldwatch Institute. State of the world 2003. New York, WW Norton & Company, 2003:90.

oil daily, and saved Brazil more than US$52 billion in avoided fuel imports, many times the total investment in ethanol production[24].
    - Germany has transformed itself into a renewable energy leader, and has pledged to reduce its CO2 emissions 21% below 1990 levels by 2010. Electricity produced from renewable sources increased by 35% between 200 and 2001, and the German government aims for wind to generate 25% of electricity needs by 2025, and considers solar PVs as a viable option for large-scale power generation[25]
    - It has been estimated that every dollar invested in energy efficiency displaces 7 times as much emitted CO2 as a dollar invested in nuclear power, and with essentially no downside
    - The Intergovernmental Panel on Climate Change has concluded: 'In the longer term, renewable sources of energy could meet a major part of the world's demand for energy.'
- Further, renewable energy sources are generally domestic, pose few or no fuel or transport hazards, are much less vulnerable to terrorist attack, do not have the potential to be used to develop weapons of mass destruction, and do not pose risks of catastrophic accident or a need for extremely long-term management of contaminated sites and highly dangerous waste.

In addition to the overall evidence on economic aspects and greenhouse gas displacement being unfavourable for nuclear power, are the unique and largely unquantifiable issues of waste disposal, weapons proliferation, and risk of accident or attack.

To provide for much of the world's growth in electricity consumption and substantially replace fossil fuel fired plants would require construction of close to 2000 nuclear power plants (1000 megawatts each) in the next several decades. Given the long lead times involved, widespread and deep-seated community opposition, extraordinary cost – several trillion dollars, and massive environmental and proliferation risks, such an approach is not economically or socially feasible or in any way sustainable. It would involve production of about 50,000 tons of high-level radioactive waste annually, and the global inventory of commercial plutonium would rise to about 20,000 tons (20 million kg) by the middle of this century[26]. Around 10 kg is required for a nuclear bomb which can destroy a city. A scenario developed under the auspices of the Intergovernmental Panel on Climate Change (IPCC) projects that ten-fold expansion of nuclear power production over this century would produce 50-100 million kg of plutonium; posing a 'colossal' security threat.

Nuclear power facility accidents

All technology and all human behavior, to a greater or lesser degree, is prone to error. I was personally present at the 5th World Congress of International Physicians

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[24] Sawin JL. Mainstreaming renewable energy in the 21st century. Worldwatch Paper 169. Washington DC, Worldwatch Institute 2004:13.
[25] Worldwatch Institute. State of the world 2003. New York, WW Norton & Company, 2003:98.
[26] Makhijani A. Nuclear power: No solution to global climate change. Science for Democratic Action 1998;6(3):1-16.

for the Prevention of Nuclear War in Budapest when the Head of the Soviet Nuclear Energy Dept stated that the risk for a meltdown or similar catastrophe in a nuclear reactor was less than one in a million reactor years. That was less than one year before the accident at Chernobyl. The accident resulted in radiation exposures to almost 8.4 million people in Belarus, Ukraine and Russia, contamination of 150,000 square km, and agricultural areas covering almost 52,000 square km ruined for many centuries at least. Almost 400,000 people were eventually resettled, and millions continue to live in an environment of continued excess radiation exposure[27]. At least 6000 deaths resulted, with up to 34-fold increases in rates of thyroid cancer documented (highest in females aged up to 14 years at time of exposure)[28]. At least 3 million children require medical follow-up as a result of the accident[29], and health consequences will continue to accrue over decades for acute exposures, and millennia for longer-term exposures resulting from environmental contamination. By 1 Jan 2003, the Ukranian government had registered almost 100,000 individuals with 'disabilities connected with the Chernobyl disaster'[30].

Numerous other incidents and near misses underscore that risks of serious reactor accidents are not confined to specific types of reactors or particular countries – notable examples include the 30 Sep1999 criticality accident at the Tokai-mura nuclear power plant in Japan, the country's oldest nuclear reactor; the 28 March 1979 partial core meltdown at the Three Mile Island nuclear power plant in Pennsylvania; and a 2002 accident at the Davis-Besse nuclear power plant in Ohio, when boric acid corroded a hole within half a centimeter of breaching the 17 cm thick steel reactor vessel head that contained the reactor coolant, risking meltdown of the reactor core. Many nuclear power plants around the world, constructed in the 1960s and 70s, are now entering the last phase of life, increasing the probability of reactor failure and catastrophic accidents[31].

There is as yet almost no experience with decommissioning nuclear power plants effectively and providing assured long-term security and isolation of the radioactive and other toxic materials they contain from the environment, essentially indefinitely.

Continuation and expansion of nuclear power generation would magnify these major, long-term risks.

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[27] UN - Office for the Coordination of Humanitarian Affairs. Chernobyl: needs great 18 years after nuclear accident. Press release, 26 April 2004.
[28] Mahoney MC et al. Thyroid cancer incidence trends in Belarus: examining the impact of Chernobyl. Int J Epidemiology, 27 May 2004.
[29] Annan K, cited in: Schneider M. The Chernobyl disaster. A human tragedy for generations to come. In: IPPNW Global Health Watch. Rethinking nuclear energy and democracy after September 11, 2001. IPPNW Global Health Watch Report Number 4. Cambridge, MA, International Physicians for the Prevention of Nuclear War 2004:7-11.
[30] Report of the government of Ukraine. Annex III in: UNSG. Optimising the international effort to study, mitigate and minimize the consequences of the Chernobyl disaster. Report of the Secretary-General, UN General Assembly. 29 August 2003.
[31] Assadourian E. Nuclear energy. In: Worldwatch Institute. State of the world 2005. New York, WW Norton & Company, 2005:120-1.

Attacks on nuclear power facilities

Currently, 438 commercial nuclear power plants operate in 30 countries. Nuclear reactors and associated facilities, particularly spent fuel storage facilities, which contain large quantities of long-lived radioactive substances, potentially pose a highly attractive target for terrorist attack. Indeed considering feasibility, visibility, large number of potential targets, potential for severe consequences, with persistent environmental contamination over large areas and need for costly clean-up, major social disruption following widespread fear and panic and need for evacuation of populations in the fallout path, economic damage and political effect, it is hard to envisage many more attractive potential targets for terrorists. US reports indicate that diagrams of nuclear power plans were found in Al Qaeda hideouts in Afghanistan in 2002.

It is likely more a matter of good luck than good planning that thus far there has not been a terrorist attack on a nuclear facility which has resulted in release of radioactivity. Lesser attacks, however, have occurred on reactors under construction, including in Argentina, Spain, France and South Africa[32]. The closest the world has come to a major attack on a functioning nuclear plant (excluding the Israeli bombing of the near completed Osiraq reactor under construction in Iraq) may have been the fourth airliner which crashed into a Somerset, Pennslvania field on 11 Sept 2001, reportedly after passengers and crew fought the hijackers. This Boeing 767, after initially heading west and slightly south, looped around and headed east again. When it crashed, the plane was headed towards and only about 180 km (no more than 15 minutes flying time) from the Three Mile Island nuclear power plant[33]. Had it collided with the reactor, breach of the reactor containment and massive release of its radioactive contents is likely to have occurred.

Statements by the IAEA and US Nuclear Regulatory Commission, and research studies conducted by the US Dept of Energy, confirm that all current containment structures surrounding nuclear reactors could be breached by attacks such as those which occurred at the World Trade Centre in New York in 2001[34].

In both the US and Russia, simulated attacks on nuclear power plants have shown that many reactors are poorly secured, even against an attack by a handful of relatively lightly armed persons: 27 of the 57 simulated attacks in the US in the 1990s revealed significant vulnerabilities that could have caused reactor core damage and release of radioactivity[35]. Even unarmed environmental groups have been readily able to demonstrate the vulnerability of nuclear plants eg Greenpeace activists scaled the Sizewell reactor in the UK after storming the plant, and others similarly accessed the reactor complex at Lucas Heights in Sydney. Attacks could

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[32] Barnaby F. Nuclear terrorism. In: Taipale I et al (eds). War or health? A reader. London, Zed Books/ Physicians for Social Responsibility (Finland)/IPPNW 2002:164-72.

[33] Swedish Section of International Physicians for the Prevention of Nuclear War. Human factor - and the risk of nuclear war. Stockholm, SLMK, 2004:16.

[34] Sutton PM, Gould RM. Nuclear, radiological and related weapons. In: Levy BS, Sidel VW (eds). Terrorism and public health. New York, Oxford University Press/American Public Health Association 2003:220-242.

[35] Assadourian E. Nuclear energy. In: Worldwatch Institute. State of the world 2005. New York, WW Norton & Company, 2005:120-1.

also, alone or in combination, target more peripheral but important components of a nuclear plant's operation, such as the switchyard, cooling towers or cooling water conduits, or plant safety systems, such as emergency diesel generators. In a pressurized water reactor, core meltdown could occur within less than 1 minute after loss of coolant; with other types of reactor it might take a few minutes[36].

Of even greater concern than reactors are fuel storage facilities, particularly storage ponds for highly radioactive spent nuclear fuel. These often contain much larger radioactive inventories than reactors themselves, and generally are housed in simple buildings without robust containment structures, and therefore are more vulnerable to attack, and attacks would be more likely to result in catastrophic release of radioactivity.

Prof Joseph Rotblat, Nobel Peace Prize laureate, distinguished nuclear physicist and member of the Canberra Commission on the Elimination of Nuclear Weapons, demonstrated 24 years ago the dangers posed by conventional or nuclear attack on nuclear reactors[37]. The decay of radioactivity of a nuclear reactor is much slower than that following a nuclear explosion, because of a greater inventory of long-lived isotopes. Rotblat showed that an attack on a nuclear reprocessing plant or fuel storage tank would result in even greater and longer-lived radioactivity release than following an attack on a reactor, as illustrated in the Table.

Table. Areas affected by detonation of nuclear weapons alone and on nuclear power facilities[38]

Radiation dose between 1 month and 1 year after detonation(Gray)	Area (square km) 1 Mt bomb	1 Mt bomb on a 1000 MW reactor	1 Mt bomb on a spent fuel storage tank
1	2000	34,000	61,000
0.1	25,000	122,000	164,000

Mt –million tons TNT equivalent explosive power, MW – million watts electricity output

Thus even without the use of nuclear weapons, targeting of operating nuclear reactors and/or associated fuel storage or reprocessing facilities would essentially convert a war to a nuclear war, and a conventional terrorist attack into a nuclear attack.

The threat of nuclear terrorism is thus compounded by the dangerous nexus between nuclear weapons, a surfeit of often inadequately secured weapons-usable radioactive materials available to determined state and non-state actors who may be willing to

[36] Stockholm International Peace Research Institute. Nuclear radiation in warfare. London, Taylor & Francis Ltd, 1981:125-130.
[37] Stockholm International Peace Research Institute. Nuclear radiation in warfare. London, Taylor & Francis Ltd, 1981:125-130.
[38] ibid

use them for their own political purposes, and to the widespread presence of nuclear facilities and potential nuclear targets around the world.

Radioactive waste

It must be emphasized that the radioactive waste generated by nuclear reactors is long-lived and extremely dangerous: a typical 1000 megawatt (MW) reactor produces around 300 kg of plutonium per year. There is as yet no proven solution to the need to isolate with extreme reliability large volumes of extremely dangerous waste for the hundreds of thousands to millions of year periods required for their decay – essentially permanently. This is unprecedented: no such demand of human society has ever been made and no demonstrated human capacity has come within multiple orders of magnitude of meeting such a requirement. No human institution has persisted for more than hundreds to thousands of years.

No comprehensive and viable plan for long-term radioactive waste management is in place in any country. This and the previous two generations are forcibly committing virtually all future human generations to deal with this radioactive and toxic burden and be exposed to its dangers. Continuation and expansion of nuclear power would only add to this problem, with its inevitable risks of accident, leakage or sabotage, resulting in atmospheric, groundwater, soil and potential food chain radioactive contamination.

Radioactive waste could be used by terrorist groups to construct a radiological weapon, or 'dirty' bomb, involving release of radioactive material, for example in an urban area, or contaminating a water supply, resulting in thousands to tens of thousands of acute deaths, extensive environmental contamination and severe socio-economic disruption[39].

Health and environmental hazards of uranium mining, enrichment and transport

These are clearly important issues in Australia for the Committee to address, including denial of rights of Aboriginal people, contributing to adverse health outcomes; evidence of poor mine management practices and of frequent incidents of leakage of radioactive materials into the environment, particularly at the Ranger and Roxby Downs mines; and absence of long-term follow-up of health outcomes for uranium mining workers. However these are not be addressed in detail in this submission; it is expected that they will be covered in appropriate detail in other submissions to the Inquiry.

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[39] Sutton PM, Gould RM. Nuclear, radiological and related weapons. In: Levy BS, Sidel VW (eds). Terrorism and public health. New York, Oxford University Press/American Public Health Association 2003:220-242.

Conclusions

1. The nexus between civil and military nuclear technology is inextricable.

2. The proliferation, accident, terrorist attack, and inherent nuclear fuel cycle health and environmental dangers of nuclear reactors, have never been more apparent. They are unacceptable and unsustainable.

3. Uranium mining inevitably contributes both to risks related to nuclear reactors and to nuclear weapons. Its expansion would exacerbate these risks, with potential for catastrophic and incalculable consequences which would utterly overwhelm any short-term economic gain.

4. Nuclear power does not represent a solution to the serious problem of global warming.

5. The priorities for Australia's energy future should be urgent, substantive and coordinated action to increase energy efficiency, reduce energy demand, and replace conventional fossil fuel energy sources with environmentally benign renewable energy technologies. These measures do constitute a sustainable solution to global warming, are associated with few risks, and have many other benefits.

6. Research and development into uranium enrichment in Australia, if successful, can be expected to increase dangers of nuclear weapons proliferation, is inconsistent with support for nuclear non-proliferation and disarmament, and should be stopped immediately.

7. The only sustainable defence against the threat posed by nuclear weapons is their elimination, along with measures to ensure that they will never again be produced. This will require phasing out of nuclear power. The sooner we embark on this path, the less risk a nuclear catastrophe will overtake us.

8. Uranium mining in Australia, rather than being expanded, should be rapidly phased out as another dangerous relic of a century in which the demise of human societies and unimaginable harm to the ecosphere, of which they are a part and which supports them, was seriously courted.

9. Annex 1 – Background to MAPW

Mission Statement

MAPW as the Australian affiliate of the global federation, International Physicians for the Prevention of Nuclear War, affirms the mission statement of IPPNW as its own:

"IPPNW is a non-partisan international federation of physicians' organisations dedicated to research, education and advocacy relevant to the prevention of nuclear war. To this end, IPPNW seeks to prevent all wars, to promote non-violent conflict resolution and to minimise the effects of war on health, development and the environment."

MAPW Objectives

- Consider and formulate the ethical responsibilites of physicians in relation to war;
- Inform medical practitioners, other health professionals, governments and the general public about the consequences to health of war and its preparation, particularly nuclear, chemical and biological warfare;
- Examine the psychological mechanisms by which people come to accept war as a necessity, and promote non-violent methods of conflict resolution at personal, community and national levels;
- Oppose the use of medical science for any purpose other than the prevention and relief of suffering;
- Urge that the financial, technical and human resources spent on armaments be directed to uses that promote the health and welfare of humanity;
- Cooperate with all medical practitioners having the same aims, in all countries.

About MAPW

Medical Association for Prevention of War Australia (MAPW) was founded in 1981.

We work for the elimination of all weapons of mass destruction and for the prevention of armed conflict. We aim to reduce the physical and psychological impact, and the environmental effects of war. We promote the use of human and technological resources for human and environmental well-being rather than the acquisition of armaments.

MAPW is the Australian affiliate of International Physicians for the Prevention of Nuclear War (IPPNW). This international federation has affiliates in 58 countries and

was awarded the Nobel Peace Prize in 1985. MAPW has contributed to IPPNW almost since its inception. MAPW was awarded the Australian Peace Award in 1986 by former Prime Minister Bob Hawke during the International Year of Peace. The XIIIth IPPNW World Congress was held in Melbourne in December 1998. MAPW will hold its next National Conference in Melbourne on 6-7 August 2005.

There are branches of MAPW in each Australian state and territory and the eight Branch Coordinators together with the Executive comprise the National Council of the Association.

MAPW is independent of all political parties.

Annex 2 – MAPW 1987 policy statement regarding uranium mining and nuclear power

V. Uranium mining and nuclear power in Australia

Preamble

MAPW (Australia) opposing all preparations to use or threaten to use nuclear weapons and strongly supporting the abolition of all nuclear weapons, recognizes the following:

1. The nuclear fuel cycle, particularly nuclear power reactors, plays a significant role in the horizontal and vertical proliferation of nuclear weapons.
2. The consequences of human and technical failure in reactor systems can be disastrous, global and long term in their effects, able to affect many future human generations. The continued existence of the world's people must not depend on the perfect functioning of such fallible technology.
3. The targeting of nuclear power stations in either nuclear or conventional war would in the former case significantly increase the radiological burden for survivors, and in the latter case, convert it into a nuclear war.
4. There are no tested and secure methods for the long-term disposal of nuclear waste.
5. The need to ensure the existence of facilities to safely produce, store and dispose of isotopes for medical, research and peaceful industrial uses. Such facilities must not in any way be linked with the nuclear fuel cycle.

Policy

MAPW (Australia) opposes:

1. the mining of uranium in Australia and its export from Australia.
2. the design, construction and commissioning of nuclear power stations, enrichment and reprocessing plants, and waste storage and disposal facilities anywhere in Australia.

1987