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NUCLEAR POWER AND WEAPONS PROLIFERATION

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An initiative of the Medical Association for Prevention of War www.mapw.org.au
the International Campaign to Abolish Nuclear Weapons www.icanw.org.au
and Friends of the Earth, Australia http://www.foe.org.au/anti-nuclear

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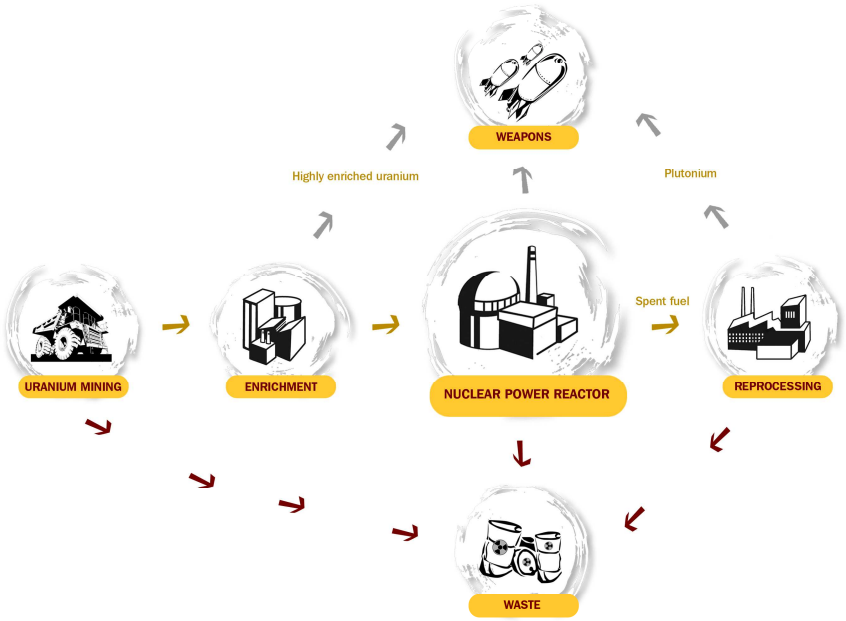

Summary

Key points:
* There is a long history of peaceful nuclear programs providing political cover and technical support for nuclear weapons programs. An expansion of nuclear power is likely to exacerbate the problem.
* All existing and proposed nuclear power concepts pose unacceptable risks of facilitating weapons proliferation.
* The nuclear 'safeguards' system is flawed, limited in its scope, and seriously under-resourced.

Of the 10 nations to have produced nuclear weapons
* Six did so with crucial political cover and/or technical support from their supposedly peaceful nuclear program – France, India, Pakistan, Israel, South Africa and North Korea.
* The other four nuclear weapons states (US, Russia, China, UK) developed nuclear weapons before nuclear power − but there are still significant links between their peaceful and military nuclear programs (e.g. routine transfer of personnel).
* Eight of the 10 nations have nuclear power reactors (with those eight countries accounting for nearly 60% of global nuclear power capacity).
* North Korea has no operating power reactors (but nevertheless its nuclear power development program was central to its weapons program).
* Israel has no power reactors, though the pretence of an interest in the development of nuclear power helped to justify nuclear transfers to Israel.

Click here for a Choose Nuclear Free webpage for country case studies illustrating the links between nuclear power and weapons. <www.choosenuclearfree.net/energy/countries>

Direct connections between nuclear power and weapons

Examples of the direct use of nuclear power reactors in weapons programs include the following:

North Korea's nuclear weapons tests have used plutonium produced in an Experimental Power Reactor.

Power reactors are used in support of India's nuclear weapons program − this has long been suspected and is no longer in doubt since India is refusing to allow eight out of 22 reactors to be subject to International Atomic Energy Agency safeguards inspections.

The use of power reactors in the US to produce tritium for use in 'boosted' nuclear weapons.

The 1962 test of sub-weapon-grade plutonium by the US may have used plutonium from a power reactor.

Pakistan may be using power reactor/s in support of its nuclear weapons program.

Australian Prime Minister John Gorton had military ambitions for the power reactor he pushed to have constructed in the late 1960s at Jervis Bay on the NSW coast. He later said: "We were interested in this thing because it could provide electricity to everybody and it could, if you decided later on, it could make an atomic bomb."

France's civilian nuclear program provided the base of expertise for its later weapons program, and material for weapons was sometimes produced in power reactors.

Magnox reactors in the UK had the dual roles of producing weapon grade plutonium and generating electricity.

Indirect connections between nuclear power and weapons

Nuclear power programs have facilitated and provided cover for weapons programs even without direct use of power reactor/s in the weapons program. Nuclear power programs provide a rationale for the acquisition and use of:
* enrichment technology (which can produce low enriched uranium for power reactors or highly enriched uranium for weapons)
* reprocessing technology (which divides spent nuclear fuel into three streams − uranium, high-level waste, and weapons-useable plutonium).
* research and training reactors (which can produce plutonium and other materials for weapons and also be used for weapons-related research).

The nuclear weapons programs in South Africa and Pakistan were outgrowths of their power programs although enrichment plants, not power reactors, produced the fissile material for use in weapons.

Research and training reactors, ostensibly acquired in support of a power program or for other civil purposes, have been the plutonium source for weapons in India and Israel and have been used for weapons-related research and experiments in numerous other countries including Iraq, Iran, South Korea, North Korea, Taiwan, Yugoslavia, and possibly Romania.

Nuclear power programs can facilitate weapons programs even if power reactors are not actually built. Iraq provides a clear illustration of this point. While Iraq's nuclear research program provided much cover for the weapons program from the 1970s to 1991, stated interest in developing nuclear power was also significant. Iraq pursued a 'shop til you drop' program of acquiring dual-use technology, with much of the shopping done openly and justified by nuclear power ambitions. According to Khidhir Hamza, a senior nuclear scientist involved in Iraq's weapons program: "Acquiring nuclear technology within the IAEA safeguards system was the first step in establishing the infrastructure necessary to develop nuclear weapons. In 1973, we decided to acquire a 40-megawatt research reactor, a fuel manufacturing plant, and nuclear fuel reprocessing facilities, all under cover of acquiring the expertise needed to eventually build and operate nuclear power plants and produce and recycle nuclear fuel. Our hidden agenda was to clandestinely develop the expertise and infrastructure needed to produce weapon-grade plutonium."

Plutonium production

Power reactors have been responsible for the production of a vast quantity of weapons-useable plutonium. A typical power reactor (1000 MWe) produces about 300 kilograms of plutonium each year. Total global production of plutonium in power reactors is about 70 tonnes per year. As at the end of 2009, power reactors had produced an estimated 2000 tonnes of plutonium.

Using the above figures, and assuming that 10 kilograms of ('reactor grade') plutonium is required to produce a weapon with a destructive power comparable to that of the plutonium weapon dropped on Nagasaki in 1945:
* The plutonium produced in a single reactor each year is sufficient for 30 weapons.
* Total global plutonium production in power reactors each year is sufficient to produce 7,000 weapons.
* Total accumulated 'civil' plutonium is sufficient for 200,000 weapons.

The 'reactor-grade' plutonium routinely produced in nuclear power reactors can be used in nuclear weapons though there are ongoing debates concerning the implications for weapon reliability and yield. Moreover, using a power reactor to produce many hundreds of kilograms of weapon grade

plutonium per year could hardly be simpler – all that needs to be done is to shorten the irradiation time, thereby maximising the production of plutonium-239 relative to other, unwanted plutonium isotopes. Just a few kilograms of this weapon grade plutonium is required for one nuclear weapon. www.foe.org.au/anti-nuclear/issues/nfc/power-weapons

Adding to the proliferation risk is the growing stockpile of unirradiated plutonium (as opposed to plutonium contained in spent fuel), as reprocessing outstrips the use of plutonium in MOX (mixed oxide fuel containing plutonium and uranium) and its (negligible) use in fast neutron 'breeder' reactors. Unirradiated plutonium can be used directly in weapons or after simple chemical processing, and is therefore of greater proliferation concern than plutonium in spent fuel (which can only be separated in a nuclear reprocessing plant).

As at December 2008, there were 256 tonnes of civil unirradiated plutonium − increasing at an average annual rate of 7.9 metric tonnes since 1996.

All that would need to be done to address the problem of growing stockpiles of unirradiated plutonium would be to slow or suspend reprocessing until the stockpile is drawn down.

Alternative reactor types

There is little reason to believe that minimising proliferation risks will be a priority in the evolution of nuclear power technology. The growing stockpiles of unirradiated plutonium provide compelling evidence of the low priority given to non-proliferation initiatives compared to commercial and political (and sometime military) imperatives.

A number of the 'advanced' reactor concepts being studied involve fast neutron reactors (a.k.a. fast spectrum reactors or breeder reactors) which use plutonium as the primary fuel. There are various possible configurations of these systems. Most rely on irradiation of a natural or depleted uranium blanket which produces plutonium which can be separated and used as fuel. Fast reactors can potentially produce more plutonium than they consume, and they are generally well suited for the production of weapon grade plutonium.

Fast reactors can be 'breeders' (producing more fissile material than they consume) or burners or they can produce as much fissile material as they consume. Burner reactor concepts have some obvious attractions from a non-proliferation standpoint but the claims made about the proliferation resistance of these reactor concepts has been grossly overblown. (Click here for more information.) http://www.foe.org.au/anti-nuclear/issues/nfc/power-weapons/g4nw

Like conventional reactors, proposed 'Pebble Bed' reactors are based on uranium fission. The nature of the fuel pebbles may make it somewhat more difficult to separate plutonium from irradiated fuel. However, uranium (or depleted uranium) targets could be inserted to produce weapon-grade plutonium for weapons. The enriched uranium fuel could be further enriched for weapons − particularly since the proposed enrichment level of 9.6% uranium-235 is about twice the level of conventional reactor fuel. The reliance on enriched uranium will encourage the use and perhaps proliferation of enrichment plants, which can be used to produce highly enriched uranium for weapons.

Fusion power systems remain a distant dream, and fusion also poses a number of weapons proliferation risks including the following:
* Using neutron radiation to bombard a uranium blanket (leading to the production of fissile plutonium) or a thorium blanket (leading to the production of fissile uranium-233).
* Research in support of a (thermonuclear) weapon program.

Fusion power has yet to generate a single Watt of useful electricity but it has already contributed to proliferation problems. According to Khidhir Hamza, a senior nuclear scientist involved in Iraq's weapons program in the 1980s: "Iraq took full advantage of the IAEA's recommendation in the mid 1980s to start a plasma physics program for "peaceful" fusion research. We thought that buying a plasma focus device ... would provide an excellent cover for buying and learning about fast electronics technology, which could be used to trigger atomic bombs."

The use of thorium-232 as a reactor fuel is sometimes suggested as a long-term energy source, partly because of its relative abundance compared to uranium. No thorium-based power system would negate proliferation risks altogether. Neutron bombardment of thorium (indirectly) produces uranium-233, a fissile material which is subject to the same safeguards requirements as uranium-235.

The US has successfully tested weapons using uranium-233 (and France may have too). India's thorium program must have a WMD component − as evidenced by India's refusal to allow IAEA safeguards to apply to its thorium program. Thorium fuelled reactors could also be used to irradiate uranium to produce weapon grade plutonium. The possible use of HEU or plutonium to initiate a thorium-232/uranium-233 reaction, or proposed systems using thorium in conjunction with HEU or plutonium as fuel, present further risks of diversion of HEU or plutonium for weapons production as well as providing a rationale for the ongoing operation of dual-use enrichment and reprocessing plants and the construction of new plants.

Click here for more information on the proliferation risks associated with thorium.)
http://www.foe.org.au/anti-nuclear/issues/nfc/power-weapons/thorium

Safeguards

The International Atomic Energy Agency's safeguards system is seriously flawed and under-resourced. Recently-retired IAEA Director-General Mohamed El Baradei has described the IAEA's basic inspection rights as "fairly limited", complained about "half-hearted" efforts to improve the system, and expressed concern that the safeguards system operates on a "shoestring budget ... comparable to a local police department".

More information: www.choosenuclearfree.net/safeguards

Terrorism and sabotage

Examples of nuclear terrorism include:
* The hijacking of a plane in 1972 and the ensuing threat to crash it into the Oak Ridge nuclear research reactor.
* Basque separatists bombing a nuclear power plant under construction in Spain in 1982.
* ANC guerrilla fighters bombing the Koeberg nuclear plant under construction in South Africa in 1982.
* Sabotage of three of the four off-site power lines leading to the Palo Verde nuclear power plant in Arizona in 1986.
* A man ramming a station wagon under a partly opened door in the turbine building at the Three Mile Island nuclear plant in Pennsylvania in 1993.

A 12.5 kiloton bomb (a little smaller than the Hiroshima bomb) smuggled on a cargo ship into New York City, according to US government analytical tools, is estimated to cause: 52,000 immediate deaths from heat and blast; 238,000 people exposed to direct radiation, of which 10,000 would die and 44,000 would suffer acute radiation sickness; 1.5 million people would be exposed to radioactive fallout in the following few days – in the absence of effective evacuation or sheltering this could kill

an additional 200,000 people and cause hundreds of thousands to suffer acute radiation sickness. (Helfand I., Forrow L., Tiwari J., 2002, 'Nuclear terrorism', British Medical Journal, 324:356-9.)

(For more information on nuclear terrorism see Tilman Ruff, 2006, 'Nuclear Terrorism', EnergyScience Coalition Briefing Paper #10, <www.energyscience.org.au/factsheets.html>)

Nuclear theft and smuggling

The IAEA Illicit Trafficking Database contains more than 1000 confirmed reports on incidents involving smuggling, theft, loss and illegal disposal, illegal possession and transfer, and attempted illegal sales of nuclear material. Around 800 additional incidents are as yet unconfirmed. Globally, the number of reported incidents of trafficking has been increasing through some combination of increased trafficking and better detection. (www-ns.iaea.org/security/itdb.htm)

Conventional military strikes on nuclear plants

There is a long history of conventional military strikes on ostensibly peaceful nuclear plants in the Middle East, driven by proliferation fears. Examples include the destruction of reactors in Iraq by Israel and the US; Iran's attempts to strike nuclear facilities in Iraq during the 1980-88 war (and vice versa); Iraq's attempted strikes on Israel's nuclear facilities; and, most recently, Israel's bombing of a suspected nuclear reactor site in Syria in 2007.

If we extend that line of thought, what happens when two nuclear-powered nations go to war? Will they shut down their power reactors and go without electricity, or take the risk of a Chernobyl-scale catastrophe initiated by missile strikes? What happens on the Indian subcontinent if there is a major expansion of nuclear power? The US National Counterterrorism Center has documented 4462 terrorist incidents in India and 3687 in Pakistan over the past five years. A large expansion of nuclear power will increase the risk of subcontinental terrorism going nuclear.

Clean energy comparison

There are no connections between renewable energy or energy efficiency technologies and Weapons of Mass Destruction. This is arguably the single most compelling reason to pursue clean energy options rather than nuclear power.

Terrorism, sabotage and conventional military strikes pose no risk of catastrophic outcomes for renewable energy systems, with the exception of some hydro plants.

Theft and smuggling are of no consequences for clean energy systems, and safeguards inspections are not required.

Quotable Quotes

Former US Vice President Al Gore:
"For eight years in the White House, every weapons-proliferation problem we dealt with was connected to a civilian reactor program. And if we ever got to the point where we wanted to use nuclear reactors to back out a lot of coal ... then we'd have to put them in so many places we'd run that proliferation risk right off the reasonability scale."
(<www.grist.org/news/maindish/2006/05/09/roberts>)

Former US President Bill Clinton:
"The push to bring back nuclear power as an antidote to global warming is a big problem. If you build more nuclear power plants we have toxic waste at least, bomb-making at worse." (Clinton Global Initiative, September 2006.)

Former Australian Prime Minister Paul Keating:
"Any country with a nuclear power program "ipso facto ends up with a nuclear weapons capability". (AAP, October 16, 2006.)

Assoc. Prof. Tilman Ruff from the International Campaign to Abolish Nuclear Weapons:
"A world free of nuclear weapons will be much more readily achieved and sustained were nuclear power generation being phased out."
(9 November 2009, 'Hiroshima and the World: We can imagine and build a world free of nuclear weapons', www.hiroshimapeacemedia.jp/mediacenter/article.php?story=20091109140250161_en)

Editorial in the Bulletin of the Atomic Scientists:
"As we see it, however, the world is not now safe for a rapid global expansion of nuclear energy. Such an expansion carries with it a high risk of misusing uranium enrichment plants and separated plutonium to create bombs. The use of nuclear devices is still a very dangerous possibility in a world where Russian and U.S. ballistic missiles are on hair trigger and long-standing conflicts between countries and among peoples too often escalate into military actions. As two of our board members have pointed out, 'Nuclear war is a terrible trade for slowing the pace of climate change.'"
(14 January 2010, www.thebulletin.org/content/media-center/announcements/2010/01/14/it-6-minutes-to-midnight)

Victor Gilinsky, former member of the US Nuclear Regulatory Commission:
"We should support as much nuclear power as is consistent with international security; not as much security as the spread of nuclear power will allow." ('A call to resist the nuclear revival', Bulletin of the Atomic Scientists, 27 January 2009, <www.thebulletin.org/web-edition/op-eds/call-to-resist-the-nuclear-revival>.)

Dr Mark Diesendorf, University of NSW:
"On top of the perennial challenges of global poverty and injustice, the two biggest threats facing human civilisation in the 21st century are climate change and nuclear war. It would be absurd to respond to one by increasing the risks of the other. Yet that is what nuclear power does." ('Need energy? Forget nuclear and go natural', October 14, 2009, www.theage.com.au/opinion/society-and-culture/need-energy-forget-nuclear-and-go-natural-20091014-gvzo.html)

International Panel on Fissile Materials:
"Even with stringent and equitable new rules to govern nuclear power, its continued operation and certainly any global expansion will impose serious proliferation risks in the transition to nuclear disarmament. A phase-out of civilian nuclear energy would provide the most effective and enduring constraint on proliferation risks in a nuclear-weapon-free world." (Global Fissile Material Report, 2009, www.fissilematerials.org/ipfm/pages_us_en/documents/documents/documents.php)

Ranger Uranium Environmental Inquiry, 1977:
"The nuclear power industry is unintentionally contributing to an increased risk of nuclear war. This is the most serious hazard associated with the industry."

Sir Phillip Baxter, former head of the Australian Atomic Energy Commission:
"Almost every action, every piece of research, technological development or industrial activity carried out in the peaceful uses of atomic energy could also be looked upon as a step in the manufacture of

nuclear weapons. There is such an overlap in the military and peaceful technologies in these areas that they are virtually one." (Australian Doubts on the Treaty, Quadrant, Vol.XII(3), 1968, p.31.)

(Then) IAEA Director-General Mohamed El Baradei:
"If a country with a full nuclear fuel cycle decides to break away from its non-proliferation commitments, a nuclear weapon could be only months away. In such cases, we are only as secure as the outbreak of the next major crisis. In today's environment, this margin of security is simply untenable." (December 2005, 'Reflections on Nuclear Challenges Today'.)

Myth-busting

John Carlson from the Australian Safeguards and Non-proliferation Office states: "I have pointed out on numerous occasions that nuclear power as such is not a proliferation problem – rather the problem is with the spread of enrichment and reprocessing technologies ..."

Carlson's claim is false and disingenuous:
* Power reactors have been used directly in weapons programs.
* Power programs have facilitated and provided cover for weapons programs even without direct use of power reactor/s in the weapons program − not least by justifying the acquisition and use of enrichment and reprocessing technology.
* Power reactors produce large volumes of weapons-useable 'reactor grade' plutonium and can be operated on a short irradiation cycle to produce large volumes of weapon grade plutonium.

Claims made about power reactors also ignore the fact that research and training reactors, ostensibly acquired in support of a power program or for other civil purposes, have been the plutonium source in India and Israel. Small volumes of plutonium have been produced in 'civil' research reactors then separated from irradiated materials in a number of countries suspected of or known to be interested in the development of a nuclear weapons capability - including Iraq, Iran, South Korea, North Korea, Taiwan, Yugoslavia, and possibly Romania. Pakistan announced in 1998 that a powerful 'research' reactor had begun operation at Khusab; if so, the reactor can produce unsafeguarded plutonium. (The links between research reactor programs and nuclear weapons are addressed in detail in Green, 2002.)

Some nuclear advocates (e.g. Prof Barry Brook from Adelaide University) claim that the weapons 'genie is out of the bottle' and that we therefore need not concern ourselves about the proliferation risks assocated with an expansion of nuclear power. However:
* Only 5% of the world's nations have produced nuclear weapons − so that particular genie is not out of the bottle.
* About 25% of the world's nations have the capacity to produce significant quantities of fissile (explosive) material for nuclear weapons. In a large majority of cases, the fissile material production capacity arises from the operation of power reactors or research reactors.

According to Ian Hore-Lacy from the Uranium Information Centre: "Happily, proliferation is only a fraction of what had been feared when the NPT was set up, and none of the problem arises from the civil nuclear cycle." That claim ignores the widespread use of ostensibly civil facilities and materials in weapons programs.

Some nuclear advocates claim that the 'reactor grade' plutonium routinely produced in power reactors cannot be used in weapons. The claim is false and in any case it ignores the potential to operate power reactors on a short irradiation cycle to produce large volumes of weapon grade plutonium.

The IAEA claims that: “The large scale production of plutonium for nuclear weapons has always been through specially designed plutonium production reactors.” This ignores the use of 'research’ reactors used to produce plutonium for weapons in India, Israel and possibly Pakistan, and it ignores North

Korea's 'Experimental Power Reactor' and the use of power reactors to produce plutonium for weapons in India, the UK, possibly France, and possibly Pakistan.

The IAEA (1997) claims that: “The availability of plutonium for weapons is not dependent on continued civil nuclear power activities.” However, civil nuclear programs are a potential source of plutonium for states which want plutonium or want more than they already have.

Nuclear proponents sometimes attempt to downplay the significance of the dual-use capabilities of nuclear facilities and materials by noting the dual-use capabilities of many non-nuclear materials. For example, steel has a myriad of military and civil uses, and planes can be used as missiles. This overlooks the problem that nuclear weapons are unique in their destructive potential – far more destructive than conventional weapons and considerably more destructive than other Weapons of Mass Destruction’. It ignores the fact that there are typically a myriad of pathways to the production of conventional, chemical andbiological weapons, whereas for nuclear weapons the are just a couple of fundamental choices − pursuit of highly-enriched uranium and/or plutonium, and a dedicated (sometimes secret) weapons program or the pursuit of weapons under cover of a peaceful program.

More information

Country case studies on links between civil and military nuclear programs:
* Nuclear Threat Initiative: www.nti.org/e_research/profiles/index.html
* Institute for Science and International Security, "Nuclear Weapons Programs Worldwide: An Historical Overview", http://isis-online.org/nuclear-weapons-programs
* Nuclear Weapon Archive, "Nuclear Weapon Nations and Arsenals", nuclearweaponarchive.org/Nwfaq/Nfaq7.html
* GlobalSecurity.org www.globalsecurity.org/wmd/world/index.html
* Friends of the Earth - Case Studies: Civil Nuclear Programs and Nuclear Weapons Proliferation www.foe.org.au/anti-nuclear/issues/nfc/power-weapons
* Otfried Nassauer, December 2005, "Nuclear Energy and Proliferation", Nuclear Issues Paper No. 4, <www.boell.de/ecology/climate/climate-energy-1350.html> or direct download: www.boell.de/downloads/ecology/NIP4NassauerEndf.pdf

More information on the connections between civil and military nuclear technologies and programs:
* Alan Roberts, Generating Electrical Power - And Atomic Bombs, Briefing Paper #17, www.energyscience.org.au/factsheets.html
* Nuclear weapons and nuclear power − International Campaign to Abolish Nuclear Weapons (ICAN) Australia briefing paper, December 2009, http://icanw.org/weapons_power
* Friends of the Earth website www.foe.org.au/campaigns/anti-nuclear/issues/nfc/power-weapons
* Steven E. Miller & Scott D. Sagan, Nuclear power without nuclear proliferation?, Daedalus, Fall 2009, http://iis-db.stanford.edu/pubs/22659/Sagan_Nuclear_power_without_nuclear_proliferation.pdf
* Victor Gilinsky, A call to resist the nuclear revival, 27 January 2009, Bulletin of the Atomic Scientists, www.thebulletin.org/web-edition/op-eds/call-to-resist-the-nuclear-revival
* EnergyScience Briefing Papers inc #9, 11, 15 and 17, www.energyscience.org.au/factsheets.html
* Paul Leventhal, 2002, Sharon Tanzer, Steven Dolley (eds), Nuclear power and the spread of nuclear weapons: can we have one without the other?, order online e.g. at Amazon.

Information on safeguards:
* IAEA: <www.iaea.org/OurWork/SV/Safeguards/index.html>
* Medical Association for Prevention of War <www.mapw.org.au/nuclear-chain/safeguards>
* Friends of the Earth safeguards section: <www.foe.org.au/anti-nuclear/issues/oz/u/safeguards>
* Medical Association for the Prevention of War and Australian Conservation Foundation, 2006, "An Illusion of Protection: The Unavoidable Limitations of Safeguards", <www.mapw.org.au/download/illusion-protection-acf-mapw-2006>

* Non-Proliferation Policy Education Centre, <www.npolicy.org/taxonomy/term/35>
* Nuclear Power Joint Fact Finding Dialogue, June 2007, <www.keystone.org/spp/energy/electricity/nuclear-power-dialogue>
* Who's watching the nuclear watchdog?, Richard Broinowski and Tilman Ruff, Online Opinion, 10 September 2007, <www.onlineopinion.com.au/view.asp?article=6339>
* Richard Leaver, Value-subtracting: Form vs. substance in Australian uranium safeguard policy, Austral Special Report 09-08S, 11 December 2009, <www.globalcollab.org/Nautilus/australia/apsnet/reports/2009/leaver-safeguards.pdf>
* Richard Leaver, Nuclear Safeguards: some Canadian questions about Australian policy, Austral Policy Forum 09-5A, 23 February 2009, <www.globalcollab.org/Nautilus/australia/apsnet/policy-forum/2009/leaver>