Energy ~ Climate ~ Security

http://www.nirs.org/southeast/nukesclimatetalk092007.pdf (citation links are hot)

Expanding Nuclear Power is Not a Solution to the Climate Crisis

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As the world reeled in the wake of the atomic destruction of Hiroshima and Nagasaki, it is understandable that many people innocently embraced the idea that splitting atoms could be a good thing. Atoms for Peace spoke to a generation that needed to address their collective conscience and anxiety. Unfortunately atoms that are split are ***not*** peaceful: all industrial-scale fission results in massive new radioactivity with the capacity to do harm at both high levels (causing tissue and organ damage) and low levels (causing cellular damage, often to DNA resulting in mutations that cause cancer, sterility, birth defects and a host of other complications[1]). Splitting uranium atoms for energy results in the production of plutonium; this plutonium can be (and has been) used to make nuclear weapons. Even in medicine, it is the destructive force of radiation that is harnessed to attack disease or to penetrate tissue. *Radioactive atoms are not peaceful!*

Just as nuclear energy is intrinsically incapable of stopping the spread of nuclear weapons, atomic power is also intrinsically incapable of reversing – or even significantly slowing the global Climate Crisis. Nonetheless, Bush and Cheney are promoting nuclear power as a key remedy to climate change, and concomitantly listing climate as a key reason for the world to re-invest in this failed energy technology. Nuclear energy *is* failed -- it is only the considerable liability of CO2 production that creates any kind of an "economy" in which investment of either public or private funds in new nuclear infrastructure would be considered in the USA, at all – *but nuclear should be rejected as a climate "fix" since a technology that cannot compete with other options should not be the preferred strategy in the face of crisis*.[2]

Nuclear Power Will Not, and *Cannot* Solve the Climate Crisis[3]

There are multiple issues that must be considered when engaging with the issue of nuclear power. Expanding the nuclear power infrastructure worldwide will not be an effective response to the climate crisis precisely because nuclear energy is known not to be viable in non-monopoly free markets – it cannot compete. It has been three decades since any energy corporation in the United States ordered a nuclear power reactor that was not subsequently canceled. Indeed, the current rush for new reactor applications is **only** because of massive subsidies that have been signed into law under the Bush administration. Few energy corporations located in states where energy is no longer fully regulated by the state and where there are no longer monopolies of production, distribution and sale are considering participation in this nuclear welfare due, no doubt, to the fact that without such monopolies consumers are no longer hostage to the higher electric power prices that new nuclear investment will bring.[4] Wall Street analysts also noted early in this attempt at nuclear revival that trying nuclear in anything but a fully regulated market would be more than risky. [5]

The good news is that nuclear is not only expensive when compared to burning coal (which must be phased out to reduce carbon emissions) – it is significantly more expensive that truly green, sustainable energy options as well.

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- **A dollar invested in new wind generation infrastructure returns two to three times more electricity than a dollar invested in new nuclear power infrastructure will.**[6]
- **A dollar invested in energy efficiency – including technologies like cogeneration that prevent the loss of potential energy from industrial systems – will yield 7 – 10 times more avoided-energy-use (and therefore need for generation) than the dollar invested in new nuclear power generating infrastructure.**[7]

For some years now, wind has been the fastest-growing new electric power generating capacity[8] – and for honest market-based reasons! Energy efficiency is finally making a foothold as mega-corps such as DuPont Chemical are making investments that not only cut their energy consumption, but are immediately *profitable, due to the averted cost of energy not used.*[9] It is universally true that the cost of energy not-needed is less than any form of new power generation. What has taken time to comprehend is that this reduced-need can be traded as "nega-watts."[10] Energy efficiency is not a new thought, but it is a new way of thinking!

Please note that US spot-market prices quoted today for "the price of nuclear power" **do not** adequately represent the cost of new nuclear generating capacity. This is because today's reactors were built with funds that in many cases were never paid off – during the 1980's and 1990's reactors sold for a dime on the dollar – the large conglomerates that emerged have trimmed expenses in ways that likely will not be sustainable over time; let alone all the true costs that are never included, such as impacts on health and the true long-term waste costs.

So when it comes to the climate crisis, the fact that nuclear energy **cannot** compete is a crucial piece of information – for the same level of investment (of either commercial or public funds) – one gets 3 – 10 times more reduction in greenhouse gas emissions from non-nuclear energy infrastructure and programs compared to building new nuclear power reactors. Since the overall level of investment in nuclear power that would be required to take a sizable bite out of global greenhouse emissions is on the order of 1500 new power plants[11] – each projected to cost somewhere between $2 and $6 billion for **each unit**[12] this is an astronomical amount of money – running in the many trillions dollars. What about *trillions* spent on wind and wave energy? – The numbers say we would get more energy (turn off more coal plants) than spending it on nukes – without the health and security risks!

The climate crisis is real – and rapid action is required. News from this past week confirms that changes in Earth's systems are, unfortunately, progressing far more rapidly than previously thought. A scientist interviewed on the radio Friday warned that we have no time to delay. [13] We cannot afford to invest limited resources for dealing with this crisis in a technology that does not give a good rate of return on the money invested! New nuclear generating capacity is like a black hole when it comes to addressing this crisis. For those seeking real reduction in greenhouse gas emissions from the US "energy pig" energy efficiency is the number one option – with wind, appropriate hydro and solar all more preferable than investment in new nuclear power.

In a detailed consideration of a revival of nuclear energy, many "conventional" concerns are worthy of consideration – including:

1. Radiological concerns:
    - routine radioactive emissions by air[14], water and solid wastes[15] (nuclear power is not clean; not healthy; not "Green")
    - potential for catastrophic accidents[16] (not safe; not secure; not healthy)
    - radioactive waste production that contains the vast majority of global source term[17] (not secure; not clean; not safe) including the biggest reservoir of plutonium – a burden for 11,000 human generations

2. Danger of nuclear weapons proliferation:
    - "front-end" uranium enrichment can produce both low-enriched reactor fuel or highly enriched nuclear weapons production material
    - "back-end" separation of plutonium via reprocessing from waste that is an automatic by-product of electric power production from uranium fuel
    - even greater potential for nuclear weapons proliferation if plutonium fuel (including MOX) is further commercialized

These concerns are intrinsic reasons why nuclear energy has failed, and worthy of extensive study. The reader is directed to the extensive discussion of these concerns, specifically in the context of the climate crisis, in recently published works:

Dr. Helen Caldicott, "*Nuclear Power is Not the Answer*" New Press, 2007.
Dr. Brice Smith: "*Insurmountable Risks: The Dangers of Using Nuclear Power to Combat Global Climate Change*" IEER Press and RDR Books, 2006.

Two other nuclear technology issues receive less attention, but are perhaps even more potent reasons why nuclear energy CANNOT fix the climate problem:

- **Nuclear, more than any other energy source, is vulnerable to turbulent weather**
- **Nuclear reactors do not work in warming water[18]**

These two points will be taken in order.

Nuclear is Vulnerable to Climate Impacts

Extreme weather often causes loss of electric power, which in turn, causes nuclear power reactors to go off-line automatically (also called a "scram"). Reactors go off-line because they – all of them – depend on energy from the grid to operate. Since the core of a reactor continues to generate heat for ***years*** (even "off-line") it is vital that emergency cooling equipment be operable around the clock. As is sensible, every reactor site is equipped with back-up power, most often in the form of (two) diesel generators. Unfortunately these generators, in part because of intermittent use, are not terribly reliable.[19] When both the grid and the back-up power fail, the site is said to be in "station blackout." According to the US Nuclear Regulatory Commission, station blackout contributes a full one-half of the total risk of a major reactor accident at US nuclear power stations.[20]

Recent years have seen an escalation in all kinds of extreme weather: intense heat, drought, blizzards, tornados, and perhaps most compelling – hurricanes and cyclones. All of these conditions may contribute to electric grid failures. The loss of grid power will not necessarily trigger a nuclear crisis, but it elevates the risk. As overall incidence of grid blackout increases, so will the over all risk for nuclear power accidents. Nuclear energy is an enormous liability in these turbulent times.

Nuclear Power Does Not Work in Hot Water

The heat waves of 2003 were a turning point: the frequency and also the duration of periods of elevated temperatures in the rivers, lakes and even oceans, used for cooling nuclear power reactors have been increasing each summer ever since. With this have come reports of nuclear power reactors being forced to low power or off-line until the water temperatures dropped. In 2004 a number of nuclear reactors in France were impacted[21] not because of nuclear safety issues – but because of the basic design of a nuclear reactor.

Essentially an expensive, dangerous "tea pot," a nuclear power reactor harvests the heat from splitting atoms to make steam, to turn a turbine – essentially 19th century stationary steam

technology with an atomic "fire." The closed-loop steam system relies on the heat differential between the temperature of the steam, and the temperature of a condenser, to turn the steam back into liquid, in order to repeat the process. When the water used to cool the condenser gets too warm, this temperature differential is lost; the steam no longer condenses back to liquid. When river and lake water gets too hot, electric power cannot be generated.[22] As temperatures rise, nuclear power will be less and less qualified as a means to even **try** to generate electric power.

To sum up, no one has said it better than my friend David Lochbaum: "We're going to have to solve the climate-change problem if we're going to have nuclear power, not the other way around." David is a nuclear engineer with the Union of Concerned Scientists; his comment was reported in the May 20, 2007 International Herald Tribune.

Nuclear power will never solve any crisis – nuclear energy **is** a crisis. The following references are offered to support your understanding of this situation.

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[1] For basic information on ionizing radiation see Nuclear Information and Resource Service fact sheets posted at: http://www.nirs.org/radiation/radiationhome.htm . Milestone work on radiation health effects was done by the late Dr. John Gofman who's many works are available via: http://www.ratical.org/radiation/CNR/CNRtitles.html

[2] The classic analysis by Amory Lovins "Nuclear Power: Economics and Climate-Protection Potential" posted at: http://www.rmi.org/images/PDFs/Energy/E05-08_NukePwrEcon.pdf

[3] For more NIRS documents on nuclear energy and climate, see: http://www.nirs.org/climate/climate.htm

[4] Olson, Mary "We Don't Need New Nukes" http://www.nirs.org/southeast/wedontneednewnukes.pdf

[5] Bradford, Peter and David Schlissel 2007. "Why A Future For the Nuclear Power Industry is RISKY" posted at: http://www.cleanenergy.org/resources/reports/WhyNewNukesAreRiskyFACTSHEET.pdf

[6] See a variety of sources including: Greenpeace France "Wind Vs Nuclear 2003" posted at: http://www.greenpeace.org/raw/content/international/press/reports/wind-vs-nuclear-2003.pdf, Amory Lovins as cited in note 27 above and also IEER's interesting comparison of wind and plutonium (MOX) fuel for Japan posted at: http://www.ieer.org/reports/wind/index.html

[7] See Lovins, Amory as cited in note 27.

[8] See for instance, US State Department press release in 2005: http://usinfo.state.gov/xarchives/display.html?p=washfile-english&y=2005&m=April&x=20050422130541lcnirellep0.9051172

[9] See 2005 press release of Alliance to Save Energy: http://www.ase.org/content/news/detail/2249 and also Amory Lovins, "More Profit With Less Carbon," Scientific American: September 2005.

[10] Amory Lovins coined the name "nega-watt" to describe energy formerly but no longer consumed. Perhaps it was his brisk business in helping corporations trade in this newly "excess capacity" during the California electric power crisis in 2001 that lead him to remove this term from his parlance.

[11] J. Deutsch and E. Moniz (co-chairs), The Future of Nuclear Power, MIT, 2003. http://web.mit.edu/nuclearpower/

[12] In recent years the media has reported that a nuclear power reactor can be built for $2 billion – however all current construction is running much higher than that –and the last reactors in the US to go on line weighed in at $4.5 -- $6 billion dollars per unit. See also: http://www.nirs.org/factsheets/quickeconfact1206.pdf

[13] See Mark Serreze cited in note # 4.

[14] Drey, Kay "Hidden Radioactive Releases from Nuclear Power Plants in the United States" posted at: http://www.nirs.org/factsheets/drey_usa_pamphlet.pdf Note: region-specific pamphlets are in the same directory.

[15] For a wealth of information on radioactive waste see: http://www.nirs.org/factsheets/fctsht.htm

[16] For a compendium of information on the 1986 Chernobyl nuclear power plant disaster and updated reports as of the 20 year mark: http://www.nirs.org/c20/c20us.htm

[17] "Source term" describes the type of radioactivity (what elements are present) and the duration of the hazard.

[18] A current, very telling editorial about the connection of electric power and water, "Water Power," September 24, 2007 Raleigh (North Carolina) "News and Observer" posted at: http://www.newsobserver.com/opinion/editorials/story/714061.html. Here is a selection of news reports of nuclear power reactors being taken off-line due to elevated temperatures of the cooling water supplies:
May 20, 2007 "Climate Change Puts Nuclear Energy in Hot Water" International Herald Tribune, http://iht.com/articles/2007/05/20/business/nuke.php?page=2
June 8, 2007 "Court Blocks Yankee's Warm Water Discharge" Rutland Herald (VT) http://www.rutlandherald.com/apps/pbcs.dll/article?AID=/20070608/NEWS04/706080387

July 31, 2007 “US Heat Wave…” Bloomberg.com
http://www.bloomberg.com/apps/news?pid=20601087&sid=aNtzVaLCaNc8&refer=home
August 17, 2007 “TVA Reactor Shut Down: Cooling Water Drawn From River Too Hot” reported on WAFF48 News http://www.waff.com/global/story.asp?s=6944527 and “Heat Wave Ignites Problems in ET” Knoxnews
http://www.knoxnews.com/news/2007/aug/18/heat-wave-ignites-problems-in-et/
August 23, 2007 “Rising Temperatures Undermine Nuclear Power’s Promise” Union of Concerned Scientists
http://www.nirs.org/climate/background/ucsrisingtemps82307.pdf
July 30, 2006 “Heat Wave Shuts Down Nuclear Power Plants” The Observer (London)
http://observer.guardian.co.uk/world/story/0,,1833620,00.html
July 27, 2006 “Heat Wave Shows Limits of Nuclear Energy” IPS http://www.ipsnews.net/news.asp?idnews=34121
August 10, 2006 “Hot Temps Chill Nuclear Power's Appeal” Christian Science Monitor, posted at
http://www.cbsnews.com/stories/2006/08/10/tech/main1881980.shtml

[19] Summary of findings given in: http://www.nirs.org/reactorwatch/mox/nirsmcguirecatawbacontentions.htm

[20] U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG-1150, 1990.

[21] For a review of French reactors off line due to heat listen to NPR’s Morning Edition August 21, 2007:
http://www.npr.org/templates/story/story.php?storyId=13818689