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Editorial

Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor, academic Kate Brown, author of 'Plutopia', writes about the contaminated Hanford site in the US. Philip Webber from Scientists for Global Responsibility writes about the climatic impacts of nuclear warfare. Pete Roche writes about the never-ending problems at Sellafield. Nuclear Monitor editor Jim Green calls climate scientist James Hansen's to account for his nuclear junk science. P. K. Sundaram unpicks industry rhetoric regarding the 'World's Safest Reactor'. Finally, the 'In Brief' section has nuclear news updates from Japan, Switzerland, Taiwan, France, Canada, India, and the US.

Feel free to contact us if there are issues you would like to see covered in the Monitor.

Regards from the Nuclear Monitor editorial team
Email: monitor@wiseinternational.org

Monitored this issue:

The humanitarian and climatic impacts of the use of the UK's nuclear weapons

Dr Philip Webber, Scientists for Global Responsibility, presents the evidence that the launch of the nuclear missiles of just one Trident submarine could cause devastating climatic cooling.

760.4299 The UK Trident nuclear weapon system consists of four nuclear powered submarines each of which carries 10 missiles carrying 40 independently targetable nuclear warheads (40 missiles, 160 warheads deployed in total). Each warhead has an explosive power of 100,000 tonnes of TNT equivalent (100kT). The UK has 'co-mingled' access to 58 missiles from the USA, who maintain and refit them from a random selection on a rotating basis from a large US trident missile stockpile at Kings Bay naval base Georgia, Tennessee (rather like hailing a cab from an approved rank). Only the submarine itself and the nuclear warhead is built in Britain.

The UK Government and military present this system as a "minimum deterrent", a stealthy, elite, silent submarine system manned by highly trained professional crew whose stated purpose is part of "keeping Britain safe". What the UK Government do not mention is what the missile system was actually designed for and what it is capable of.

The Trident missile system was conceived and designed at the height of the Cold War. The missile nose-cone was designed with countermeasures (such as decoy warheads) to get past anti-missile defences (the only relevant case being those ringing Moscow). The stated requirement for the UK deterrent, according to papers released under the 30-year rule, was to kill at least 40% of Moscow's 11 million inhabitants and severely damage the physical infrastructure. Nuclear weapons are literally weapons of mass destruction and, while this is clearly demonstrated from an official source [1], Trident is capable of much worse destruction than this.

One Trident submarine can in fact hit 40 targets from 10 missiles, with a total of four million tonnes of TNT explosive power.[2] Rather astonishingly, this is more than the estimated three million tonnes explosive power of all the weapons, including the two nuclear bombs used during the whole of World War 2 [3]. The UK has four such submarines, so the UK

as part of its so-called minimum deterrent has five times the equivalent of World War II ready to unleash.

One Trident submarine has the power to devastate an area 160 times that of the Hiroshima bomb and to devastate 5–20 major cities anywhere within its huge 7,000 mile strike range with 2–8 warheads per city.[2] The immense explosive power of a nuclear weapon means that large areas are destroyed and those living in them killed and injured by a combination of a fierce fireball, massive blast pressure, intense winds, fires, conflagrations and firestorms and, for a ground burst, intense radioactive fallout extending downwind or in rainfall beyond the areas of immediate destruction rendering large areas dangerously radioactive for several years. Communications and electronics systems such as the internet, the electrical grid, water supplies, and vehicle engine management systems would be inoperative.

The casualties caused depend mainly on the population density and would range from 10 million in typical European and Russian cities, up to around 20 million if world super cities in the Indian sub-continent, China or North Korea were targeted. These shocking figures do not tell the full story as literally millions of people would be maimed, burned, blinded or poisoned by the weapons effects. Organisations of physicians are clear that the consequences of the use of even one warhead – let alone 40 – would overwhelm the capacity of a country's health and medical services.[4]

Climatic impacts

But what is less well known, and it is certainly not acknowledged by the UK or any other nuclear power, is that the detonation of just a few dozen nuclear warheads, which would in any case be used in such a way as to deliberately kill and poison tens of millions of civilians (air detonations are chosen to maximise the areas of blast destruction), would also, through creating immense fires and firestorms, create devastating climatic impacts across the globe.

Climatic effects follow the use of nuclear weapons because of the large and particularly intense fires they cause. The fierce nuclear fireballs would ignite cars, fossil fuel stocks and chemical plant and buildings across cities, especially if blast damage has already occurred from a previous explosion. The fires lift vast quantities of black carbon (soot) high into the atmosphere, reducing the levels of sunlight through a high altitude 'smog'. The soot persists for several years as the small particles float well above most clouds and rainfall. This effect is well known from the observed climate impacts of particles from volcanic eruptions. As climate models have been further developed to study the threat of a warming world due to human emissions of greenhouse gases, it has been possible for scientists to update earlier studies of the 'nuclear winter' carried out in the 1980s. Also, recent work has found that earlier estimates of the incendiary effects of nuclear weapons underestimated the impact.[5]

Studies in 2007, using the latest weather and climate models, running on supercomputers, found that a major nuclear weapons conflict involving the nuclear weapons of mass destruction of the US and Russia (up to 5,000 million tonnes of explosive power injecting 150 million tonnes of soot into the atmosphere) would result in a massive cooling effect of 20-30 °C in two key crop growing areas, Iowa and Ukraine, with temperatures below freezing for two years, seven years of drought and cold along with the wiping out of the Indian, African and North American Monsoon seasons.[6]

These absolutely catastrophic results, while confirming the findings of the 1983 studies, show that the effects would last much longer than at first thought – for a decade rather than 2-3 years. Following these extreme impacts, it is estimated that about 90% of the world's population would die of famine. The only exceptions being in latitudes 20-30° South, which includes Australia, New Zealand and parts of Southern Africa and South America, assuming of course that these areas were themselves untargeted, where the effects would be somewhat less severe and there could be up to 30% survivors. This means that no advantage could be gained by the use of the large US and Russian nuclear arsenals numbering in the thousands. Their use would be simply suicidal.

In 1983 it was thought that upwards of a few hundred of the typical large nuclear warheads could trigger dangerous nuclear cooling.[2] The new studies found that a regional India-Pakistan conflict involving up to 100 Hiroshima sized weapons, could cause serious climate disruption for up to a decade (five million tonnes of soot). The effect would be similar to that which followed the eruption in 1815 of Mount Tamburo which led to the 1816 "Year without a summer" and widespread food shortages. The climatic effects seen in the Alps, formed the backdrop for Mary Shelley's writing of Frankenstein in the same year.

Turning back to the UK Trident deployment, one submarine carries a huge destructive power, equivalent to 160 Hiroshima weapons which alone is larger than the combined destructive power of the 100 Indian and Pakistan nuclear weapons referred to above. The fire zones would create soot from fires in the 7–30 million tonne range. This would be more severe than a regional nuclear conflict. An average global temperature drop in the 1.5-3.0 °C range could be expected – causing extremely serious social and environmental problems. Also, even such a "limited" use would cause severe economic consequences. World markets would crash due to fears of nuclear escalation, people would not trust that money held electronically was safe, causing a run on the banks, and food, gold and important commodity prices would dramatically increase. Even at the most limited scale of impact, food shortages upon an already stressed global food supply system could cause deaths from famine of about one billion.[7]

What this means is that use of the US or Russian missiles in an attempted first strike (or retaliation) would be suicidal. Use of the smaller Chinese, French, Indian, Pakistan, Israeli or UK Trident arsenals would have terrible consequences both for the targeted and targeter alike. The uncomfortable realities of the effects of nuclear weapons make their use in numbers above a few dozen a suicidal risk because of long term environmental impacts upon world food supplies and economy.

For the UK, the reality is that Trident does not increase the country's security. Trident poses the risk that its use would cause devastating harm to the UK itself as well as to many non-targeted non-nuclear states across the globe. Its continued deployment and the UK Government's deterrence stance promote a dangerously misleading view of the scientific reality, and undermine realistic attempts to reduce nuclear weapon numbers in the nuclear weapon states. The Trident warheads should be taken off deployment and into verifiable storage as part of measures to build confidence and understanding of the need to negotiate a nuclear free world.

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Plutopia

In her new book Plutopia, Kate Brown, Associate Professor of History at the University of Maryland in Baltimore, draws on official records and dozens of interviews to tell the stories of Richland, Washington and Ozersk, Russia – the first two cities in the world to produce plutonium. US and Soviet leaders created 'plutopias' – communities of nuclear families living in highly-subsidised, limited-access atomic cities. Plutopia shows that the segregation of permanent and temporary workers and of nuclear and non-nuclear zones created a bubble of immunity, where dumps and accidents were glossed over and plant managers freely embezzled and polluted. In this article for the Nuclear Monitor, Assoc. Prof. Brown focuses on the Hanford Nuclear Reservation in eastern Washington.

760.4300 When faced with something frightening and unsightly, a primary human reaction is to bury it. That is what corporate contractors have been doing with high-level radioactive waste for five decades at the Hanford Nuclear Reservation, the world's first plutonium factory in eastern Washington. The great irony of the global nuclear industry is that despite the 20th century's vaulting inventions in nuclear physics, no one has yet figured out how to safely store volatile and dynamic radioactive waste that self-heats to hundreds of degrees, corrodes metals, and seeps readily through soils to plant and animal life – and will do so for tens of thousands of years. Recent headlines about leaking waste storage tanks at Hanford alongside a lawsuit by Donna Busche, a health physicist who claims the San Francisco-based corporate contractor URS tried to stifle her warnings about unsafe procedures at Hanford is yet another chapter in a sadly repetitious history of nuclear waste management.

The first repressed Hanford whistle-blower on record is health physicist Herbert Parker. In 1948, three years after the plant produced its first plutonium, Parker shut down operations because he was worried about the high levels of radioactive iodine pouring from the stacks, and with it, milligram-size particles, fiercely radioactive, that came from corroded duct work inside the processing plant. Monitors tracked the particles, which burned skin on contact, a hundred miles to Spokane. Parker worried that if one tiny flake, among an estimated 800 million, was eaten on a French fry in a local drive-in, it could lodge in soft organs and remain there, a tiny bomb decaying for years to eventually produce cancer. Parker acted responsibly, writing he stopped processing because he did not "dare" to expose workers and neighboring populations. Two days later, however, a high-powered team of scientists sent by the Atomic Energy Commission arrived in the remote town of Richland and upbraided Parker. They ordered the plant going again, at full speed.

In the forties and fifties, AEC contractors spent more federal dollars on tiny Richland's school system than on storing lethally dangerous radioactive waste. They buried the most hazardous waste in temporary tanks underground and cooled them so they would not overheat and explode. They dumped mid and lower level waste in holes, trenches and man-made 'swamps' as well as into the Columbia River. That was the cheapest way to treat radioactive waste, as if it were any other industrial waste, though health physicists knew better. A couple broke ranks in the 1970s passing news to the press that Hanford's tanks had leaked a half million gallons of lethal waste into the surroun-

Hanford whistleblower settles with Fluor

A Hanford contractor hired by the US federal government to train workers involved in radiation clean-up work has agreed to pay $1.1 million to settle a lawsuit filed by the Justice Department. As part of the settlement, a whistleblower who filed a lawsuit under the False Claims Act in 2011 will receive $200,000. The suit alleged that the contractor, Fluor, used federal government money from the Department of Energy to lobby for additional government customers at another facility.
(5 April 2013, **www.whistleblower.org/blog/44/2618**)

ding soils.

During the Cold War, the rationale to sacrifice safety in order to produce bombs made sense to a lot of people, but since 1987 Hanford has not issued a drop of plutonium. Instead the federal reservation's main mission and massive billion dollar budgets has been cleanup. Even so tanks are still leaking and the problem of storing waste appears intractable. In the 1990s, a series of Hanford contractors – Rockwell, Westinghouse, Fluor Daniel, and Battelle – each in turn took on the Hanford contract. The contractors spent scores of billions of dollars only to have reviewers conclude at the end of the decade that they had made no substantial progress.
In each case, contractors, rushing to make deadlines so that top executives could receive handsome bonuses, stifled whistle-blowers. In 1991, a Department of Labor investigator found that Westinghouse had a spy-master's arsenal of bionic ears, pinhole video cameras, helicopter gunships, listening devices and a mobile home modified as a spy center which it had turned on its dissenting employees who threatened to go to the press.

In the 21st century, Battelle, Bechtel National and now URS have fought lawsuits against employees charging they were blocked from pointing out safety concerns. Dr. Walter Tamosaitis, a designer of the multi-billion dollar vitrification plant that is supposed to turn waste sludge into glass logs for storage, told his superiors at Bechtel that their designs would lead to a massive hydrogen explosion at the plant. Tamosaitis was given a basement office and iced out. Last summer, the Department of Energy sent a memo in concord with Tamosaitis, stating that Bechtel's designs were not technically viable and the corporation "not competent" as a design authority.

Perhaps there is a problem with corporate culture and the bonus system that prioritises deadlines and speed over safety and long-term solutions. But the larger problem, the elephant in the room, is that the mission to safely contain 1,700 pounds (770 kgs) of plutonium-239 scattered among 53 million gallons (200 million litres) of chemical toxins and other fission products has never before been attempted. This is a problem we can no longer bury. So far, after 75 years of nuclear waste production, no one nowhere on the globe has figured out how to safely store industrial sized quantities of radioactive waste. Until that happens, nuclear power is a road to ruin.

Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters
Kate Brown
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Hardcover, 416 pages

Sellafield – 'an intolerable risk'

Sellafield in West Cumbria, north-west England, was originally a military site set up immediately post-war to provide plutonium for nuclear bombs. Today it is the site of two reprocessing plants. The first, B205, opened in 1964 to reprocess waste fuel from Britain's oldest reactors, known as Magnox reactors. The last of these reactors will close on 30 September 2014, but B205 isn't expected to complete the reprocessing of spent fuel until sometime between 2017 and 2028 depending on how well it operates.

Pete Roche
760.4301 The second reprocessing plant – THORP (the Thermal Oxide Reprocessing Plant) opened in 1994 to reprocess waste fuel from the UK's newer Advanced Gas-cooled Reactors (AGRs) and overseas Light
Water Reactors.

These projects have been overseen by the Nuclear Decommissioning Authority (NDA) since 2005 – a public body set up to replace the widely discredited British Nuclear Fuels (BNFL). The NDA also replaced Nirex – originally the Nuclear Industry Radioactive Waste Executive – which was responsible for developing "safe and environmentally sound options for dealing with radioactive waste in the long term".

A new study commissioned by West Cumbria & North Lakes Friends of the Earth investigates how hazardous nuclear waste at Sellafield has been stored and handled over the past 13 years. The study took place within the context of a decision at the end of January by the local municipality, Cumbria County Council, not to go forward with a search for a Geological Disposal Facility, and a November 2012 National Audit Office (NAO) report on managing risk reduction at Sellafield which clearly demonstrated the need for immediate improvements in the management of major projects at the site.

The NAO report said the site posed a "significant risk to people and the environment" because of the deteriorating conditions of radioactive waste storage facilities. In February 2013 a report from the House of Commons Public Accounts Committee described Sellafield as "an extraordinary accumulation of hazardous waste, much of

it stored in outdated nuclear facilities", and chair of the committee, Margaret Hodge MP, said Sellafield posed an "intolerable risk".

Deadlines for cleaning up Sellafield have been missed, while total lifetime costs for dealing with the waste and decommissioning the site continue to rise each year and now stand at £67.5 billion. An enormous amount of public money – some £1.6 billion – is spent at Sellafield each year.

The NAO report didn't look at Sellafield's commercial operations. Cumbrians Opposed to a Radioactive Environment discovered that in the 13-year period between financial years 2000/01 and 2012/13, the site missed 83% of commercial targets and that since the NDA took ownership of Sellafield in 2005 the failure rate has risen to 94%.

The NDA claims it now has a credible plan for decommissioning Sellafield, but given its track record – with only two of the 14 major projects being delivered on or ahead of schedule in 2011-12 – it is small wonder many remain to be convinced that sufficient progress is actually being made.

THORP reprocessing plant

THORP was expected to reprocess 7,000 tonnes of spent fuel in its first decade of operation – two-thirds from overseas customers – but it only managed 5,000 tonnes due to a range of equipment failures and accidents. In April 2005 an internal leak of 22 tonnes of dissolved fuel shut the plant for almost two years. This was followed by another mechanical failure which delayed the slow return to operation until March 2008. Even then a delay in returning to full operation was caused by a lack of high-level waste evaporative capacity.

In 2005, when the NDA took over, THORP was expected to complete its reprocessing contracts by 2010, but this date has now been pushed back to 2018. In June 2012 the NDA announced that it would only reprocess the spent fuel it was contracted to reprocess – in other words it would not attempt to reprocess AGR waste spent fuel for which the contracts allowed for storage or reprocessing. This means the plant will be limping along with a low throughput of around 350 tonnes per year for another five years – less than half the rate it was originally expected to achieve.

High level liquid waste treatment facilities

HLW liquids are so radioactive that they generate their own heat, and are stored at Sellafield in special cooling tanks which prevent the liquid from boiling. The consequences of a prolonged cooling failure could be 'very severe' leading to boiling after 12 hours, and to the tanks drying out after three days. Consequently the HLW facility at Sellafield is probably one of the most dangerous nuclear facilities in the world. Following the 9/11 terrorist attacks in 2001, a review found that a terrorist attack on the tanks could require the evacuation of an area between Glasgow and Liverpool, and cause around two million fatalities.

Thirteen years ago the Nuclear Installations Inspectorate (NII) warned that the HLW liquid storage tanks needed to be emptied and the waste solidified "as soon as reasonably practicable", and levels reduced from approximately 1,600 cubic metres to a buffer level of 200 cubic metres by 2015. Any shortfall would be "publicly unacceptable". By 2011, even though stocks had only been reduced to 900 cubic metres, the Office for Nuclear Regulation (ONR) (which now incorporates the NII) decided to increase the permitted level of highly active liquid stocks to almost three times the limits defined under the earlier legal requirement. The ONR appears to have sanctioned something which 12 years ago it deemed "publicly unacceptable", because it is not prepared to use its regulatory powers to end reprocessing early.

In 1998 the liquid HLW was stored in 21 stainless steel tanks, the eight oldest of which were built between 1955 and 1968. Even the 13 newest tanks were causing concern because of leaks in the cooling system. In 2008 the NII declared that Sellafield needed new liquid HLW storage tanks "with utmost urgency". The NDA estimated the cost of six new replacement tanks to be £83m with delivery expected in March 2013. But by 2011 the cost had shot up to £474m and delivery was not expected until March 2018. Then in June 2012 the NDA abandoned the project. The ONR simply said the information it had been given suggests that replacement tanks "may no longer represent the 'as low as reasonably practicable' position with regard to hazard reduction activities on the site".

So failure by the NDA has been responded to by the ONR changing its recommendations, rather than using its regulatory powers to ensure action. ONR appears to be sanctioning a cost-cutting exercise rather than insisting on maximum safety.

The highly active liquid wastes that come out of the two plutonium separation plants operating at Sellafield are evaporated to reduce their bulk. A range of problems with the evaporation facility at Sellafield over the years has meant that plans to reduce liquid HLW stocks, whilst continuing with reprocessing and plutonium separation operations which produce the waste, have not gone according to plan. There are three evaporators at Sellafield, and the NDA gave approval for the construction of a fourth to start in 2009. The construction project is the biggest single nuclear project in the UK. It was originally estimated to cost £90m and was due to be completed as early as 2010. But the cost has now jumped up to £673m, and it won't be ready until at least 2016.

Treatment of solid wastes

In 2002 The Observer newspaper, reporting on a document from Nirex, declared that "almost 90 per cent of Britain's hazardous nuclear waste stockpile is so badly stored it could explode or leak with devastating results at any time".

A decade later, the description by the NAO makes the situation sound very similar: "Some of the older facilities at Sellafield containing highly hazardous radioactive waste have deteriorated so much that their contents pose significant risks to people and the environment."

The recent NAO report says a quarter of Sellafield Limited's annual spending – £381m in 2011-12 – is on waste retrieval and clean-up of high hazard legacy ponds and silos containing spent fuel, spent fuel cladding, and intermediate-level waste sludges, etc. But limited progress has been made on starting some key waste retrieval projects, and completing waste retrieval from legacy ponds and silos has been postponed by seven years until 2036.

Conclusions

Despite a focus which should have been "squarely on the nuclear legacy" the NDA, since taking over Sellafield in 2005, has continued with operations which produce yet more waste because of short-term income generation. We are now told it is too late to come up with an alternative used waste fuel management process so

the two reprocessing plants must limp on another five years or so before decommissioning can begin.

Between 2000 and 2008 the nuclear regulator said that the liquid HLW needed to be solidified "as soon as reasonably practicable", that new storage tanks "should be progressed with the utmost urgency", and that further evaporator capacity was "essential for the longer term safe management of highly active liquor".

But despite the NDA's failure to urgently replace old tanks containing highly radioactive liquid waste and build new evaporator capacity to reduce the bulk of dangerous liquid waste as quickly as possible, the regulator has allowed reprocessing to continue – not just of overseas spent fuel, which the NDA has claimed it is legally bound to reprocess, but mainly of AGR waste spent fuel – perhaps to free up space so that EdF Energy can extend the life of its ageing AGR reactors, and avoid the cost of new spent fuel storage facilities.

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James Hansen's junk science

Pushker Kharecha and James Hansen have published an article in *Environment, Science and Technology* radically downplaying the risks of nuclear power. The article has attracted a good deal of attention given Hansen's global prominence as a climate scientist.

760.4302 The article abstract states: "Using historical production data [from 1971-2009], we calculate that global nuclear power has prevented an average of 1.84 million air pollution-related deaths and 64 gigatonnes of CO2-equivalent greenhouse gas emissions that would have resulted from fossil fuel burning. On the basis of global projection data that take into account the effects of the Fukushima accident, we find that nuclear power could additionally prevent an average of 420 000–7.04 million deaths and 80–240 GtCO2-eq emissions due to fossil fuels by midcentury, depending on which fuel it replaces [gas or coal]."

Kharecha and Hansen largely ignore the potential of renewables and energy efficiency and conservation; instead they set up a false dichotomy between fossil fuels (mostly coal) and nuclear.

Kharecha and Hansen "calculate" 4,900 deaths from nuclear power from 1971–2009. They state: "About 25% of these deaths are due to occupational accidents and about 70% are due to air pollution-related effects (presumably fatal cancers from radiation fallout; see Table 2 of ref 16)." Ref 16 is a 2007 article in The Lancet – which makes no effort to explain or justify its figures for nuclear power deaths (Markandya and Wilkinson, 2007).

Kharecha and Hansen claim that "empirical evidence indicates that the April 1986 Chernobyl accident was the world's only source of fatalities from nuclear power plant radiation fallout." What empirical evidence? Why narrow the focus from the full energy cycle to power plants? And why limit consideration of fatalities to radiation fallout alone? There have been countless fatal accidents at nuclear fuel cycle facilities (http://scott-ludlam.greensmps.org.au/let-the-facts-speak).

Kharecha and Hansen cite UNSCEAR (2011) to justify their claim that the death toll from Chernobyl was 43. But the UNSCEAR report did not attempt to calculate long-term deaths from radiation exposure from Chernobyl, citing "unacceptable uncertainties in the predictions". The credible estimates of the Chernobyl death toll range from 9,000 (in Eastern Europe) to 93,000 (across Eastern and Western Europe).

Regarding Fukushima, Kharecha and Hansen state that "one early analsis indicates that annual radiation doses in nearby areas were much lower than the generally accepted 100

mSv threshold for fatal disease development." In defence of the claim regarding a 100 mSv threshold, they cite (and misrepresent) an UNSCEAR report. The UNSCEAR report (2011, p.183) claims that no studies provide conclusive evidence of carcinogenic effects of radiation at levels below 100 mSv. That claim is disputed (see for example Karamoskos, 2010) and in any case UNSCEAR is not claiming that radiation doses below 100 mSv do not cause fatalities, but rather that evidence is lacking for such effects. Indeed UNSCEAR's (2011b) view is that "the current balance of available evidence tends to favour a non-threshold response for the mutational component of radiation-associated cancer induction at low doses and low dose rates." Kharecha and Hansen's assertion regarding a 100 mSv threshold isn't even UNSCEAR's position let alone a "generally accepted" position.

There are many reasons to conclude that Kharecha and Hansen's figure of 4,900 deaths from nuclear power from 1971–2009 is a gross underestimate, yet they claim that the figure "could be a major overestimate relative to the empirical value (by 2 orders of magnitude)."

Kharecha and Hansen state that the linear no-threshold (LNT) model of radiation risks "might not be valid for the relatively low radiation doses that the public was exposed to from nuclear power plant accidents." But LNT has some heavy-hitting scientific support. For example the Committee on the Biological Effects of Ionising Radiation of the US National Academy of Sciences states that "the risk of cancer proceeds in a linear fashion at lower doses without a threshold and ... the smallest dose has the potential to cause a small increase in risk to humans" (BEIR, 2006).

Kharecha and Hansen's junk science has gone down a treat with the nuclear lobby – World Nuclear News describes it as a "landmark study" and states that it "presents a dramatic new case for nuclear energy".

Australian NGOs have attempted a comparative risk assessment which overcomes the flaws evident in studies such as that of Kharecha and Hansen (Choose Nuclear Free, 2011). A brief summary follows.

Comparisons of the risks associated with different energy sources need to consider several factors:
1. Power plant accidents.
2. Accidents at other stages of the energy cycle.
3. Impacts of routine operations and emissions.
4. Attacks on power plants and other stages of the energy cycle (by nation-states or sub-national groups).
5. Weapons/WMD proliferation risks.

Claims that nuclear power is safe, or that it is one of the safest energy sources, often rest on flawed assessments of the risks and impacts of power plant accidents, and completely ignoring the other four aspects of risk assessment. When both accidents and routine emissions across the energy cycle are considered, renewable energy sources are shown to be far less hazardous than both coal and nuclear power as the table indicates.

The connection between fossil fuels and global warming, and the connection between the civil nuclear fuel cycle and nuclear weapons proliferation, are arguably the greatest hazards associated with all energy sources and are thus represented qualitatively in the above table since they cannot
be quantified.

There is a passing acknowledgement in Kharecha and Hansen's article of "potential mortality from proliferation of weapons-grade material" but the problem is then ignored on the grounds that it "cannot meaningfully be quantified". The authors state: "Serious questions remain about [nuclear] safety, proliferation, and disposal of radioactive waste, which we have discussed in some detail elsewhere." But the paper they refer to doesn't come close to providing a detailed discussion of those issues.

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Fatalities per gigawatt-year	
Coal	9.7 – 31.2 + global warming
Nuclear (with reprocessing)	<8.2 – 31.4 + WMD proliferation
Oil	4.5 + global warming
LPG	3.5 + global warming
Biomass	1.4
Hydro	0.6–4.3 (higher figure includes a major dam accident in China in 1975)
Gas	0.5 + global warming
Solar (rooftop)	0.05
Wind	0.02

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Does India have the World's Safest Reactor?

P. K. Sundaram

760.4303 The claim of Koodankulam reactors being 'safest in the world' appeared in the newspapers on April 5, for the nth time in the last couple of years. The Russian Deputy PM said in October last year that Koodankulam is the world's safest reactor. I thought of doing a google search for the term 'safest reactor of the world'. Here are some interesting observations.

The independent experts would rightly tell us that while every nuclear accident might be a different kind of accident and we might be able to incorporate its lessons in new designs, it simply means that new reactors might undergo new kind of accidents. Simply put, there cannot be an objective criteria for deciding on a nuclear 'top 10'. The US at one time did publish a list of 10 most dangerous reactors, but that was more to demonise USSR-vintage reactors and to claim implicitly that its own nuclear power plants are safe.

This is not to underestimate the danger of the Soviet/Russian reactors, however. Out of the 10 listed reactors, several were VVERs – or the VVER–440s to be precise, previous versions of the VVER1000 reactors being installed in Koodankulam. VVERs – voda voda (water water) energy reactors, so called because they use water both as moderator and coolant – are known to be high-risk. These are water hungry reactors and need uninterrupted water supply. Again, Koodankulam reactors are perhaps the only reactors that do not have a natural source of fresh water supply. They depend on a desalination plant of inadequate capacity, making them highly vulnerable.

Rosatom-owned company accused of selling shoddy equipment

Russian federal prosecutors have accused a company owned Rosatom with massive corruption and manufacturing substandard equipment for nuclear reactors under construction both at home and abroad. The ZiO-Podolsk machine building plant's procurement director, Sergei Shutov, was arrested for buying low quality raw materials on the cheap and pocketing the difference. Reactors in India, Bulgaria, Iran, China as well as several reactor projects in Russia itself may have been affected. According to prosecutors, ZiO-Podolsk began shipping shoddy equipment in 2007 or perhaps earlier. Former chairman of India's Atomic Energy Regulatory Board, Dr A. Gopalakrishnan, has demanded an immediate investigation into the safety of the Koodankulam nuclear power plant as Podolsk supplied components for the reactor. *(DiaNuke.org, 8 April 2013, 'Is Koodankulam Unsafe?: Russian Supplier Arrested for Corruption and Substandard Equipment')*

Since the publication of the world's 10 most dangerous reactors list quoted above, there have been several claims about most dangerous reactors – from Monju in Japan to Metsamor in Armenia and Indian Point in the US. But even these negative top lists are subjective.

Coming back to the world's safest reactors, it seems a typical vendor's trick. Every vendor claims its reactor to be the world's safest. And the IAEA, the promoter-in-chief of these nuclear vendors, has been quite generous in granting 'world's most safe' status. In 2007, it called China's Tianwan reactor the safest in the world. Within a fortnight after Fukushima, Ontario claimed to have world's safest reactor. Before Fukushima, Bill Gates was building the world's safest reactor in China. Just four days after Fukushima, then French President Nicholas Sarkozy declared his country's reactors to be the safest in the world. Exelon's flagship reactor in Illinois, the Byron Station, was touted to be world's safest until it lost operability to all of its safety-related equipment in January 2012. In 1988, the world's safest reactor (Fort St. Vrain, USA) remained safe because it didn't run much and was eventually closed. Austria's world safest reactor in Zwentendorf never went into operation.

Just a few months back, when the IAEA team was in Rawatbhata, it called the reactors among the world's safest. This

came from IAEA soon after two consecutive incidents of tritium leaks in Rawatbhata, where more than 30 exposed contractual workers are still struggling for independent radiation monitoring, leave aside compensation and health facilities.

So, the world's safest reactors are either closed or are yet to be built. India's nuclear establishment, not its reactors, is perhaps among the safest. Safe from any public scrutiny and accountability.

P.K. Sundaram is editor of DiaNuke.org, where this article was originally published.

In Brief

Peace activists ask court to reopen protest area at Y-12.

The Oak Ridge Environmental Peace Alliance is seeking a restraining order to stop federal officials from blocking access to an area at the Y-12 nuclear weapons plant that has been used for more than 700 protests and other gatherings over the past 25 years. OREPA and 18 individuals have filed a lawsuit in the US District Court in Knoxville calling on the court to order the National Nuclear Security Administration to open up the "public forum area" at Y-12. Barriers have been erected across the front of the federal installation and no-trespassing signs have been posted on the temporary fence line. Protests and gatherings at the site have never posed a security threat, OREPA said, suggesting Y-12 is taking action not to protect the plant but to stymie protests. On April 6, about 75 demonstrators gathered at a park across the street from the facility; three were reportedly arrested for stepping into the street during the march from the park to Y-12 and charged with impeding a roadway. Concerns include the government's plan to build a new $6.5 billion weapons facility in Oak Ridge. (Knox News, April 4, 5; Associated Press, April 7.)

Quebec uranium moratorium.

No permits for uranium exploration or mining will be issued in Quebec until a study into its impacts has been completed. Quebec environment minister Yves-Francois Blanchet has asked the province's environmental assessment agency to conduct studies into the environmental and social impacts of uranium exploration and mining. These studies are expected to begin later this year, with a final report to be completed next year. The process will include public hearings. In October 2012, the Canadian Nuclear Safety Commission issued a licence authorising uranium exploration at the Matoush Underground Exploration Project in Quebec. Groups including the region's indigenous population, part of the Cree Nation, opposed the development and pushed for a moratorium on uranium exploration and mining in Quebec. (World Nuclear News, 3 April 2013, 'Quebec imposes uranium moratorium')

Accident at Entergy's Arkansas Nuclear One kills worker.

An industrial accident on March 31 at Entergy Nuclear's Arkansas Nuclear One left one worker dead and sent eight others to the hospital. The worker who died was Wade Walters, aged 24. An Entergy spokesman said on April 1 that seven of the eight people who were hospitalised after the accident had been released. Entergy said Unit 1's turbine lift device failed during the movement of its main turbine generator stator, which weighs about 500 tons. The falling stator damaged water lines and electrical equipment, which caused 1,065-MW Unit 2 at the site, which had been operating at full power, to shut automatically. Damage to a breaker caused a loss of all offsite power for Unit 1 (which was offline at the time), after which emergency diesel generators supplied power to Unit 1. There was no radiological release and no effect on public health, the company said. (Platts,1 April 2013, 'Accident at Entergy's Arkansas Nuclear One kills worker'; Entergy www.entergy-nuclear.com; NRC www.nrc.gov/reading-rm/doc-collections/event-status)

Taiwan premier promises haste on nuclear waste.

Taiwan's Premier Jiang Yi-huah said on April 8 that his government would actively seek a solution to the problem of nuclear waste and would remove waste stored on Orchid Island, 60 kms off the south-east coast of Taiwan in Taitung County. The island, mainly inhabited by indigenous Tao people, has been the destination for radioactive waste for the country's three operating nuclear power plants for decades. Under a 2006 law governing the choice of a storage site for the nation's nuclear waste, Kinmen County's Wuqiu Township and Taitung County's Daren Township were chosen, but the local governments have so far refused to hold referendums on the issue. Jiang met anti-nuclear groups, including the Green Citizens' Action Alliance and Tao Foundation, on April 3. (Taiwan News, 9 April 2013, 'Taiwan premier promises haste on nuclear waste'; Taiwan Today, 8 April 2013, 'Jiang vows to remove Orchid Island nuclear waste', http://taiwantoday.tw)

Canada, India proceed with nuclear deal.

Canada and India have taken the next step towards implementation of a nuclear co-operation agreement. The Canadian Nuclear Safety Commission and India's Department of Atomic Energy have finalised an arrangement that is to allow Canadian companies to export nuclear items to India for peaceful uses. The announcement comes after Prime Minister Stephen Harper and his Indian counterpart, Manmohan Singh, sealed a nuclear deal last November. A nuclear co-operation agreement was signed more than two years ago, but its implementation stalled over the details. The agreement ensures Canadian exports only go to facilities in India subject to IAEA safeguards (which is not to say that safeguards inspections will actually take place). Forty years ago India violated an agreement not to use a Canadian-supplied research reactor to produce material for weapons, leading to India's first nuclear weapons test in 1974. (Canadian Press, 9 April 2013, www.ctvnews.ca)

GE chief Immelt cautious on nuclear energy.

GE chief executive and chairman Jeff Immelt has again expressed caution about the outlook for nuclear power. He told The Australian newspaper: "The issue is always one of economics and, for right now, nuclear is a sovereign business, a gover-

nment to government business. It's not really a commercial business. There's a liability regime, there's government approval processes and things like that. To me the future of nuclear is very much about where governments want to spend the money, as it is about safety or technology. If governments want to use their own balance sheet to promote nuclear power, it's going to go forward. But if governments don't want to use their own balance sheet to promote nuclear power, it's not going to go forward." Immelt said the world may swing back to nuclear power if there is a "tremendous dislocation in the global energy markets". He said that the increased availability of natural gas and the dramatic fall in the cost of solar energy panels have been "big surprises" on the energy front, and that energy efficiency will become increasingly important regardless of which forms of power prove to be the most viable as costs will be rising. (The Australian, 23 March 2013, 'GE chief Immelt cautious on nuclear energy')

EDF 'in big trouble' says French nuclear expert.

Mycle Schneider, a former energy adviser to the French government, said that EDF with debts of €39 billion might not have the cash to put into a nuclear plant at Hinkley Point in Somerset, UK. "EDF is in big trouble. The whole of the nuclear power industry in France is in big trouble," he told BBC Radio. Negotiations on a deal between EDF and the UK Government over Hinkley are deadlocked because the two sides have failed to agree on a price for electricity and a range of other guarantees. EDF is also trying to find a partner to fill the gap left by Centrica, which has abandoned nuclear power. "There are a long list of issues that need to be agreed, not only the strike price," Schneider said. "Even if there is an agreement the financing package has to be put together. It's a very long-term investment of very uncertain levels of realisation." (The Telegraph, 8 April 2013, EDF 'in big trouble' says French nuclear expert')

Fukushima updates

These news items are taken from the excellent, twice-weekly 'Nuclear Crisis Updates' compiled by Greenpeace www.greenpeace.org/international/en/news/Blogs/nuclear-reaction

On April 5, TEPCO reported that around 110,000 liters of radioactive water had leaked from tank #2 at Fukushima Daiichi. There are seven tanks at the facility, each consisting of a hole dug into the ground and then lined with two layers of polyethylene, and an outer layer of clay. Prof Masanori Aritomi, from the Tokyo Institute of Technology, said TEPCO is underestimating the seriousness of this incident. Officials said that the leak was first discovered on April 3, but they waited two days to report it to the Nuclear Regulation Authority (NRA). On April 7, TEPCO reported a second, much smaller leak in tank #3. Officials suspect that both leaks are a result of failures in the polyethylene sheets. Experts are now raising concerns that all seven underground tanks, which are all constructed similarly, may be at risk of leaking. Some have charged TEPCO with trying to save money by cutting corners and digging what are essentially storage pits, rather than building more expensive steel-reinforced tanks.

TEPCO has been grappling with issues regarding contaminated water since March 2011. Each day, the utility pumps 370 tons of water into the damaged reactors in order to keep them cool. In addition, an estimated 400 tons of groundwater seep into the reactor basements, through cracks in the buildings. That water also becomes contaminated. The plant currently has capacity to store 325,000 tons of water in hundreds of holding tanks on the premises, but has already used 80% of that space. Overall, the Fukushima Daiichi facility is currently holding 370,000 tons of radioactive water, including water in the reactors themselves. More tanks are being built. But, because the decommissioning process is expected to take 40 years or more, company officials are scrambling to come up with a better plan.

Officials insist that none of the water has seeped into the ocean, which lies approximately 800 meters away. Nevertheless, local fishermen remain highly concerned that their livelihoods, already destroyed by the Fukushima disaster, will be further damaged. "I am afraid that we will continue to be plagued by this kind of problem until the reactors are finally decommissioned [40 years from now]. We fishermen are the ones who will have to suffer until the end, due to the increasing amount of contaminated water at the plant," said one fisherman.

TEPCO said power to critical cooling systems at reactor #3's spent fuel pool was lost for a second time in less than a month, after workers installing a net designed to keep rodents away from a switchbox accidentally touched cables, causing a short in the system. Workers were installing nets in response to a larger power loss last month, in which cooling systems connected to several spent fuel pools at the plant were halted for up to 29 hours, after a rat ran across cables on a switchbox that had been operating outdoors on a truck for more than two years.

NRA officials have decided to relax new requirements – originally scheduled to take effect in July – mandating offsite control rooms located at least 100 metres away from nuclear reactors. Instead, officials said that utilities will have up to five years to build those, as well as to install remote-controlled cooling systems. In the interim, the NRA said that power companies can use mobile operation centres.

A new exposè by The Mainichi Daily News shows that workers tasked with decontaminating cities and towns near the Fukushima nuclear disaster are living in Spartan conditions and receiving very low pay, as multiple layers of contractors and subcontractors shave off percentages of their wages. Workers are forced to sleep in tiny areas, and most are provided only vegetables to eat, despite working in fields all day, clearing radioactive grass and brush. A contracting firm representative said: "You can't really turn a profit unless you hit the workers' wages or shave them down somehow. In the end, the whole system is designed to make money for the big construction companies at the top."

Japan's central government has announced plans to build a new reactor decommissioning research centre in Naraha, Fukushima. The new facility, located approximately 25 kms from the Fukushima Daiichi power plant, will include a simulated reactor where scientists can use robots to simulate the steps required to dismantle TEPCO's crippled reactors. That process is expected to take at least 40 years. The Naraha facility is slated to open in March 2015.

A third-party panel of external experts appointed by TEPCO and led by former US Nuclear Regulatory Commission Chair Dale Klein, released a report accepting responsibility for the Fukushima nuclear disaster as well as approving a TEPCO-created plan for reforms at the utility. Reversing the company's earlier claims that the disaster was entirely caused by the

March 2011 tsunami, the panel said that emphasis on the economic bottom line, rather than safety, led to failures at the plant. "Our safety culture, skills, and ability were all insufficient. We must humbly accept our failure to prevent the accident, which we should have avoided by using our wisdom and human resources to be better prepared," said TEPCO President Naomi Hirose.

More than two years after the triple-disaster, the market for vegetables harvested from Fukushima Prefecture has virtually collapsed, as a result of fear of high radiation levels in food and lack of public confidence in government regulations and monitoring. One Tokyo vegetable dealer noted, "There are no takers even now. Some supermarkets in Western Japan don't accept them at all, and there are no deals."
Anti-nuclear activists are celebrating a decision by Tohoku Electric Power Company to scrap plans for a nuclear power plant in Namie and Minamisoma in Fukushima Prefecture. Namie town officials originally signed an agreement with Tohoku Power in 1967 to build the reactor just 10 kms from the Fukushima Daiichi plant. Since the Fukushima disaster, public opposition to nuclear power has grown significantly, and in 2011, both Namie and Minamisoma passed resolutions formally opposing the plant. Last week, Tohoku finally relented and reversed its plans for construction, admitting that local anti-nuclear opposition led to its decision. Nevertheless, Prime Minister Shinzo Abe's administration is continuing to push for construction of new reactors in Japan, as well as restarting reactors idled since the Fukushima disaster. Power companies have submitted plans for 11 new reactors, with construction already begun on three.

The Japanese government is suing Taro Fuchigami and Taichi Masakiyo, two representatives of an anti-nuclear group that is continuing protest activities on the premises of the Ministry of Economy, Trade and Industry. The protest site was established in September 2011. Fuchigami, a 70-year-old leader of the group, said they want to keep their tents in place and will challenge the government's legal action in court. Katsutaka Idogawa, who served as mayor of Futaba, Fukushima Prefecture, until February, visited the protesters on April 6. During his term as mayor, Idogawa pursued the government's responsibility for the nuclear disaster. "State-owned land belongs to the public," he said. "We want the government to listen to the voices of the public." (Jiji Press, Asahi Shimbun)

WISE / NIRS Nuclear Monitor

The World Information Service on Energy (WISE) was founded in 1978 and is based in Amsterdam, the Netherlands.

The Nuclear Information & Resource Service (NIRS) was set up in the same year and is based in Washington D.C., US.

WISE and NIRS joined forces in the year 2000, creating a worldwide network of information and resource centers for citizens and environmental organizations concerned about nuclear power, radioactive waste, proliferation, uranium, and sustainable energy issues.
The WISE / NIRS Nuclear Monitor publishes information in English 20 times a year. The magazine can be obtained both on paper and as an email (pdf format) version. Old issues are (after 2 months) available through the WISE homepage: www.wiseinternational.org

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