NUCLEAR MONITOR

January 30, 2015 | No. 797

A PUBLICATION OF WORLD INFORMATION SERVICE ON ENERGY (WISE) AND THE NUCLEAR INFORMATION & RESOURCE SERVICE (NIRS)

Editorial

Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor, our first for 2015:

- We reprint some anti-nuclear cartoons from the French satirical publication *Charlie Hebdo*, which has for decades been an ally of the anti-nuclear movement.
- We review global nuclear power developments in 2014 − yet another year of stagnation for an industry that has been stagnant for the past two decades.
- We report on claims that the US and India have resolved a disagreement over accident liability that has stymied US investment in India's nuclear power program.
- Charly Hultén from WISE Sweden reports on the decision of Vattenfall, the state-owned power company, to stop all work relating to the potential development of new reactors.
- We look at the year ahead in Japan, with the looming restart of some of the fleet of 48 idled reactors.

The Nuclear News section includes good news from Canada regarding non-reactor medical isotope production; a Greenpeace report on inadequate nuclear emergency preparedness in Belgium; and we finish with more good news concerning declining renewable energy costs.

Feel free to contact us if you have feedback on this issue of the Nuclear Monitor, or if there are topics you would like to see covered in future issues.

Regards from the editorial team.

Email: monitor@wiseinternational.org

Monitored this issue:

Nuclear power: 2014 review

Author: *Jim Green − Nuclear Monitor editor*

NM797.4440 Global nuclear power capacity increased slightly in 2014 according to the World Nuclear Association[1]:

- Five new reactors (4.76 gigawatts (GW)) began supplying electricity (three in China, one each in Argentina and Russia), and three were permanently shut down (Vermont Yankee, USA; Fukushima Daiichi #5 and #6).
- There are now 437 'operable' reactors (377.7 GW) compared with 435 reactors (375.3 GW) a year ago. Thus the number of reactors increased by two (0.5%) and nuclear generating capacity increased by 2.4 GW (0.6%). (For comparison, around 100 GW of solar and wind power capacity were built in 2014, up from 74 GW in 2013.[2])
- Construction started on just three reactors during 2014, one each in Belarus, the United Arab Emirates, and Argentina. A total of 70 reactors (74 GW) are under construction.

Thus a long-standing pattern of stagnation continues. Global nuclear power capacity grew by 10.6% in the two decades from 1995−2014, and just 2.6% in the decade from 2005−2014.[3]

The pattern of stagnation is likely to persist. Steve Kidd, a nuclear consultant who worked for the World Nuclear Association for 17 years, wrote in a May 2014 article: "Upper scenarios showing rapid nuclear growth in many countries including plants starting up in new countries now look very unlikely, certainly before the late 2020s. If there is to be a nuclear renaissance, it is now much more likely to happen later, and with a new generation of reactors. On the other hand, predictions that another major accident would shut down nuclear in lots of countries have been negated by the experience of Fukushima. Although there remain some uncertainties, the outlying upper and lower cases are much less credible than before."[4]

Despite 20 years of stagnation, the World Nuclear Association remains upbeat. Its latest report, *The World Nuclear Supply Chain: Outlook 2030*, envisages the start-up of 266 new reactors by 2030.[5] The figure is implausible − it would require completion of the 70 reactors under construction, start-to-finish construction of another 196 reactors, and start-to-finish construction of dozens more reactors to replace those that are shut down ... all in the space of 15 years! If only the World Nuclear Association took bets on its ridiculous projections.

Nuclear Energy Insider is more sober and reflective in an end-of-year review published in December: "As we embark on a new year, there are distinct challenges and opportunities on the horizon for the nuclear power industry. Many industry experts believe that technology like Small Nuclear Reactors (SMR) represent a strong future for nuclear. Yet, rapidly growing renewable energy sources, a bountiful and inexpensive supply of natural gas and oil, and the aging population of existing nuclear power plants represent challenges that the industry must address moving forward."[6]

Steve Kidd is still more downbeat, arguing that nuclear advocates have not made much progress gaining public acceptance over the past few years.[7] Kidd writes: "[W] e have seen no nuclear renaissance (instead, a notable number of reactor closures in some countries, combined with strong growth in China) ... Countries such as Germany and Switzerland that claim environmental credentials are moving strongly away from nuclear. Even with rapid nuclear growth in China, nuclear's share in world electricity is declining. The industry is doing little more than hoping that politicians and financiers eventually see sense and back huge nuclear building programmes. On current trends, this is looking more and more unlikely. The high and rising nuclear share in climate-friendly scenarios is false hope, with little in the real outlook giving them any substance. Far more likely is the situation posited in the World Nuclear Industry Status Report[8] ... Although this report is produced by anti-nuclear activists, its picture of the current reactors gradually shutting down with numbers of new reactors failing to replace them has more than an element of truth given the recent trends."

Kidd's comments on renewables are also worth quoting: "The nuclear industry giving credence to climate change from fossil fuels has simply led to a stronger renewables industry. Nuclear seems to be "too difficult" and gets sidelined − as it has within the entire process since the original Kyoto accords. And now renewables, often thought of as useful complements to nuclear, begin to threaten it in power markets when there is abundant power from renewables when the wind blows and the sun shines."[7]

Kidd proposes reducing nuclear costs by simplifying and standardising current reactor designs. Meanwhile, as the International Energy Agency's *World Economic Outlook 2014* report noted, nuclear growth will be "concentrated in markets where electricity is supplied at regulated prices, utilities have state backing or governments act to facilitate private investment." Conversely, "nuclear power faces major challenges in competitive markets where there are significant market and regulatory risks, and public acceptance remains a critical issue worldwide."[9]

Four countries supposedly driving a nuclear renaissance

Let's briefly consider countries where the number of power reactors might increase or decrease by 10 or more over the next 15−20 years. Generally, it is striking how much uncertainty there is about the nuclear programs in these countries.

China is one of the few exceptions. China has 22 operable reactors, 27 under construction and 64 planned. Significant, rapid growth can be expected unless China's nuclear program is derailed by a major accident or a serious act of sabotage or terrorism.[10]

In the other three countries supposedly driving a nuclear renaissance − Russia, South Korea and India − growth is likely to be modest and slow.

Russia has 34 operating reactors, nine under construction and 31 planned. Only three reactors have begun operation over the past decade, and the pattern of slow growth is likely to continue. As for Russia's ambitious nuclear export program, Steve Kidd noted in October 2014 that it "is reasonable to suggest that it is highly unlikely that Russia will succeed in carrying out even half of the projects in which it claims to be closely involved".[11]

South Korea has 23 operating reactors, five under construction and eight planned. Earlier plans for rapid nuclear expansion have been derailed by the Fukushima disaster, a major scandal over forged safety documents, and a hacking attack on Korea Hydro's computer network.[12] Growth will be, at most, modest and slow.

India has 21 operating reactors, six under construction and 22 planned. But India's nuclear program is in a "deep freeze" according to a November 2014 article in the *Hindustan Times*.[13] Likewise, *India Today* reported on January 8: "The Indian nuclear programme is on the brink of distress. For the past four years, no major tender has gone through − a period that was, ironically, supposed to mark the beginning of an Indian nuclear renaissance in the aftermath of the landmark India−US civil nuclear deal."[14]

India's energy minister Piyush Goyal said in November 2014 that the government remains "cautious" about developing nuclear power. He pointed to waning interest in the US and Europe: "This government would like to be cautious so that we are not saddled with something only under the garb of clean energy or alternate energy; something which the West has discarded and is sought to be brought to India."[15]

A November 2014 article in *The Hindu* newspaper notes that three factors have put a break on India's reactor-import plans: "the exorbitant price of French- and U.S.-origin reactors, the accident-liability issue, and grass-roots opposition to the planned multi-reactor complexes."[16] In addition, unresolved disagreements regarding safeguards and non-proliferation assurances are delaying US and European investment in India's nuclear program.[17]

Saudi Arabia last year announced plans to build 16 reactors by 2032. Already, the timeline has been pushed back from 2032 to 2040.[18] As with any country embarking on a nuclear power program for the first time, Saudi Arabia faces daunting logistical and workforce issues.[19] Numerous nuclear supplier are lining up to supply Saudi Arabia's nuclear power program but political obstacles could easily emerge, not least because Saudi officials (and royalty) have repeatedly said that the Kingdom will build nuclear weapons if Iran's nuclear program is not constrained.[20]

South Africa's on-again off-again nuclear power program is on again with plans for 9.6 GW of nuclear capacity in addition to the two operating reactors at Koeberg.[21] In 2007, state energy utility Eskom approved a plan for 20 GW of new nuclear capacity. Areva's EPR and Westinghouse's AP1000 were short-listed and bids were submitted. But in 2008 Eskom announced that it would not proceed with either of the bids due to a lack of finance. Easy come, easy go.

Thus the latest plan for 9.6 GW of new nuclear capacity in South Africa is being treated with scepticism. Academic Prof. Steve Thomas noted in a July 2014 report: "Overall, a renewed call for tenders (or perhaps bilateral negotiations with a preferred bidder) is likely to produce the same result as 2008: a very high price for an unproven technology that will only be financeable if the South African public, either in the form of electricity consumers or as taxpayers, is prepared to give open ended guarantees."[22]

Pro-nuclear commentator Dan Yurman is also sceptical: "Depending on who's pricing analysis you accept, the reactors alone will cost between [US]$5000 (Rosatom) and $6500/Kw (Eskom) or between $48 billion and $62.4 billion. Adding in balance of plant equipment and power line infrastructure, and the total price tag heads north to between $65 billion and $84 billion. Given that the intended power purchase firm is state-owned Eskom, which is perpetually broke due to government resistance to rate increases, the entire exercise seems implausible at this scale. ... Almost no one believes that as long as Zuma is in power that anything remotely resembling an orderly procurement process is likely to take place."[23]

Iran has one operable power reactor. Last year, Russia and Iran signed a contract to build two power reactors, and they signed a protocol envisaging possible construction of an additional six reactors.[24]

Plans for significant nuclear power expansion in one or two other countries − such as the **Pakistani** government's plan for 40 GW of nuclear capacity by 2050 − are implausible.[25]

Nuclear negawatts

Now to briefly consider those countries where a significant decline of nuclear power is possible or likely over the next 15−20 years.

Patterns of stagnation or slow decline in north America and western Europe can safely be predicted. Steve Kidd wrote in May 2014 that uranium demand (and nuclear power capacity) "will almost certainly fall in the key markets in Western Europe and North America" in the period to 2030.[4] In January 2014, the European Commission forecast that EU nuclear generating capacity of 131 GW in 2010 will decline to 97 GW in 2025.[26]

The United States has 99 operable reactors. Five reactors are under construction, "with little prospect for more" according to Oilprice.com.[27] Decisions to shut down just as many reactors have been taken in the past few years. As the *Financial Times* noted last year, two decisions that really rattled the industry were the closures of Dominion Resources' Kewaunee plant in Wisconsin and Entergy's Vermont Yankee − both were operating and licensed to keep operating into the 2030s, but became uneconomic to keep in operation.[28]

The US Energy Information Administration estimated in April 2014 that 10.8 GW of nuclear capacity − around 10% of total US nuclear capacity − could be shut down by the end of the decade.[29]

The most that the US nuclear industry can hope for is stagnation underpinned by new legislative and regulatory measures favouring nuclear power along with multi-billion dollar government handouts. The situation is broadly similar in the **UK** − the nuclear power industry there is scrambling just to stand still.

France's lower house of Parliament voted in October 2014 to cut nuclear's share of electricity generation from 75% to 50% by 2025, to cap nuclear capacity at 63.2 GW, and to pursue a renewables target of 40% by 2030 with various new measures to promote the growth of renewables.[30,31] The Senate will vote on the legislation early this year.

However there will be many twists and turns in French energy policy. Energy Minister Segolene Royal said on January 13 that France should build a new generation of reactors, and she noted that the October 2014 energy transition bill did not include a 40-year age limit for power reactors as ecologists wanted.[32]

Germany's government is systematically pursuing its policy of phasing out nuclear power by 2023. That said, nothing is certain: the nuclear phase-out policy of the social democrat / greens coalition government in the early 2000s was later overturned by a conservative government.

Japan's 48 operable reactors are all shut down. A reasonable estimate is that three-quarters (36/48) of the reactors will restart in the coming years. Before the Fukushima disaster, Tokyo planned to add another 15−20 reactors to the fleet of 55 giving a total of 70−75 reactors. Thus, Japan's nuclear power industry will be around half the size it might have been if not for the Fukushima disaster.

The elephant in the room − aging reactors

The problem of aging reactors came into focus in 2014 − and will remain in focus for decades to come with the average age of the world's power reactors now 29 years and steadily increasing.[33,34]

Problems with aging reactors include:

- the increased risk of accidents (and associated problems such as generally inadequate accident liability arrangements);
- an increased rate of unplanned reactors outages (at one point last year, less than half of the UK's nuclear capacity was available due to multiple outages[35]);
- costly refurbishments;
- debates over appropriate safety standards for reactors designed decades ago; and
- the costs associated with reactor decommissioning and long-term nuclear waste management.

Greenpeace highlighted the problems associated with aging reactors with the release of a detailed report last year[36], and emphasised the point by breaking into six aging European nuclear plants on 5 March 2014.[37]

The International Energy Agency (IEA) said in its *World Energy Outlook 2014* report: "A wave of retirements of aging nuclear reactors is approaching: almost 200 of the 434 reactors operating at the end of 2013 are retired in the period to 2040, with the vast majority in the European Union, the United States, Russia and Japan."[9]

IEA chief economist Fatih Birol said: "Worldwide, we do not have much experience and I am afraid we are not well-prepared in terms of policies and funds which are devoted to decommissioning. A major concern for all of us is how we are going to deal with this massive surge in retirements in nuclear power plants."[38]

The *World Energy Outlook 2014* report estimates the cost of decommissioning reactors to be more than US$100 billion (€89b) up to 2040, adding that "considerable uncertainties remain about these costs, reflecting the relatively limited experience to date in dismantling and decontaminating reactors and restoring sites for other uses."

The IEA's head of power generation analysis, Marco Baroni, said that even excluding waste disposal costs, the final cost could be as much as twice as high as the $100 billion estimate, and that decommissioning costs per reactor can vary by a factor of four.[34]

Baroni said the issue was not the decommissioning cost per reactor but "whether enough funds have been set aside to provide for it." Evidence of inadequate decommissioning funds is mounting. To give just one example, Entergy estimates a cost of US$1.24 billion (€1.10b) to decommission Vermont Yankee, but the company's decommissioning trust fund for the plant − US$0.67 billion − is barely half that amount.[39]

Michael Mariotte, President of the Nuclear Information & Resource Service, noted in a recent article: "Entergy, for example, has only about half the needed money in its decommissioning fund (and even so still found it cheaper to close the reactor than keep it running); repeat that across the country with multiple and larger reactors and the shortfalls could be stunning. Expect heated battles in the coming years as nuclear utilities try to push the costs of the decommissioning fund shortfalls onto ratepayers."[40]

The nuclear industry has a simple solution to the problem of old reactors: new reactors. But the battles over aging and decommissioned reactors − and the raiding of taxpayers' pockets to cover shortfalls − will make it that much more difficult to convince politicians and the public to support new reactors.

References

1. WNA Weekly Digest, 16 Jan 2015, 'Slight increase in nuclear capacity in 2014', http://us1.campaign-archive2.com/?u=140c559a3b34d23ff7c6b48b9&id=4785fc1dba&e=ae5ca458a0
2. Tierney Smith, 9 Jan 2015, '5 Countries Leading the Way Toward 100% Renewable Energy', http://ecowatch.com/2015/01/09/countries-leading-way-renewable-energy/
3. www.iaea.org/PRIS/WorldStatistics/WorldTrendNuclearPowerCapacity.aspx
4. Steve Kidd, 6 May 2014, 'The future of uranium – higher prices to come?', www.neimagazine.com/opinion/opinionthe-future-of-uranium-higher-prices-to-come-4259437
5. WNA, 2014, 'The World Nuclear Supply Chain: Outlook 2030, http://online-shop.world-nuclear.org/bfont-size18pxthe-world-nuclear-supply-chain-broutlook-2030fontb-18-p.asp
6. John Johnson, 5 Dec 2014, 'Nuclear power to change shape in 2015', http://analysis.nuclearenergyinsider.com/small-modular-reactors/nuclear-power-change-shape-2015
7. Steve Kidd, 21 Jan 2015, 'Is climate change the worst argument for nuclear?', www.neimagazine.com/opinion/opinionis-climate-change-the-worst-argument-for-nuclear-4493537/
8. http://worldnuclearreport.org
9. International Energy Agency, 2014, 'World Economic Outlook 2014', www.worldenergyoutlook.org
10. China's nuclear power plans: safety and security challenges, 19 Dec 2014, Nuclear Monitor #796, www.wiseinternational.org/nuclear-monitors
11. Steve Kidd, 6 Oct 2014, "The world nuclear industry – is it in terminal decline?", www.neimagazine.com/opinion/opinionthe-world-nuclear-industry-is-it-in-terminal-decline-4394815/
12. Heesu Lee, 15 Jan 2015, 'Fukushima Meltdowns Pervade S. Korea Debate on Reactor Life', www.bloomberg.com/news/2015-01-14/fukushima-meltdowns-pervade-korea-debate-on-longer-reactor-life.html
13. Shishir Gupta and Jayanth Jacob, 30 Nov 2014, 'Govt plans N-revival, focuses on investor concerns', www.hindustantimes.com/india-news/govt-plans-n-revival-looks-for-answers-to-investor-concerns/article1-1291627.aspx
14. Pranab Dhal Samanta, 8 Jan 2015, 'Splitting the liability atom', http://indiatoday.intoday.in/story/obama-republic-day-visit-nuclear-power-programme-india-intensifies-efforts/1/412184.html
15. 6 Nov 2014, 'Govt cautious about tapping nuclear energy for power generation', www.thehindu.com/news/national/govt-cautious-on-westdiscarded-nuclear-technology-says-piyush-goyal-at/article6570575.ece
16. Brahma Chellaney, 19 Nov 2014, 'False promise of nuclear power', www.thehindu.com/opinion/lead/false-promise-of-nuclear-power/article6612000.ece
17. Indrani Bagchi, 19 Nov 2014, 'American officials put up hurdles, try to scuttle India-US nuclear deal', http://timesofindia.indiatimes.com/india/American-officials-put-up-hurdles-try-to-scuttle-India-US-nuclear-deal/articleshow/45198136.cms
18. Reuters, 19 Jan 2015, http://uk.reuters.com/article/2015/01/19/saudi-nuclear-energy-idUKL6N0UY2LS20150119?rpc=401

19. Dan Yurman, 24 Jan 2015, 'Saudi Arabia delays its nuclear plans', http://neutronbytes.com/2015/01/24/saudi-arabia-delays-its-nuclear-plans/
20. 18 Sept 2014, 'Saudi Arabia's nuclear power program and its weapons ambitions', Nuclear Monitor #791, www.wiseinternational.org/node/4195
21. 'South Africa's stop-start nuclear power program', Nuclear Monitor #792, 2 Oct 2014, www.wiseinternational.org/node/4193
22. Steve Thomas, July 2014, 'Nuclear technology options for South Africa', http://earthlife.org.za/www/wp-content/uploads/2014/09/nuclear-cost_report1.pdf
23. Dan Yurman, 6 Dec 2014, 'China jumps into the action in South Africa', http://neutronbytes.com/2014/12/06/china-makes-haste-to-develop-its-nuclear-energy-future/
24. 5 Dec 2014, 'Russia to build more reactors in Iran', Nuclear Monitor #795, www.wiseinternational.org/nuclear-monitors
25. 20 Jan 2015, 'N-safeguards steps implemented: IAEA', www.dawn.com/news/1158113/n-safeguards-steps-implemented-iaea
26. WNN, 9 Jan 2014, 'Policies hold European nuclear steady', www.world-nuclear-news.org/EE-Politics-hold-European-nuclear-steady-0901144.html
27. Nick Cunningham, 9 Feb 2014, 'Wind and Gas Forcing Out Nuclear in Midwest', http://oilprice.com/Latest-Energy-News/World-News/Wind-and-Gas-Forcing-Out-Nuclear-in-Midwest.html
28. Ed Crooks, 19 Feb 2014, 'Uneconomic US nuclear plants at risk of being shut down', www.ft.com/intl/cms/s/0/da2a6bc6-98fa-11e3-a32f-00144feab7de.html
29. Reuters, 29 Apr 2014, 'U.S. expects about 10 pct of nuclear capacity to shut by 2020', http://in.reuters.com/article/2014/04/28/utilities-nuclear-eia-idINL2N0NK23D20140428
30. 10 Oct 2014, 'France to cut nuclear's share of power market to 50% by 2025', www.platts.com/latest-news/electric-power/london/france-to-cut-nuclears-share-of-power-market-26900954
31. Michel Rose, 15 Oct 2014, 'French energy transition law to cut red tape on renewables', http://planetark.org/enviro-news/item/72327
32. Reuters, 13 Jan 2015, 'French energy minister wants new nuclear reactors', www.reuters.com/article/2015/01/13/france-nuclear-idUSL6N0US1P320150113
33. Michael Mariotte, 3 April 2014, 'Nuclear reactors are getting old – and it's showing', www.wiseinternational.org/node/4056
34. Nina Chestney and Geert De Clercq, 19 Jan 2015, 'Global nuclear decommissioning cost seen underestimated, may spiral', www.reuters.com/article/2015/01/19/nuclear-decommissioning-idUSL6N0UV2BI20150119
35. Nuclear Free Local Authorities, 9 Dec 2014, 'NFLA concerns over the reliability of aging nuclear reactors in the UK', www.nuclearpolicy.info/docs/briefings/A241_%28NB127%29_Aging_nuclear_reactor_concerns.pdf
36. Greenpeace International, 2014, 'Lifetime extension of ageing nuclear power plants: Entering a new era of risk', www.greenpeace.nl/Global/nederland/2014/Documenten/Rapport%20Lifetime%20extension%20of%20ageing%20nuclear%20power%20plants.pdf
37. http://out-of-age.eu
38. WNN, 12 Nov 2014, 'Nuclear industry shares IEA concern', www.world-nuclear-news.org/NP-Nuclear-industry-shares-IEA-concern-12111401.html
39. Robert Audette, 19 Dec 2014, 'Vermont Yankee decommissioning plan submitted to NRC', www.reformer.com/localnews/ci_27171602/vermont-yankee-decommissioning-plan-submitted-nrc
40. Michael Mariotte, 5 Jan 2015, 'Nuclear industry goes hysterically ballistic over Yankee shutdown', http://safeenergy.org/2015/01/05/nuclear-industry-goes-hysterical

A breakthrough with India's nuclear liability law?

NM797.4441 Nuclear suppliers from the US and some other countries have balked at investing in India's nuclear power program because of India's Civil Liability for Nuclear Damage Act 2010. The legislation does not completely indemnify nuclear suppliers, in particular suppliers of "equipment or material with patent or latent defects or sub-standard services."

Recent media reports have trumpeted a landmark, breakthrough deal between the US and India on the liability issue which will unlock billions in investments. But a joint statement released by President Obama and Prime Minister Modi was more circumspect and vague, welcoming "understandings reached" on the issue.[1]

It seems likely any agreement would involve a nuclear accident insurance pool − possibly amounting to around US$250 million (€222m), and possibly with contributions from the Indian government and from five Indian government-owned insurance companies.[2]

But insurance pool or no insurance pool, suppliers would likely still be vulnerable to legal challenge unless Indian legislation is amended (as the US has been demanding), and it seems unlikely that the Indian government is prepared to attempt to change the legislation (or whether any such attempt would win parliamentary approval). Modi's recent statement − "we are moving towards commercial cooperation, consistent with our law" − suggests no appetite to attempt to amend the legislation.

Details remain vague, *The Guardian* noted on January 26, and officials stressed they were still working out the finer arrangements of the scheme, which is designed to avoid the need to change Indian law. "We think we came to an understanding of the liability" issue, said the US ambassador to Delhi, Richard Verma, which will operate "through a memorandum of law within the Indian system".[3]

Even if the liability issue is resolved to the satisfaction of nuclear suppliers in the US and elsewhere, other obstacles will slow the development of nuclear power in India, not least finance and public opposition.

And if nuclear suppliers believe they are indemnified, that in itself is a problem. Siddharth Varadarajan from Shiv Nadar University writes:

"US companies say that exposing them to damage claims, either by the operator of a nuclear facility or the victims of an accident, would make them unviable commercially since they would be liable for potentially unlimited claims.

"Let us parse this argument carefully. On the one hand, suppliers argue that their reactors are so safe that the probability of an accident is virtually zero. On the other, they argue that the damages from an accident are potentially so enormous that they would go bankrupt if they were held liable in any way. The latter statement is true, considering the Fukushima

clean up has cost nearly $20 billion already. While this circle should be squared by asking suppliers to put their insurance money where their safety mouth is, all international liability regimes like the compensation treaty [Convention on Supplementary Compensation for Nuclear Damage] and the Paris and Vienna Conventions shift the burden entirely on to the operator.

"This is absurd from an economic standpoint. While designing a reactor, how can a supplier decide what the optimum level of safety is if he is not forced to internalise the cost of an accident in some way? Nuclear regulators play an important role in the design and implementation of safety features but can never fully substitute for liability-driven incentives."[4]

In addition to progress on the liability issue, Obama and Modi claimed to have made progress on another sticking-point: India's reluctance to allow the tracking of nuclear materials through the nuclear fuel cycle to guard against diversion for weapons. In their joint statement, Modi and Obama said they welcomed "understandings reached on ... administrative arrangements for civil nuclear cooperation".

But as with the liability issue, detail is lacking. NDTV (New Delhi Television) cited "sources" saying the US "has forfeited its demand on insistence on "flagging" or tracking the nuclear material they supply to India, required under its rules to ensure it is not being used for military purposes."[5] According to *The Guardian*, the opposite is true: "India will also allow closer tracking of spent fuel to limit the risk of it falling into terrorist hands."[3]

References:

1. WNN, 26 Jan 2015, 'Deal close for Indian reactor imports', www.world-nuclear-news.org/NP-Deal-close-for-Indian-reactor-imports-2601151.html
2. M Saraswathy, 26 Jan 2015, 'Insurers to offer Rs 750 cr capacity for nuclear pool; rest from govt', www.business-standard.com/article/current-affairs/insurers-to-offer-rs-750-cr-capacity-for-nuclear-pool-rest-from-govt-115012500552_1.html
3. Dan Roberts, 26 Jan 2015, 'Obama and Modi agree to limit US liability in case of nuclear disaster', www.theguardian.com/world/2015/jan/25/obama-modi-limit-us-liability-nuclear-disaster
4. Siddharth Varadarajan, 25 Jan 2014, 'Why India should say no to US demand to dilute its nuclear liability law', http://scroll.in/article/702334/Why-India-should-say-no-to-US-demand-to-dilute-its-nuclear-liability-law
5. 25 Jan 2015, 'The Short Walk Home. How PM Modi, President Barack Obama Clinched Nuclear Deal', www.ndtv.com/article/india/the-short-walk-home-how-pm-modi-president-barack-obama-clinched-nuclear-deal-653481

'Total stop' for new nuclear build in Sweden

Author: *Charly Hultén − WISE Sweden*

NM797.4442 Vattenfall, the state-owned Swedish power company, announced on January 23 that it has terminated all work to develop a new generation of nuclear reactors in Sweden. The company has also withdrawn its application for a permit for new nuclear build, submitted in 2012.

In 2012, the company made it clear that the application did not necessarily mean that they *intended* to build a new reactor, only that they wanted to assess the prospects of launching a new generation of reactors. In order to make a full assessment, they needed to initiate a process within the regulatory agency, SSM (Swedish Nuclear Safety Authority). Hence the application.

Since then, Vattenfall has put millions into the project. But the January 23 announcement definitely has a ring of finality. The unit dedicated to developing new reactors has been disbanded. Some 40 Vattenfall employees are affected; some will be transferred to other positions, some are being offered retirement. "No one at Vattenfall will be working with New Build," said Mats Lideborn, who headed the unit, in response to a direct question.

The withdrawal of the application has an impact on the regulator, as well; 15 or more employees assigned to deal with Vattenfall's application now face transfer or retirement.

On January 15, only days before these steps were made public, Vattenfall announced a major reorganisation at group company level. The company will henceforth be organised according to function: Heat, Wind, Distribution, Generation, etc. The company's controversial lignite operations in eastern Germany have been carved out to form an independent unit, with the intention of sale in the coming year (at the urging of the new Board of Directors).

CEO Magnus Hall described the changes as strategic: "Vattenfall operates in a challenging market climate, where cost-effectivness and sustainability are key to success. ... A first step is to establish an overarching strategy. Some elements of that strategy are already clear: we need to defend our position as a European company and to develop our portfolio so that we can offer our customers more sustainable solutions. We shall also produce electricity with a focus on emissions-free or emissions-efficient solutions."

Directive or 'reality check'?

Initial press reports suggest that the new government ordered the change of course. In September 2014, Minister of Environment and Sustainability, Åsa Romson (Green Party), announced that the government would be exercising its ownership to guide Vattenfall away from nuclear power and toward sustainable energy sources. But within 24 hours her statement was qualified – not to say countermanded – by PM Staffan Löfven (Social Democrat), who stated that the future of nuclear power would be decided by a multi-stakeholder Energy Commission (see Nuclear Monitor #793).

That Commission has yet to be appointed. Yet, Vattenfall has taken these drastic steps.

It is possible, even likely, that Vattenfall instead may be responding to its own viability studies. Sweden has the benefit of plentiful hydroelectric power. The country's base-load is covered. And the market for electricity is rapidly changing. The per-kWh cost of renewables – wind power in particular – is falling, which is encouraging many actors to 'grow their own'. Several hangar-type store chains, IKEA among them, have announced plans to become energy self-sufficient through energy efficiency measures and installing rooftop photovoltaic. Cheaper renewable capacity means that spikes in electricity prices are nowhere near as sharp as they were only a year or two ago, and there is no sign that prices will rise again.

Vattenfall, to be sure, is itself a major actor in the wind power sector, with several large-scale farms in different parts of Sweden. In November 2014, the company boasted investments in wind power amounting to SEK 40 billion (€4.3b; US$4.8b) over the past six years and a doubling of its wind power production since 2011. Investments of an additional SEK 11 billion in Sweden and Europe overall are slated for the coming four years. The simple reason is that wind power is profitable.

Wind power accounts for roughly 7% of Sweden's electricity production (13 terrawatt-hours) today, but the share is steadily growing. Vattenfall's press release adds: "Our growth objectives for renewable electricity production stand firm, despite the tougher times that Vattenfall and the energy sector as a whole face today."

In August 2014, Mikael Oldenberg – formerly a Conservative politician, now Executive Director of Svenska Kraftnät, the national distribution utility − called nuclear new build "utopian". "There is currently no rational basis for investing in new nuclear capacity," Oldenberg wrote. Perhaps Vattenfall has simply come to the same conclusion.

Sources:

Ci Holmgren: "Total stopp för kärnkraft", Sveriges Radio/P1 (Eko newscast, 23 Jan 2015)

L A Karlberg: "Stopp för kärnkraft ger SSM personalproblem", Ny Teknik (23 Jan 2015)

Vattenfall: Ny organisation för Vattenfalls framtida strategi (press release, 15 Jan 2015)

Jan Nylander: "Vattenfall stoppar planer för ny kärnkraft", Sveriges Television (27 Nov 2014)

– Vattenfall: Vattenfall bygger ny vindkraftpark för en halv miljard (press release, 7 Nov 2014)

Reactor restarts in Japan

Author: *Jim Green − Nuclear Monitor editor*

NM797.4443 No power reactors have operated in Japan since 16 September 2013 but the slow process of restarting reactors is in train and the first restarts − Kyushu's two reactors at Sendai − will likely occur in the first half of this year. Next in line are Takahama #3 and #4.

Twelve utilities have applied to restart 21 reactors, and further applications will follow (Japan has a total of 48 operable reactors). The World Nuclear Association cites a 'high case' scenario developed by Itochu Corporation, with about 10 reactor restarts annually and a total of up to 35 restarts within five years.[1]

The Japanese public remains sceptical. A November 2014 poll by the *Asahi Shimbun* newspaper found that twice as many respondents oppose reactor restarts as support them (56:28).[2] More than 16,000 people gathered in Tokyo last September to protest against the decision to approve the restart of the Sendai reactors.[3] Of the 18,711 comments on the government's draft basic energy plan, 94.4% opposed reactor restarts, while only 1.1% were in favour.[4]

On the other hand, Prime Minister Shinzo Abe and the Liberal Democratic Party comfortably won the December 2014 election, and the government is intent on reactor restarts. Public opposition will delay many reactor restart approval processes and it may force the closure of at least a few reactors (in addition to those already slated for closure).

The government/corporate collusion that was a central feature of Japan's pre-Fukushima 'nuclear village' is re-emerging (if it ever went away). Junko Edahiro, chief executive of Japan for Sustainability, noted in a November 2014 speech: "Before the Abe administration, I was a member of an energy committee, an advisory body for the government charged with providing input on energy policies until 2030 for Japan. We had 25 members, of whom myself and seven others were not in favor of nuclear power. It was a small contingent, but this was still a huge departure from the past because citizens and experts against nuclear power have never been assigned as members of a governmental advisory body. The new administration, however, restructured the committee, eliminating anyone against nuclear power. ... In Japan we have what some people refer to as a "nuclear village": a group of government officials, industries, and academia notorious for being strongly pro-nuclear. There has been little change in this group, and the regulatory committee to oversee nuclear policies and operations is currently headed by a well-known nuclear proponent."[5]

With the nuclear village back in charge, familiar patterns are re-emerging. A November 2014 editorial in *Japan Times*, commenting on the Sendai restart approval, said the "move contains serious safety and procedural problems" such as inadequate evacuation plans, the lack of a permanent off-site command centre in the case of an emergency, the exclusion of eight municipalities from

the approval process, and numerous other problems. “As the seemingly last key hurdle for the restart of the Sendai nuclear power plant is lifted,” *Japan Times* editorialised, “a dangerous precedent has been set and many fundamental questions remain unanswered.”[6]

One post-Fukushima reform that has not yet been destroyed is TEPCO’s outside advisory committee, the Nuclear Reform Monitoring Committee, chaired by former US Nuclear Regulatory Commission chair Dale Klein.[7] Klein said late last year that TEPCO should convene a panel of foreign operators to review safety standards.

“I would like to see what I call a readiness review,” Klein told Reuters. “You’ve got regulatory aspects – Do you meet everything? Do you have right training? – and then, I think, because of Fukushima Daiichi, the Japanese public would feel better if another group came in and said operationally they are ready. I have been pushing for that.”[8]

So, might TEPCO appoint an outside committee to review safety standards and supplement the work of the Nuclear Reform Monitoring Committee? A more likely outcome is that the Nuclear Reform Monitoring Committee itself will be abolished.

Permanent reactor shut-downs

A minimum of five reactors will be permanently shut down (in addition to the six Fukushima Daiichi reactors).[9] The five reactors are Kansai’s Mihama #1 and #2, Japan Atomic Power’s Tsuruga 1, Chugoku’s Shimane 1, and Kyushu’s Genkai 1. All are relatively small (320−529 MW), and by October 2015 all will be more than 40 years old. Another two reactors, Kansai’s Takahama #1 #2, which began commercial operation in 1974 and 1975, may also be shut down although Kansai may fight to restart them.

Other reactors may also be permanently shut down. Cantor Fitzgerald forecasts that in the long-term 32 of the 48 reactors will restart and the other 16 shut down.[10] One of the other candidates for permanent closure is Tsuruga #2 − Japan’s Nuclear Regulatory Authority disagrees with Japan Atomic Power Corporation about seismic risks.[11]

TEPCO’s plan to restart reactors #6 and #7 at the Kashiwazaki−Kariwa plant (badly damaged by an earthquake in 2007) is meeting stiff resistance from the governor of Niigata province, Hirohiko Izumida. The governor says TEPCO must address its “institutionalized lying” before it can expect to restart reactors.[12] He wants TEPCO executives held accountable for the negligence that led to the Fukushima disaster, but government prosecutors have refused to bring charges against TEPCO executives.[13]

Japan’s Ministry of Economy, Trade and Industry, which oversees the nuclear industry, is reportedly considering revising accounting rules to lighten the financial burden on utilities that decommission nuclear reactors, with decisions expected by March.[9] In other words, the government is planning to do what the government does best: throw taxpayers’ money at the nuclear industry.

Among other smoke-and-mirror tricks:

- Reactors are limited to a 40-year operating life ... but utilities can apply for a 20-year extension.
- Government and industry are not (yet) promoting the construction of new reactors, but efforts are being made to move ahead with reactors under construction before March 2011. Expect double-dipping and triple-dipping: the closure of a small number of reactors is being used to quell opposition to reactor restarts, then the closure of the same reactors will be used to quell opposition to the completion of reactors under construction and reactors in the planning stages.

Debates over the future of the Monju fast reactor and the Rokkasho reprocessing plant will add spice to Japan’s nuclear debate this year. Monju may be doomed, but Japan Nuclear Fuel Ltd hopes to begin operating Rokkasho in early 2016.[1]

References

1. www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Japan/
2. 6 Jan 2015, ‘Editorial: Consensus-building process needed for nuclear policy decisions’, http://ajw.asahi.com/article/views/editorial/AJ201501060058
3. 23 Sept 2014, ‘What’s your anti-disaster plan?’ Thousands protest Japanese nuclear revival’, http://rt.com/news/190068-japan-nuclear-energy-protest/
4. Atsushi Komori, 12 Nov 2014, ‘Energy plan overlooked flat-out opposition to nuclear power, analysis shows’, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201411120044
5. Junko Edahiro, November 2014, ‘Toward a Sustainable Japan: Fukushima Accidents Show Japan’s Challenges’, JFS Newsletter No.147, www.japanfs.org/en/news/archives/news_id035110.html
6. 12 Nov 2014, ‘Bad precedent for nuclear restart’, www.japantimes.co.jp/opinion/2014/11/12/editorials/bad-precedent-nuclear-restarts/
7. www.nrmc.jp/en/index-e.html
8. Kentaro Hamada, 2 Dec 2014, ‘Japan’s Tepco needs safety review from foreign nuclear operators − adviser’, http://uk.reuters.com/article/2014/12/02/uk-nuclear-tepco-idUKKCN0JG0QV20141202
9. 11 Jan 2015, ‘5 old nuclear reactors headed for decommissioning scrap heap’, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201501110012
10. 1 Jan 2015, ‘Japan turns ignition key on efforts to restart its nuclear fleet’, http://neutronbytes.com/2015/01/01/japan-turns-ignition-key-on-efforts-to-restart-its-nuclear-fleet/
11. 20 Nov 2014, ‘Nuclear watchdog panel: Fault under Tsuruga reactor is active’, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201411200043
12. Antoni Slodkowski and Kentaro Hamada, 29 Oct 2013, ‘Tepco can’t yet be trusted to restart world’s biggest nuclear plant: governor’, http://planetark.org/enviro-news/item/70199
13. Reuters, 22 Jan 2015, ‘Prosecutors won’t indict former Tepco execs over Fukushima’, www.reuters.com/article/2015/01/22/us-japan-nuclear-prosecution-idUSKBN0KV0SC20150122

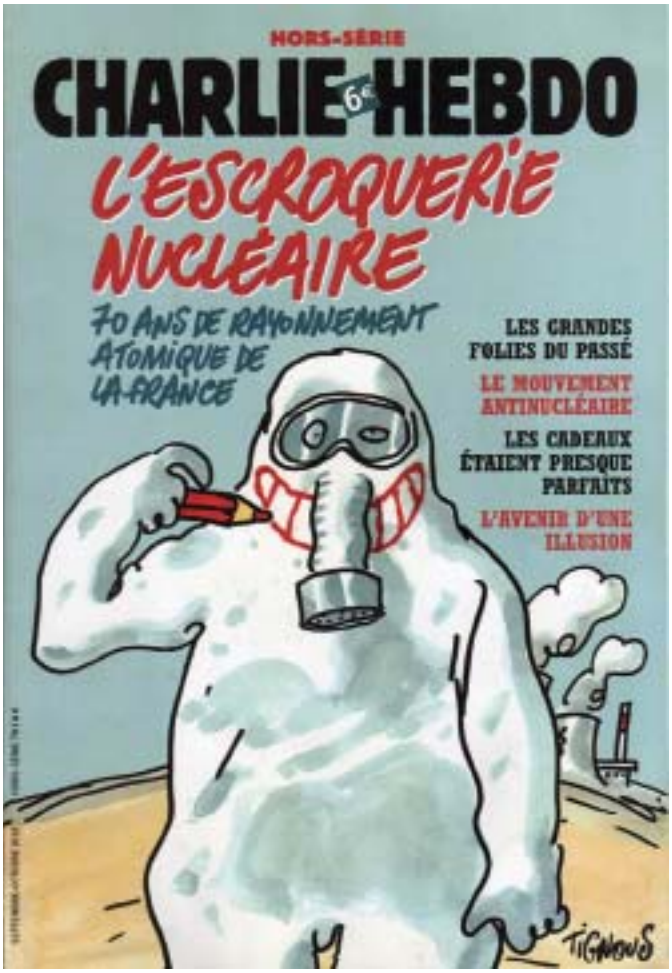
Charlie Hebdo –
an ally of the anti-nuclear movement

French satirical magazine *Charlie Hebdo* has been at the forefront of the denunciation of nuclear threats − from nuclear weapons and from the nuclear fuel cycle − since its creation in 1969; indeed since its predecessor magazine *Hara Kiri* was first printed in 1960.

Several *Charlie Hebdo* staffers supported anti-nuclear struggles, including murdered editor Stéphane 'Charb' Charbonnier. Staffer Fabrice Nicolino, who was wounded on January 7, was the author of a special edition of *Charlie Hebdo* in 2012 called 'The Nuclear Swindle' − with democracy the victim of the swindle.

Some nuclear cartoons from Charlie Hebdo are posted at: http://sortirdunucleaire.org/Solidarite-Charlie

'Precautionary measure after Greenpeace's latest incursion into a nuclear plant.
' 'Do not leave the gate open. Thank you.'



'The Nuclear Swindle'

'Waste. Soon you'll be able to bury it in your back garden.'

NUCLEAR NEWS

Canada: Progress with non-reactor isotope production

A research team at the University of British Columbia is making progress developing non-reactor methods to produce technetium-99m (Tc-99m), the isotope used in 70−80% of diagnostic nuclear imaging procedures. Using its Triumf cyclotron, they produced enough Tc-99m in six hours to enable about 500 scans, thereby creating a "viable alternative" to the NRU reactor which is scheduled to close in 2016.[1]

Clinical trials involving 50−60 patients are expected to begin this year to prove that the cyclotron-produced Tc-99m behaves in the same way as that from nuclear reactors. If the three-month trials are successful, the university says, one of Triumf's cyclotrons "would likely be dedicated to medical isotope production", possibly as soon as 2016.

Only a handful of research reactors around the world produce molybdenum-99 (Mo-99), the parent of Tc-99m. The supply chain has been vulnerable to interruptions from unplanned reactor outages.

The Canadian government has invested around C$60 million (€43m; US$48m) in projects, including Triumf, to bring non-reactor-based isotope production technologies to market through its Isotope Technology Acceleration Program initiative.

Production of Tc-99m using cyclotrons does not require the highly enriched uranium targets that are commonly used in reactors to produce Mo-99 (and Mo-99 production has sometimes been used to justify the use of highly enriched reactor fuel). Instead, Tc-99m is produced by bombarding a Mo-100 target with a proton beam.

Another technique that is showing some promise uses the Canadian Light Source in Saskatoon, Saskatchewan.[2] The accelerator bombards a target of enriched Mo-100 with high-energy X-rays, which knock a neutron out of some of the Mo-100 atoms to produce Mo-99. If all goes to plan, two or three accelerator systems like the Canadian Light Source facility could produce enough isotopes to supply Canada's domestic needs. Production of the parent isotope Mo-99 is preferable to direct production of Tc-99, as its longer half-life (66 hours vs. 6 hours for Tc-99m) facilitates more widespread distribution.

Numerous non-reactor methods of Mo-99/Tc-99m production have been proposed over the past few decades, and some methods have been proven on an experimental scale.[3] There is a reasonable chance that the looming closure of the NRU reactor in Canada will result in viable, affordable methods of large-scale, non-reactor Mo-99/Tc-99m production.

1. WNN, 9 Jan 2015, 'New record for cyclotron isotope production', www.world-nuclear-news.org/RS-New-record-for-cyclotron-isotope-production-0901158.html
2. WNN, 17 Nov 2014, 'Canada ships first synchrotron isotopes', www.world-nuclear-news.org/RS-Canada-ships-first-synchrotron-isotopes-1711148.html
3. www.foe.org.au/anti-nuclear/issues/oz/lh/tc99

Belgium not ready for major nuclear accident

Contingency plans for a major nuclear accident are not up to scratch and Belgium is therefore ill-prepared for such a catastrophe. This is the conclusion of a study commissioned by Greenpeace Belgium. The study was undertaken by the French Association pour le Contrôle de la Radioactivité de l'Ouest (ACRO).

Nothing has been learned from the Fukushima disaster in Japan. Emergency preparations are very limited and "would not suffice to protect Belgians if there was serious nuclear accident."

"Zones covered by current contingency plans are too limited and must be enlarged to cover the whole country. There is no mention of the evacuation of cities such as Antwerp, Liege or Namur, in spite of their location being less than 30 kms from a nuclear power station," said Greenpeace, which also highlights power stations in Gravelines, Chooz, Cattehom (France), and Borssele (Netherlands), all along the Belgian border.

For Greenpeace, the Fukushima disaster showed that contingency plans only work to protect populations if they have been developed and tested with a worst case scenario in mind. Everyone concerned – from emergency services to potential victims – must be trained in what to do in advance of an actual incident. "This is not the case in Belgium, where the case of only a limited nuclear incident with low radioactive contamination levels has been envisaged," explains Eloi Glorieux, energy campaigner for Greenpeace Belgium.

In view of the high population density in this country, and of the problems occurring at Belgian nuclear plants in recent months, the expected lifespan of Belgian reactors should not be extended, said Greenpeace.

"Will the Belgian government act responsibly to protect Belgian citizens? For now, it seems willing to run the risk and is ignoring any lessons that were learned from Fukushima and Tchernobyl. We call this culpable negligence".

The report (in Dutch) is posted at: www.greenpeace.org/belgium/nl/nieuws-blogs/Blogs/blog-klimaat/belgi-totaal-niet-klaar-voor-nucleaire-ramp/blog/51917/

Global renewable energy knowledge hub

The International Renewable Energy Agency (IRENA) has launched 'REsource' − an online platform that enables users to easily find country-specific data, create customized charts and graphs, and compare countries on metrics like renewable energy use and deployment. It also provides information on renewable energy market statistics, potentials, policies, finance, costs, benefits, innovations, education and other topics.

www.irena.org/REsource

Renewable energy costs reaching grid parity

Maturing clean energy technologies, such as onshore wind, solar power and biomass, are reaching grid parity

in many parts of the world regardless of whether or not they receive subsidies, a new report by the International Renewable Energy Agency (IRENA) has revealed.[1]

IRENA states: "The competitiveness of renewable power generation technologies continued improving in 2013 and 2014, reaching historic levels. Biomass for power, hydropower, geothermal and onshore wind can all provide electricity competitively against fossil fuel-fired power generation. Solar photovoltaic (PV) power has also become increasingly competitive, with its levelised cost of electricity (LCOE) at utility scale falling by half in four years."

IRENA estimates fossil-fuelled power plants produce power at between US$0.07−0.19/kWh when environmental and health costs of carbon emissions and other forms of pollution are taken into account.

Deutsche Bank has released its 2015 Solar Outlook report.[2] Deutsche Bank states: "Unsubsidized rooftop solar electricity costs anywhere between $0.13 and $0.23/kWh today, well below retail price of electricity in many markets globally. The economics of solar have improved significantly due to the reduction in solar panel costs, financing costs and balance of system costs. We expect solar system costs to decrease 5-15% annually over the next 3+ years which could result in grid parity within ~50% of the target markets. If global electricity prices were to increase at 3% per year and cost reduction occurred at 5-15% CAGR [compound annual growth rate], solar would achieve grid parity in an additional ~30% of target markets globally. We believe the cumulative incremental total available market for solar is currently around ~140GW/year and could potentially increase to ~260GW/year over the next 5 years as solar achieves grid parity in more markets globally and electric capacity needs increase."

According to Bloomberg New Energy Finance, global investment in renewables jumped 16% last year to US$310 billion (€89b), five times the tally of a decade earlier. Solar investments accounted for almost half the total. China led the way with renewable investments increasing almost one-third to US$89.5 billion (€79.6b), while US investment gained 8% to US$51.8 billion (€46.1b).[3]

A November 2014 report commissioned by the Vienna Ombuds-Office for Environmental Protection compares the economics of renewables and nuclear power.[4] Five different renewable technologies were analysed: biomass, onshore and offshore wind, small-scale hydropower plants and solar photovoltaics. Calculations were conducted for five different EU Member states (UK, Poland, Germany, France and the Czech Republic) and the EU-28 overall.

The report concludes: "Generating electricity from a variety of renewable sources is more economical than using nuclear power; this is clearly shown by the model-based assessment of future developments up to 2050. Across the EU end consumers can save up to 37% on their electricity costs – in some Member States even up to 74% – when plans to build nuclear power plants are shelved in favour of renewables. In order to achieve these goals it is vital that we act quickly, but with care, to create the infrastructure and regulatory framework this requires, or to adapt that which already exists."

1. IRENA, January 2014, 'Renewable Power Generation Costs in 2014', www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=494
   For more of IRENA's ongoing renewable energy cost analysis, see www.irena.org/costs
2. Deutsche Bank, 13 Jan 2015, 'Deutsche Bank's 2015 solar outlook: accelerating investment and cost competitiveness', www.db.com/cr/en/concrete-deutsche-banks-2015-solar-outlook.htm
3. http://about.bnef.com/press-releases/rebound-clean-energy-investment-2014-beats-expectations/
   www.theage.com.au/business/renewable-investment-dives-in-australia-bucking-global-trend-20150109-12kqhk.html
4. Austrian Institute of Ecology / e-think, Nov 2014, 'Renewable Energies versus Nuclear Power: Comparing Financial Support', www.ecology.at/wua_erneuerbarevskernenergie.htm

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

Subscriptions:

US and Canada based readers should contact NIRS for details on how to receive the Nuclear Monitor (nirsnet@nirs.org).

All others receive the Nuclear Monitor through WISE.

Version	NGO's/ individuals	Institutions/ Industry
Paper 20x	100 Euro	350 Euro
Email/Pdf 20x	50 Euro	200 Euro

Contact us via:

WISE International
PO Box 59636, 1040 LC Amsterdam, The Netherlands

Web: www.wiseinternational.org

Email: info@wiseinternational.org

Phone: +31 20 6126368

ISSN: 1570-4629

WISE/NIRS NUCLEAR MONITOR

c/o WISE Amsterdam
PO Box 59636
1040 LC Amsterdam
Netherlands

PRINTED MATTER
MATIERE IMPRIME

PRIORITY
PRIORITAIRE

TPG Post
Port betaald