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wise
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Editorial

Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor:

- Jim Green reviews key nuclear power developments in 2015.
- Michael Mariotte from the Nuclear Information & Resource Service argues that 2016 could be a transformative year in the movement towards nuclear-free, carbon-free energy systems.
- Peer de Rijk from WISE summaries the latest controversies with Belgium's nuclear power program.
- Joyce Nelson writes about the ongoing struggle to prevent a nuclear waste dump being built in Canada near the Great Lakes.
- Paul Brown reviews expert opinions regarding nuclear power in the aftermath of the UN COP21 climate change conference.
- David Lowry explores some interesting connections between the UK nuclear program and North Korea's weapons program.

Feel free to contact us if you have feedback on this issue of the 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 down for the count

Author: *Jim Green – Nuclear Monitor editor*

NM817.4527 Ten new power reactors began supplying electricity last year (eight of them in China), and eight reactors were permanently shut down.[1] Thus nuclear power's 20-year pattern of stagnation continues.

At the end of 1995, there were 434 operable reactors[2]; now there are 439. Moreover the 439 figure includes 41 reactors in Japan that have been shut-down for several years, and not all of them will be restarted. Current global nuclear capacity of 382 gigawatts (again including those 41 reactors in Japan) is 12% higher than the 1995 figure of 341 GW (an annual growth rate of 0.6%).

YEAR	1995	2005	2015
OPERABLE REACTORS	434	441	439
CAPACITY (GW)	341	368	382

Construction began on seven reactors last year, and a total of 67 power reactors are now under construction.[1]

The nuclear power industry's malaise was all too evident at the COP21 UN climate change conference in Paris in December. Former World Nuclear Association executive Steve Kidd noted:

"It was entirely predictable that the nuclear industry achieved precisely nothing at the recent Paris COP-21 talks and in the subsequent international agreement. ... Analysis of the submissions of the 196 governments that signed up to the Paris agreement, demonstrating their own individual schemes on how to reduce national carbon emissions, show that nearly all of them exclude nuclear power. The future is likely to repeat

the experience of 2015 when 10 new reactors came into operation worldwide but 8 shut down. So as things stand, the industry is essentially running to stand still."[3]

According to the International Atomic Energy Agency, only seven out of 196 countries mentioned nuclear power in their climate change mitigation plans prepared for the COP21 conference: China, India, Japan, Argentina, Turkey, Jordan and Niger.[4]

China's great leap forward

With 30 operable reactors, 24 under construction, and many more in the pipeline, China remains the only country with significant nuclear expansion plans.[5] China is unlikely to meet any of its targets – 58 GW by 2020, 110 GW by 2030 and up to 250 GW by 2050 – but growth will be significant nonetheless. Growth could however be derailed by a serious accident, which is all the more likely because of China's inadequate nuclear safety standards, inadequate regulation, lack of transparency, repression of whistleblowers, world's worst insurance and liability arrangements, security risks, and widespread corruption.

Over the next 10–20 years, global nuclear capacity may increase marginally, with strong growth in China more than masking patterns of stagnation and decline elsewhere. Beyond that, the aging of the global fleet of power reactors will be sharply felt: the International Energy Agency anticipates almost 200 permanent shut-downs by 2040.[6] Steve Kidd notes that the industry is running to stand still, and it will have to run faster to stand still as the annual number of shut-downs increases.

Growth elsewhere?

India is the only other country where there is a possibility of significant nuclear growth in the nearish-future. But nuclear growth in India has been modest – six reactor start-ups over the past decade[7] – and may remain so. In early 2015, India claimed to have resolved one of the major obstacles to foreign investment by announcing measures to circumvent a liability law which does not completely absolve suppliers of responsibility for accidents.[8] But those claims were met with scepticism and a capital strike by most foreign suppliers is still in effect. Strong public opposition – and the Indian state's brutal response to that opposition – will likely continue to slow nuclear expansion.[9]

In mid-January 2016, the latest auction of solar energy capacity in India achieved a new record low price of 4.34 rupees/kWh (US$0.064; €0.059). Energy minister Piyush Goyal said: "Through transparent auctions with a ready provision of land, transmission and the like, solar tariffs have come down below thermal power cost."[10]

Russia has 35 operating reactors and eight under construction (including two very low power floating reactors).[11] Only six reactors have started up over the past 20 years, and only four over the past decade. The pattern of slow growth will 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".[12]

South Korea has 25 operable reactors and three under construction.[13] Six reactors have started up over the past decade.

South Africa plans 9.6 GW of new nuclear capacity to add to the two Koeberg reactors. But the nuclear program is more theatre than reality. Pro-nuclear commentator Dan Yurman states:

"South Africa's plans to build 9.6 GW of nuclear power will continue to be embroiled in political controversy and be hobbled by a lack of realistic financial plans to pay for the reactors. Claims by both Rosatom and Chinese state nuclear firms that they have won the business are not credible. Even if written down on paper, these claims of contracts cannot be guaranteed in the long term due to the political twists and turns by South African President Jacob Zuma. Most recently, he burned through three finance minister over differences about whether the country could afford the cost of the reactors said to be at as much as US$100 billion including upgrades to the electrical grid. Additionally, Zuma is distracted by political and personal scandals."[14]

Brazil's nuclear industry provided some theatre in 2015 with the arrest of Othon Luiz Pinheiro da Silva, the former CEO of Brazil's nuclear power utility Eletronuclear, for allegedly accepting bribes to fix the bidding process for the Angra 3 reactor under construction 100 km from Rio de Janeiro.[15] Fourteen other people were also charged as a result of the federal police's Operation Radioactivity. "The arrest is a tragedy for the industry," said former Eletrobras' chief executive Luiz Pinguelli Rosa. "The industry was already in crisis, but now the corruption concerns are bound to delay Angra 3 further and cause costs to rise even more."

Newcomer countries: The World Nuclear Association claims that "over 45 countries are actively considering embarking upon nuclear power programmes."[16] There's no truth to the claim. Only two 'newcomer' countries are actually building reactors − Belarus and the United Arab Emirates. Other countries might join the nuclear club but nuclear newcomers will be few and far between. Moreover, some countries are phasing out nuclear power. Countries with nuclear phase-out policies include Germany, Belgium, Taiwan, and Switzerland. Other countries – e.g. Sweden – may phase out nuclear power partly as a result of deliberate government policy and partly because of natural attrition: aging reactors are being shut down without replacement.

Stagnation and decline

Patterns of stagnation or slow decline in **north America** and **western Europe** can safely be predicted. In 2014, the European Commission forecast that EU nuclear generating capacity of 131 GW in 2010 will decline to 97 GW in 2025. The European Commission forecasts that nuclear's share of EU electricity generation will decline from 27% in 2010 to 21% in 2050, while the share from renewables will increase from 21% to 51.6%, and fossil fuels' share will decline from 52% to 27%.[17]

The most important nuclear power story of 2015 was legislation enacted in the **French Parliament** in July that will reduce nuclear's share of electricity generation to 50% by "around" 2025, and caps nuclear capacity at the current level of 63.2 GW. The legislation also establishes a target of 32% of electricity generation from renewables by 2030, a 40% reduction in greenhouse gas emissions and a 20% reduction in overall energy consumption by 2030.[18,19,20]

In April 2015, a report by ADEME, a French government agency under the Ministries of Ecology and Research, shows that 100% renewable electricity supply by 2050 in France is feasible and affordable.[21]

French EPR reactor projects in France and Finland are three times over budget and many years behind schedule. In April 2015 it was revealed that EPRs under construction in France and China may have cracked pressure vessels.[22,23]

A January 2016 update to the World Nuclear Industry Status Report discusses the miserable state of the French nuclear industry:

"The French state-controlled AREVA, having announced an outlook of a further "heavy loss" in 2015, was downgraded by credit-rating agency Standard & Poor's to B+ ("highly speculative"). On 29 December 2015, the company plunged to a new historic low on the stock market (€5.30 compared to €72.50 eight years ago). On 7 December 2015, Euronext ejected the French heavy weight Électricité de France (EDF), largest nuclear utility in the world and "pillar of the Paris Stock Exchange", from France's key stock market index, known as CAC40. One day later, EDF shares lost another four percent of their value, which led to a new low, a drop of over 85 percent from its 2007 level. ... The French nuclear industry's international competitors are not doing much better. AREVA's Russian counterpart Atomenergoprom as well as the Japanese controlled Toshiba-Westinghouse were both downgraded to "junk" ("speculative") by credit-rating agencies during the year."[24]

In the **United States**, utilities announced two more reactor shut-downs in 2015: the FitzPatrick reactor in New York will be shut down in 2016, and the Pilgrim reactor in Massachusetts will be closed between 2017 and 2019. Five reactors are under construction but a greater number have been shut down recently or will be shut down in the next few years. The last reactor to start up was in 1996. In August 2015 the Environmental Protection Agency released its final Clean Power Plan, which failed to give the nuclear industry the subsidies and handouts it was seeking.[25]

A decade ago, the US Nuclear Regulatory Commission was flooded with applications for US$127 billion (€117b) worth of reactor projects. Now, obituaries for the US nuclear power renaissance are being written.[26]

The situation is broadly similar in the **United Kingdom** − the nuclear power industry there is scrambling just to stand still. It should be clear by the end of this year whether the extraordinarily expensive Hinkley C EPR project will go ahead. According to the World Nuclear Association, most of the UK's reactors are to be retired by 2023.[27] If other projects prove to be as expensive and difficult as Hinkley C, it's unlikely that new nuclear capacity will match retirements.

In **Japan**, only two of the country's 43 operable reactors are actually operating. Perhaps half or two-thirds of the reactors will eventually restart. Five reactors were permanently shut down in 2015, and the six reactors at Fukushima Daiichi have been written off. 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.

New reactor types to the rescue?

Rhetoric about super-safe, better-than-sliced-bread Generation IV reactors will likely continue unabated. That said, critical reports released by the US and French governments last year may signal a shift away from Generation IV reactor rhetoric.

The report by the French Institute for Radiological Protection and Nuclear Safety (IRSN) − a government authority under the Ministries of Defense, the Environment, Industry, Research, and Health − states: "There is still much R&D to be done to develop the Generation IV nuclear reactors, as well as for the fuel cycle and the associated waste management which depends on the system chosen."[28] IRSN is also sceptical about safety claims: "At the present stage of development, IRSN does not notice evidence that leads to conclude that the systems under review are likely to offer a significantly improved level of safety compared with Generation III reactors ... "

The US Government Accountability Office released a report in July 2015 on the status of small modular reactors (SMRs) and other 'advanced' reactor concepts in the US.[29] The report concluded:

"While light water SMRs and advanced reactors may provide some benefits, their development and deployment face a number of challenges. Both SMRs and advanced reactors require additional technical and engineering work to demonstrate reactor safety and economics ... Depending on how they are resolved, these technical challenges may result in higher-cost reactors than anticipated, making them less competitive with large LWRs [light water reactors] or power plants using other fuels ... Both light water SMRs and advanced reactors face additional challenges related to the time, cost, and uncertainty associated with developing, certifying or licensing, and deploying new reactor technology, with advanced reactor designs generally facing greater challenges than light water SMR designs. It is a multi-decade process, with costs up to $1 billion to $2 billion, to design and certify or license the reactor design, and there is an additional construction cost of several billion dollars more per power plant."

According to a US think tank, 48 companies in north America, backed by more than US$1.6 billion (€14.8b) in private capital, are developing plans for advanced nuclear reactors.[30] That's a bit over US$30,000 for each company; i.e., peanuts. Even if all that capital was invested in a single R&D project, it would not suffice to commercialize a new reactor type.

Dan Yurman notes in his review of nuclear developments in 2015: "Efforts by start-up type firms to build advanced reactors will continue to generate a lot of media hype, but questions are abundant as to whether this activity will result in prototypes. For venture capital firms that have invested in advanced designs, cashing out may mean licensing a design to an established reactor vendor rather than building a first-of-a-kind unit."[14]

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2016 could be a transformative year

Author*: Michael Mariotte − President of the Nuclear Information & Resource Service*

NM817.4528 If 2015 was the year that the ongoing global energy transition away from nuclear power and fossil fuels and toward a clean energy system based on renewables gained public notice, then 2016 naturally should be the year that the transition takes visible and meaningful steps forward.

Two critical steps that occurred in December ensure that the coming year is indeed likely to be that kind of pivotal, transformative period.

The first was, of course, the international COP 21 climate agreement, which – despite its flaws – will cause a global acceleration of the transition. The second factor, here in the U.S., was the five-year extension (and eventual phase-out) of tax credits for solar and wind power deployment. Both will combine to enable 2016, and the years immediately following, to attain milestone after milestone in the development of a nuclear-free, carbon-free energy system.

A third factor, by the way, also limited to the U.S. but related to the ability to achieve the COP 21 agreement, is President Obama's Clean Power Plan.

But you don't need to take my word for it; there are plenty of energy experts predicting the same–and also throwing out new ideas for how to make the transition even faster.

First, take a step back, to those long-ago almost-forgotten first days of the Obama Administration back in 2009. As E&E Publishing put it, "If you were a time traveler from 2009, you would not recognize the energy world of 2016."[1] There is a lot of truth in that, as the article demonstrates, but there also have been a lot of changes the article doesn't address. For example, while the article does note in sort of sidestep fashion that solar and wind prices have fallen through the floor over the past seven years, it misses the fact that nuclear costs have not done the same – in fact they've increased even for paid-for operating reactors to the point where in many competitive markets, such reactors are no longer economically competitive with renewables, a gap that is only going to grow.

The World Future Council (WFC) does notice that point in its round-up of energy developments and projections for an exciting energy system quite unlike the 20th century model the dinosaur utilities are still striving to protect: "Fossil fuels and nuclear power are now bound to remain stranded assets not only because they are environmentally destructive or bad for the climate, but more importantly, because they have become a financially NOT viable option for the 21st century."[2]

WFC approvingly notes Germany's ongoing and increasingly successful *Energiewende* energy transition, and a new report from the German think-tank Agora Energiewende documents that success, which is becoming the de facto, if not necessarily publicly acknowledged, model for the rest of the world.[3]

Meanwhile, Utility Dive takes a look at the effect the five-year extension of the renewable tax credits will have on the rapidly growing clean energy technologies and predicts even faster deployment of such distributed energy resources than we've experienced to date.[4]

While last year's breakthrough developments in energy storage – the ability to save electricity generated by solar and wind during peak times and use it later, when wind dies down and the sun sets – continue to be a game-changer and will lead to more and more use of both technologies, some people at RenewableEnergyWorld.com are thinking bigger.[5] They envision a globally interconnected renewable energy system that can move around electrons as needed where needed. There are obviously a lot of roadblocks to establishment of such a system, not the least of which are political, but the idea merits consideration.

New York climate march, September 2014.

The COP 21 agreement and the Clean Power Plan both have their flaws, and both have been criticized for being under-ambitious and insufficient in their stated goals. The criticism is correct, at least in their currently-stated goals. But neither document is intended to be the last word on the subject; both, in fact, view their goals as first steps, not final ones. And, as this excellent article[6] points out, if you're a utility executive making decisions now that will affect your company and the supply of electricity 30-40 years into the future – something that at least the smart utility execs do – then you have to plan to meet not only the stated goals of these documents for the relatively near future, but the extremely high likelihood that the goals are a moving target, and that they will continue to move away from dirty energy and toward a renewable energy future. In other words, deeper decarbonization is on the not-distant horizon.

Not that any of this happens without a fight of course, as we've pointed out many, many times. A renewable-powered future is by definition an existential threat to the nuclear and fossil fuel interests, and they're not going to slink quietly away on their own, as pointed out in this article: Can We Move Forward To The Future Of Electric Power?[7]

Still, as the title of that article indicates, the world is beginning to become impatient with climate deniers and with those standing in the way of a clean energy system. With any luck at all, 2016 will be the last U.S. presidential campaign featuring climate deniers at all. If that turns out to be the case, then 2016 will indeed turn out to be the kind of pivotal, transformative year it portends.

Michael Mariotte regularly writes at www.safeenergy.org

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Belgium nuclear soap continues

Author: *Peer de Rijk – Director, World Information Service on Energy*

NM817.4529 The story of the much-plagued Belgium reactors (Tihange 1-3 and Doel 1-4) continues. It's almost impossible to keep track of the number of incidents and accidents. The Belgium government wants to extend the life of these reactors (see Nuclear Monitor #815, 3 Dec 2015) and has reached an agreement with the owner, Electrabel.

While this agreement is still to be debated in the Parliament (mid-February), more and more people in both Belgium and neighboring Netherlands are getting uneasy and angry about the ongoing sequence of accidents and incidents. So much so that the Dutch Minister responsible for nuclear safety, Schultz van Haegen, was forced to organize a 'bilateral co-inspection'. She visited the Doel reactors on January 20, accompanied by the Belgium Minister Jambon and the Dutch and Belgium safety regulators, FANC and the ANVS.

Doel nuclear plant in Belgium, January 2016.

As both Germany and Luxembourg have asked (or more or less demanded) Belgium to close at least the reactors where cracks were found (Tihange 2 and Doel 3), WISE urged the Dutch Minister to do the same – as more and more Dutch local city councils are also demanding more action from the national Dutch authorities.

The official report on the visit to be made by FANC and ANVS is still pending but the Belgium and Dutch Ministers came out of the site with the clear will to comfort people, claiming that most of the incidents are at the non-nuclear parts of the plants, the media is making it into a big issue, we and our safety people take care, we will be communicating more from now on, we will act responsibly in case of real danger, etc.

WISE organized a small action at the gates of Doel during the visit of the Minsters and organized a very successful gathering in the closest Dutch town, 20 kms from Doel, where 150 people came together to talk about possible activities. We are also building new alliances with all kinds of Belgium NGO's and citizen's initiatives.

Great Lakes nuclear waste dump: the battle continues

Author: *Joyce Nelson*

NM817.4530 Opposition to the proposed nuclear waste facility by Lake Huron continues to grow. By the end of 2015, at least 182 communities (representing more than 22 million people) on both sides of the U.S.–Canada border have adopted resolutions opposing the plan by Ontario Power Generation to build a deep geological repository (DGR) for storage of low- and intermediate-level radioactive nuclear waste.

A Canadian federal panel approved the nuclear waste dump in May 2015, accepting testimony that Lake Huron would be large enough to dilute any radioactive pollution that might leak from the DGR.

The immediate outcry on both sides of the border prompted the Conservative government of Stephen Harper to postpone any decision until Dec. 1, 2015, after the Oct. 19 federal election – in which they were booted out of office. The new government of Liberal Justin Trudeau then pushed that decision to March 1, 2016, after a dozen members of Michigan's congressional delegation urged the new prime minister to deny the construction permits necessary for the storage facility to be built.

Meanwhile, American efforts to engage the International Joint Commission (IJC), which oversees boundary waters' issues, have come to naught. As the IJC's Public Information Officer Frank Bevacqua told me by email, both the Canadian and U.S. federal governments would have to ask the IJC to intervene on the issue. "The IJC does not review proposals for site-specific projects [like the DGR] unless asked to do so by both governments," he said.

That means a final decision on the DGR may reside with a small First Nations community.

First Nation decision

The proposed DGR would be located on the territory of the Saugeen First Nation, which is in the process of evaluating the proposal. The Saugeen First Nation has a promise from Ontario Power Generation to not proceed without their support. As Saugeen Chief Vernon Roote told Indian Country Today Media Network (ICTMN) in December, "Ontario Power Generation had given us their commitment that they will not proceed unless they have community support. That's a letter that we have on file."[1]

Saugeen First Nation negotiator (and former Chief) Randall Kahgee told ICTMN that "we are starting to build some momentum on the community engagement process." The Saugeen leaders are determining how to gauge the community voice, whether by polling or by vote at public gatherings, and have already held some engagement sessions on the issue.[2]

Randall Kahgee told ICTMN, "For the communities, this is not just about the deep geological repository but also about the nuclear waste problem within our territory. We have always insisted that while this problem is not of our own design, we must be part of shaping the solution. Gone are the days when our people, communities and Nation are left on the outside looking in within our own territory. These are complex issues that will force us to really ask ourselves what does it mean to be stewards of the land. The opportunity to be able to shape the discourse on these matters is both exciting and frightening at the same time."[3]

The Saugeen First Nation is especially concerned about simply moving the proposed facility into somebody else's backyard. "We might not be the best of friends when we push nuclear waste on our brothers' and sisters' territory," he told ICTMN.

Nuclear expansion

The proposal by provincial Crown corporation Ontario Power Generation (OPG) is for at least 7 million cubic feet of nuclear wastes from Ontario nuclear power plants to be buried in chambers drilled into limestone 2,231 feet below the surface and under the Bruce nuclear site at Kincardine, Ontario. The waste to be entombed in the DGR would come from the Bruce, Pickering and Darlington nuclear sites in Ontario – currently home to 18 Candu reactors.

The eight nuclear reactors at the Bruce site (the world's largest nuclear station) are leased from OPG by a private company called Bruce Power, whose major shareholders/partners include TransCanada Corp. – better known for its tarsands pipeline projects. (TransCanada earns more than one-third of its profits from power-generation.) Bruce Power pays OPG for storage of nuclear wastes, which are currently stored and monitored above-ground on site.[4]

In December, Bruce Power announced that it will invest $13 billion to refurbish the Bruce site, overhauling six of the eight reactors on Lake Huron beginning in 2020.[5] Just weeks later, OPG announced a $12.8 billion refurbishment of four nuclear reactors at Darlington, while extending the life of its ageing Pickering nuclear power plant on Lake Ontario.[6] The Pickering move requires public hearings and approval from the Canadian Nuclear Safety Commission, but Ontario's Energy Minister Bob Chiarelli has voiced his approval and touted the nuclear industry as "emissions-free," while ignoring the issue of nuclear wastes.

OPG, Bruce Power, and the Ontario government are obviously onside with the Canadian Nuclear Association lobby, whose president and CEO John Barrett is using the COP21 Paris Climate Agreement to push for nuclear expansion. In an op-ed for The Globe and Mail, Barrett declared that "it is time to recognize the contribution – current and potential – of nuclear power in curbing greenhouse gas (GHG) emissions worldwide," and he stated that Canada, with its uranium mining and nuclear reactor technology, is "ready to play an international leadership role on climate change."[7]

Barrett, in turn, is onside with the billionaires now pushing nuclear energy expansion worldwide: Richard Branson (Virgin Group), Peter Thiel (PayPal co-founder), Bill Gates and Paul Allen (Microsoft co-founders), and Jeff Bezos (Amazon) have all endorsed nuclear energy as the solution to climate change.[8] As well, scientists James Hansen, Kerry Emmanuel, Ken Caldeira and Tom Wigley have recently called for building 115 new reactors per year as "the only viable path forward".[8] They dismiss nuclear waste as "trivial" and claim that there "are technical means to dispose of this small amount of waste safely."

In that case, the resulting nuclear waste should be stored in their basements and under the billionaires' mansions, rather than near bodies of water like the Great Lakes, which provide 40 million people with their drinking water.

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Joyce Nelson is an award-winning Canadian freelance writer/researcher working on her sixth book.

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Paris fails to revive the nuclear dream

Author: *Paul Brown*

Charlatans, or planetary saviours? Post-Paris views on the nuclear industry suggest few experts believe it will bring closer a world rid of fossil fuels.

NM817.4531 In Paris, in early December, the advocates of nuclear power made yet another appeal to world leaders to adopt their technology as central to saving the planet from dangerous climate change.

Yet analysis of the plans of 195 governments that signed up to the Paris Agreement, each with their own individual schemes on how to reduce national carbon emissions, show that nearly all of them exclude nuclear power.

Only a few big players – China, Russia, India, South Korea and the United Kingdom – still want an extensive program of new-build reactors.

To try to understand why this is so the US-based Bulletin of the Atomic Scientists asked eight experts in the field to look at the future of nuclear power in the context of climate change.

One believed that large-scale new-build nuclear power “could and should” be used to combat climate change, and another thought nuclear could play a role, although a small one. The rest thought new nuclear stations were too expensive, too slow to construct and had too many inherent disadvantages to compete with renewables.

Amory Lovins, co-founder and chief scientist of the Rocky Mountain Institute, produced a devastating analysis saying that the slow-motion decline of the nuclear industry was simply down to the lack of a business case. The average nuclear reactor, he wrote, was now 29 years old and the percentage of global electricity generated continued to fall from a peak of 17.6% in 1996 to 10.8% in 2014. “Financial distress stalks the industry”, he wrote.

Lovins says nuclear power now costs more than wind or solar energy and is so far behind in cost and building time that it could never catch up. The full details of what he and other experts said are on the Bulletin’s site[1], with some of their comments below.

Professor Jeff Terry, of the physics department at Illinois Institute of Technology, was the greatest enthusiast for new nuclear build:

“Nuclear energy is a reliable, low carbon dioxide source of electricity that can and should be used to combat climate change. China, India, Russia, and South Korea are all building nuclear plants both at home and in other countries. Therefore, nuclear energy will continue to play a role in mitigating the effects of climate change for the next 80 years. Why are these countries turning to nuclear energy? Mainly due to the versatility and stability of nuclear generation. Nuclear power has the highest capacity factor of any low carbon dioxide-emitting power source.”

Another potential enthusiast was Seth Grae, president and CEO of the Lightbridge Corporation, who believes light water nuclear reactors “must increase globally” if the world is to reach the goals of the Paris Agreement.

However, new technologies that could have a major impact on decarbonising global electricity generation, including advances such as grid-level electricity storage[2], more efficient wind turbines and new types of nuclear reactors, are not being developed fast enough, he argues.

“Unfortunately, these technologies are not economically competitive enough for utilities to deploy at a large enough scale to prevent catastrophic climate change”, Grae writes. “Sufficient improvement in economic competitiveness might not be achieved in time to prevent the worst effects of climate change.”

M.V. Ramana, of the Nuclear Futures Laboratory and the Program on Science and Global Security at Princeton University, was dismissive. “There are still some who hope that nuclear power will magically undergo a massive expansion within a relatively short period of time. The evidence so far suggests that this is a false hope, one that is best abandoned if we are to deal with climate change with the seriousness the problem demands.”

Peter Bradford, adjunct professor at the Vermont Law School, and former U.S. Nuclear Regulatory Commission member, agreed:

“In the 15th year of the era formerly known as “the nuclear renaissance,” not a single molecule of carbon dioxide emission has been avoided by a renaissance reactor built in the United States or in Europe. ... Climate change, so urgent and so seemingly intractable, has become the last refuge of nuclear charlatans throughout the Western world.”

Bradford continued:

“James Hansen, perhaps the most visible of the climate scientists who advocate heavy reliance on breeder or other innovative reactor designs without paying any attention to their track record of long and costly failure, has become ever more reminiscent of Groucho Marx leaping from a paramour’s bed to confront a disbelieving husband with: ‘Who are you going to believe, me or your eyes?’”

Hui Zhang, physicist and senior research associate at Harvard Kennedy School’s Belfer Center for Science and International Affairs, said China had a big program to build nuclear power stations. But they currently generated only 1% of the nation’s huge electricity needs, and even if the target of 110 power reactors by 2030 were achieved, they would produce only 5%:

“While a fleet of nuclear reactors with 130 GWe by 2030 would represent a substantial expansion (over four times China’s current capacity of 30 GWe, and more than the current US capacity of about 100 GWe), it would account for only 5% of total energy use in the country and would constitute just one quarter of the non-fossil energy needed. In practice, the total energy use will likely be higher than the planned cap, so the share of nuclear power in the overall energy mix would be even

less. Eventually, nuclear power is important if China is to address concerns about air pollution and climate change, but it is only one piece of a huge puzzle."

Reprinted from Climate News Network, http://climatenewsnetwork.net/paris-fails-to-revive-the-nuclear-dream/

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Paris, December 2015.

How Britain helped the North Korean nuclear weapons program

Author: *David Lowry*

NM817.4532 The news that North Korea has successfully tested its first hydrogen nuclear warhead (an assertion which has been seriously questioned by nuclear weapons experts) has set the media and politicians running pronouncing concerns over the impact on global security.

What hasn't been discussed is how British nuclear designs have been purloined by the North Koreans to build production plants for their nuclear explosives. There is significant evidence that the British Magnox nuclear plant design – which was primarily built as a military plutonium production factory – provided the blueprint for the North Korean military plutonium program based in Yongbyon.

Here is what Douglas (now Lord) Hogg, then a Conservative minister, admitted in a written parliamentary reply in 1994: "We do not know whether North Korea has drawn on plans of British reactors in the production of its own reactors. North Korea possesses a graphite moderated reactor which, while much smaller, has generic similarities to the reactors operated by British Nuclear Fuels plc. However, design information of these British reactors is not classified and has appeared in technical journals."[1]

The uranium enrichment programs of both North Korea and Iran also have a UK connection. The blueprints of this type of plant were stolen by Pakistani scientist, A.Q. Khan, from the URENCO enrichment plant in The Netherlands in the early 1970s.[2] This plant was – and remains – one-third owned by the UK government. The Pakistan government subsequently sold the technology to Iran, who later exchanged it for North Korean Nodong missiles.

A technical delegation from the A.Q. Khan Research Labs visited North Korea in 1996. The secret enrichment plant was said to be based in caves near Kumch'ang-ni, 100 miles north of the capital, Pyonyang, where U.S. satellite photos showed tunnel entrances being built. Hwang Jang-yop, a former aid to President Kim Il-sung (the grandfather of the current North Korean President) who defected in 1997, revealed details to Western intelligence investigators.[3]

Magnox machinations

Magnox is a now obsolete type of nuclear power plant (except in North Korea) which was designed by the UK Atomic Energy Authority (UKAEA) in the early 1950s, and was exported to Italy and Japan. The name magnox comes from the alloy used to clad the fuel rods inside the reactor.

The plutonium production reactors at Calder Hall on the Sellafield site – then called Windscale, operated by the UKAEA – were opened by the young Queen Elizabeth in 1956. But it was never meant as a commercial civilian nuclear plant: the UKAEA official historian Kenneth Jay wrote about Calder Hall, in his short book of the same name, published to coincide with the opening of the plant. He referred to "major plants built for military purposes, such as Calder Hall." Earlier, he wrote: "The plant has been designed as a dual-purpose plant, to produce plutonium for military purposes as well as electric power."

The term magnox also encompasses three North Korean reactors, all based on the open access blueprints of the Calder Hall Magnox reactors, including:

- A small 5 MWe experimental reactor at Yongbyon[4], operated from 1986 to 1994, and restarted in 2003. Plutonium from this reactor's spent fuel has been used in the North Korea nuclear weapons program.
- A 50 MWe reactor, also at Yongbyon, whose construction commenced in 1985 but was never finished in accord with the 1994 U.S.-North Korea Agreed Framework.[5]
- A 200 MWe reactor at Taechon, construction of which also halted in 1994.

Why enrich the people when you can enrich uranium?

Olli Heinonen[6], senior fellow at the Belfer Center for Science and International Affairs at Harvard University in the US, has explained how North Korea obtained its uranium enrichment capability:[7]

"The pre-eminence of Juche, the political thesis of Kim Il Sung, stresses independence from great powers,

a strong military posture, and reliance on national resources. Faced with an impoverished economy, political isolation from the world, and rich uranium deposits, nuclear power – both civilian as well as military – fulfils all three purposes.

"History and hindsight have shown a consistency in North Korea's efforts to develop its own nuclear capability. One of the first steps North Korea took was to assemble a strong national cadre of nuclear technicians and scientists. In 1955, North Korea established its Atomic Energy Research Institute. In 1959, it signed an agreement with the Soviet Union to train North Korean personnel in nuclear related disciplines. The Soviets also helped the North Koreans establish a nuclear research center and built a 2 MW IRT nuclear research reactor at Yongbyon, which began operation in 1969.

"Throughout the 1970s, North Korea continued to develop its nuclear capabilities, pursuing a dual track approach that was consistent with the idea of nuclear self-reliance. While engaging in discussions to obtain Light Water Reactors (LWRs) from the Soviet Union, North Korea proceeded with parallel studies on graphite moderated gas cooled reactors, using publicly available information based on the Magnox reactor design.

"North Korea also carried out plutonium separation experiments at its Isotope Production Laboratory (IPL), and successfully separated plutonium in the same decade. The North Koreans worked on the design of a reprocessing plant for which, the chemical process was modeled after the Eurochemic plant. Eurochemic was a research plant dedicated to the reprocessing of spent nuclear fuel. It was owned by thirteen countries which shared and widely published technologies developed. The plant, located in Dessel, Belgium, operated from 1966 to 1974.

"When negotiations to acquire four LWRs from the Soviet Union failed, North Korea had already embarked on its indigenous nuclear program. Throughout the 1980s, North Korea constructed a 5MWe reactor, fuel fabrication plant, and a reprocessing plant at Yongbyon, with no known documented external help and with minimal foreign equipment procured. When the joint statement on the Denuclearization of the Korean Peninsula was concluded in December 1991, all three facilities had been fully operational for a number of years, with two additional (50 MWe and 200 MWe) graphite moderated gas cooled reactors under construction.

"North Korea's closed society and isolationist position has made it immensely difficult to accurately gauge its nuclear activities. Pyongyang has gone to great lengths to hide much of its nuclear program, including its enrichment route. Nevertheless, there have been indications, including procurement related evidence, that point in the direction that North Korea has been actively pursuing enrichment since the mid-1990s, with likely exploratory attempts made up to a decade earlier.

"It is clear that North Korea received a key boost in its uranium enrichment capability from Pakistan through the A.Q. Khan network. Deliveries of P-1 and P-2 centrifuges, special oils, and other equipment from Pakistan to North Korea in the late 1990s were acknowledged by former Pakistani President General P. Musharraf in his memoirs, "In the Line of Fire." President Musharraf also wrote that, separately, North Korean engineers were provided training at A.Q. Khan's Research Laboratories in Kahuta under the auspices of a government-to-government deal on missile technology that had been established in 1994. In all likelihood, North Korea also received the blue prints for centrifuges and other related process equipment from the Khan network during that period of time.

"In the late 1980s, North Korea acquired vacuum equipment from a German company. While such equipment was primarily meant for North Korea's fuel fabrication plant then under construction, some of the vacuum pumps could have been used for enrichment experiments. But additional attempts made in 2002 to again acquire vacuum technology after the completion of the fuel fabrication plant strongly pointed to its use for enrichment purposes. Evidence of North Korea's procurement activities in the late 1990s to the early 2000s showed its objective to achieve industrial or semi-industrial scale enrichment capacity, based on a more efficient Pakistani P-2 centrifuge design. In 1997, an attempt was made to acquire large amounts of maraging steel suitable for manufacturing centrifuges. In 2002/2003, North Korea successfully procured large quantities of high strength aluminum from Russia and the United Kingdom, another requirement in making centrifuges. A simple tally of the amounts and types of equipment and material sought by North Korea suggests plans to develop a 5000-centrifuge strong enrichment capacity. This appears consistent with a separate earlier enrichment offer A. Q. Khan had made to Libya.

"For North Korea to have embarked on procuring equipment and materials meant for a (semi)industrial scale enrichment facility, it is highly likely that the known Uranium Enrichment Workshop (UEW) at Yongbyon, which in reality approximates a full sized facility, is not the only one that exists. More workshops would have been needed to serve as test beds for pilot cascades of P-1 and P-2 centrifuges prior to (semi)industrial scale enrichment operations. While we have signs of North Korea's enrichment goals, the final picture remains unclear given that the actual amount of items procured remains unknown. This problem is compounded by the fact that the North Koreans have and are continuing to source nuclear material and equipment from several parties. Moreover, there remains a high degree of uncertainty concerning the level of North Korea's enrichment technology development.

"In April 2009, after expelling IAEA inspectors, North Korea publicly announced for the first time that it was proceeding with its own enrichment program. To reinforce its intentions, North Korea followed up with a letter to the UN Security Council on September 3 to confirm that it was embarking on an enrichment phase. In November 2010, the North Koreans unveiled to Siegfried Hecker, a pre-eminent nuclear expert and former director of the Los Alamos Nuclear Laboratory, an enrichment facility in Yongbyon with 2000 centrifuge machines similar to the P-2 version, built with maraging steel rotors. The scale, level of sophistication, and brazenness for the North Koreans to have built a (until then) secret enrichment


North Korea's Yongbyon nuclear plant.

facility at the same site of a previously IAEA-monitored building, caught international attention. The plant is proof of North Korea's steady pursuit to include uranium enrichment as part of its domestic nuclear fuel cycle. ...

"On March 22, 2011, North Korea's official news agency, KCNA, portrayed Libya's decision to give up its nuclear weapons as a mistake that opened the country to NATO intervention following its domestic Arab Spring uprising. Such conclusions drawn by North Korea make an already difficult case to engage North Korea to give up its nuclear weapon deterrence that much harder. At the same time, the alternative of disengagement will in all likelihood bring about greater problems.

"In engaging North Korea, several key hurdles have to be tackled. First, North Korea shows a poor proliferation record. It was the suspected supply source of UF6 to Libya via the A.Q. Khan network. There is also mounting evidence that North Korea was involved in the construction of a secret nuclear reactor at Dair Alzour in Syria that was subsequently destroyed in 2007. It is plausible that North Korean personnel assisted Syria in building the reactor."

Reprinted from http://drdavidlowry.blogspot.co.uk/2016/01/how-britain-helped-north-korean-nuclear.html

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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.

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

Web: www.wiseinternational.org

Email: info@wiseinternational.org

Phone: +31 20 6126368

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