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Monitored this issue:

India's unyielding quest for uranium on a dangerous upswing

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The Indian Prime Minister is no stranger to the art of doublespeak. Launching the 'Status of Tigers in India Report, 2018' in July, Mr Modi lauded conservation efforts in India[1], terming the country among the 'biggest and safest habitats for tigers in the world'. More recently, in an alternately loved[2] and lampooned[3] reality show aired on Discovery Channel[4], the Prime Minister spoke eloquently of his love for nature and his government's commitment to environmental and particularly, tiger conservation efforts.

That in May this year, a Forest Advisory Committee of the Ministry of Environment and Forests, Government of India, had granted in-principle approval to a proposal of the Department of Atomic Energy (DAE) to 'survey and explore' uranium deposits over an area of 83 sq kms in the Nallamala forest, home to the Amrabad Tiger Reserve in the State of Telangana[5], did not appear to weigh down Mr Modi. Neither has the multiplicity of dissenting voices from civil society organizations, tiger conservationists, and environmentalists against the proposed uranium exploration and mining, deterred the Government from staying the course.

If anything, the government is making steady efforts to clamp down on dissenters and activists such as, Prof Kodandram, who was detained by the State Police[6] while on his way to meet and express solidarity with the protesting communities. That however, has not deterred protestors who have come together to vehemently oppose the government's plans. An online people's petition[7] to 'Save Nallamala and Stop Uranium Mining' has garnered close to 10,000 signatures over the past month.

Nallamala forest is spread over seven districts across two contiguous States of India – Andhra Pradesh and Telangana, and is home to not only the Amrabad Tiger Reserve, among the biggest in the country, but also the fast-dwindling Chenchu Tribe who live deep in the heart of the forest and have been designated a 'Particularly Vulnerable Tribal Group' (PVTG) by the Central Government[8]; the 2011 population census pegs their number at 47,315.[9] The Amrabad Tiger Reserve, spread over 2,800 sq kms across the districts of Mahabubnagar and Nalgonda of Telangana, had earlier been part[10] of the 'Nagarjunasagar-Srisailam Tiger reserve'. However, following the bifurcation of the State of Andhra Pradesh, the northern part of the reserve fell under the State of Telangana and was renamed the 'Amrabad Tiger Reserve'.

The Reserve is reported[11] to have "around 70 species of mammals, more than 300 avian varieties, 60 species of reptiles and thousands of insects, all supported and nourished by more than 600 different plant species". With a little over 18 tigers[12] and a spectacular variety of wild animals such as, the panther, sloth bear, wild dog and herbivores like the spotted deer, Sambhar, wild boar etc., the news of the proposal to mine this pristine forested area[13] has understandably, caused much concern.

Apart from the rich diversity of flora and fauna in the forest, activists argue that the area is also of significant archaeological import – 'the remnants[14] of the ancient Nagarjuna Viswa Vidyalayam run by the great Buddhist scholar Nagarjunacharya (150 AD), relics of the fort of Ikshwaku Chandragupta, ancient fort of Pratap Rudra, and several others' dot the banks of the Krishna river.

For the Government however, the proposal for uranium exploration and mining in the area is not new; it has been toying with the idea for several years now. In a written response[15] to a question in the Upper House of Parliament in 2015, the Central government had stated that the Atomic Minerals Directorate for Exploration and Research (AMD) had 'located significant uranium deposits in parts of Nalgonda District, Telangana'.

In 2016, the Field Director of the Amrabad Tiger Reserve Circle conducted a field inspection to assess the potential impact of the proposed uranium exploration on the forest. In his report[16], the Field Director minces no words in stating that mining will result in "erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. Besides creating environmental damage, the contamination resulting from leakage of chemicals also will affect the health of the native wildlife. In these areas of wilderness, mining may cause destruction and disturbance of ecosystems and habitat fragmentation", and goes on to recommend that permission 'may not' be given to the 'user agency'.

It is no less worrying according to environmentalists and activists that the proposed mining will be in violation of the Wildlife Protection Amendment Act of 2006[17], which disallows "any ecologically unsustainable land use such as, mining, industry and other projects within the tiger reserves", as well as the Panchayats (Extension to Scheduled Areas) Act, 1996 (PESA) which recognizes and protects the rights of forest dwelling communities, such as the Chenchu Tribe, and requires their approval before any developmental activity can be undertaken in areas which fall under the PESA.

The stated objective for seeking environmental clearance[18] for the exploration of uranium deposits in the region by the Department of Atomic Energy (DAE) and the Atomic Minerals Directorate (AMD) is to 'augment uranium resources and locate new uranium deposits' for the 'quantum jump' that India is set to take "in harnessing

Amrabad Tiger Reserve in the State of Telangana, now vulnerable to uranium mining.

electricity through the nuclear route". For the exploration, it is estimated that nearly 4,000 deep holes will be required to be drilled[19] which conservationists argue will not only annihilate already endangered species of plants and animals, but also contaminate the surface and groundwater.

A key apprehension voiced by several environmentalists is the fact that the area identified for carrying out the mining survey is a stone's throw away from the catchment area of the Krishna River, and that the exploration will contaminate the river with radioactive pollutants, on which the Nagarjunasagar and Srisailam reservoirs are built.[20]

No strangers to the devastation caused by uranium

The people of the region however, are no strangers to the devastation caused by uranium mining. In Andhra Pradesh from which the State of Telangana was carved out in 2014, the underground Tummalapalle uranium mine has been in operation in Kadapa District since the earlier part of the decade, and its environmental and health impacts have become too stark to ignore. Panduranga Rao, former Sarpanch from Nalgonda District, informs this researcher that the health impacts of uranium mining including, cancers of various kinds, reproductive health issues in adolescent girls and women, and crop failure, akin to those documented around the Jadugoda uranium mines[21] in Jharkhand in Central India, are now being seen in the villages around the Tummalapalle facilities, causing immense fear and resentment among local communities.

The trouble began in 2017 when agriculturists in the area around the Tummalapalle mine, dependent on drip irrigation, noticed that their banana plantations had been steadily drying up and were yielding little to no produce. Dr K Babu Rao, a retired senior scientist from the Indian Institute of Chemical Technology (IICT), who has been closely associated with the farmers' movement, informs this researcher[22] that after a sample of the water was tested by the local centre of the State Agriculture Department, *Krishi Vigyan Kendra*, it was surmised that the water was 'unfit for farming'. In addition, bore wells in the area had begun to run dry and in some places even drilling up to 1000 metres yielded no water. Moreover, some water samples collected from the bore wells had revealed an increase in the percentage of uranium and other minerals.

Following this, the farmers made several representations to the District Collector and local political representatives regarding groundwater contamination due to mining activities as well as the dumping of waste in the tailing pond at Kottalu village which is roughly at a distance of about 8 kms from the project site. In response, expert committees have been instituted on various occasions, and water and soil samples from the area taken for testing. However, argues Dr Rao, there has been no genuine effort on the part of the local administration or representatives of UCIL to address the people's concerns. Instead, consistent attempts were made to rubbish their claims and deny them an equal voice by refusing permission to experts such as, Dr Rao to represent the farmers, even as the UCIL brought in scientists from the Bhabha Atomic Research Centre (BARC) to argue on its behalf about the 'safety' of the mining project.

The charge that UCIL operations had caused ground water contamination and resultant sickness and infertility of agricultural land is not one that the UCIL faces for the first time. There have been countless instances of tailing pipe bursts[23] and leakages, dumping[24] of radioactive waste in unmanned, unlined and uncovered ponds, from where it leaks into local water bodies used by communities[25] for fishing, drinking and bathing, and enters the ground water and the food chain.

The UCIL and larger nuclear establishment continue to remain in abject denial of the devastation that uranium mining has wrought on those living in the vicinity. One of the members of the expert committee formed following the directions of the Jharkhand High Court in 2016 to examine 'the effects of uranium radiation in Jadugoda' – the former director of the Radiological Safety Division of the Atomic Energy Regulatory Board (AERB), is reported to have said that the diseases afflicting the communities of Jadugoda were on account of "economic backwardness, smoking habits and malnutrition" and not radiation.[26]

Dr Rao doesn't expect any better from the recent 'committee of experts' set up on the initiative of the newly elected State Government of Andhra Pradesh to look into allegations by communities around the Tummalapalle uranium mine.[27] The committee, comprised[28] of government scientists and 'experts' from the National Geophysical Research Institute (NGRI), the Atomic Energy Regulatory Board (AERB), as well as the Mines, Geology, Groundwater and Agriculture Departments of the State government and academics from the Indian Institute of Technology, Tirupati, can hardly be expected to make an impartial assessment, argues Rao.

It is this lived experience of the people that keeps them on the edge as the government moves in to open up newer fronts in its interminable quest for uranium and rides roughshod over environmental and health concerns and democratic processes in pursuit of its nuclear dream.

References:

1. Tiger count in India at 2,967; PM Narendra Modi lauds conservation efforts. (2019, July 29). *Times of India*. https://timesofindia.indiatimes.com/india/pm-narendra-modi-releases-all-india-tiger-estimation/articleshow/70427570.cms
2. Twitterati goes gaga over PM Narendra Modi in 'Man vs Wild'. (2019, August 13). *The Free Press Journal*. Available at https://www.freepressjournal.in/entertainment/twitterati-goes-gaga-over-pm-narendra-modi-in-man-vs-wild
3. Chitra Ramaswamy. (2019, August 16). Man vs Wild with Bear Grylls and PM Modi review – the most tasteless TV ever. *The Guardian*. https://www.theguardian.com/tv-and-radio/2019/aug/16/man-vs-wild-with-bear-grylls-and-pm-modi-review-the-most-tasteless-tv-ever
4. Narendra Modi walks in wild with Bear Grylls, talks about conserving nature. (2019, August 12). *LiveMint*. https://www.livemint.com/news/india/narendra-modi-walks-in-wild-with-bear-grylls-talks-about-conserving-nature-1565632920992.html
5. Environmental Clearance Application Form seeking prior approval under section 2 of the proposals by the state Governments and other authorities for 'Uranium Mining in Amrabad Reserve'. Part-I, Appendix, Form-A. Submitted by Regional Director, AMD-DAE, Hyderabad. Available at http://forestsclearance.nic.in/writereaddata/UploadFormA/71124122812161Form-A.pdf
6. Venkata Kondubhatla. (2019, August 03). Cops detain prof Kodandram over backing protesters of Uranium mining. *The Hans India*. https://www.thehansindia.com/telangana/cops-detain-prof-kodandram-over-backing-protesters-of-uranium-mining-551747
7. Raj Mahakala. (2019, August). "Save Nallamala Forest and Stop Uranium Mining". Petition, Change.org. Available at https://www.change.org/p/uranium-corporation-limited-stop-uranium-mining-in-nallamala-forest-in-telangana
8. State-wise list of Particularly Vulnerable Tribal Groups (PVTGs). Ministry of Tribal Affairs, Government of India. Available at https://tribal.nic.in/DivisionsFiles/SwLPVTGs.pdf
9. Tribe-wise and Sex-wise population and their Percentages to Total Population in Andhra Pradesh – 2011 Census. Tribal Welfare Department, Government of Andhra Pradesh. Available at http://www.aptribes.gov.in/pdfs/table4.pdf
10. About Amrabad Tiger Reserve. Tiger Reserves.com. Available at http://www.tigerreserves.com/information_in_amrabad_tiger_reseve.php
11. Imran Siddiqui. (2019, July 10). "Amrabad Tiger Reserve: An Eden under threat". *Down to Earth Magazine*, Centre for Science and Environment. https://www.downtoearth.org.in/blog/wildlife-biodiversity/amrabad-tiger-reserve-an-eden-under-threat-65524
12. Rashme Sehgal. (2019, July 12). "Uranium Mining Set to Destroy India's 2nd Largest Tiger Reserve". NewsClick.in. Available at https://www.newsclick.in/uranium-mining-destroy-india-largest-tiger-reserve
13. Imran Siddiqui. (2019). Op.Cit.
14. Ibid.
15. Unstarred Question No.2409. Rajya Sabha. (2015, March 19). "Uranium found in Telangana". Department of Atomic Energy, Government of India. Available at http://www.dae.nic.in/writereaddata/parl/budget2015/rsus2409.pdf
16. Field Inspection Report dated 24 July 2018, submitted by Field Director, Amrabad Tiger Reserve Circle, in context of according permission for survey and exploration of Uranium in Block-1 (38 sq.km.) and Block-2 (38 sq.km) of Amrabad R.F. (around Amrabad and Udimilla village, Mahaboob Nagar District) of Achampet Division and Block-3 (03sq.km.) and Block-4 (04 sq.km.) of Nidugal R.F. (Near Narayanapur village, Nalgonda District) of N.Sagar WLM Division of Amrabad Tiger Reserve circle. Ministry of Environment, Forest and Climate Change, Government of India. Available at http://forestsclearance.nic.in/writereaddata/0_0_24_Jul_2018_162222277_siteinspect_InspectionCF.pdf
17. Section 38 O (1)(b) of the *Wild Life (Protection) Amendment Act, 2006* (Act No. 39 of 2006). Available at http://www.indiaenvironmentportal.org.in/files/THE-20WILD-20LIFE.pdf
18. Environmental Clearance Application Form for 'Uranium Mining in Amrabad Reserve'. Op.cit.
19. Rashme Sehgal. (2019, July 12). Op.cit.
20. Bobins Abraham. (2019, July 22). "Despite Fears Of Threat To Krishna River & Tiger Reserve, Uranium Mining In Nallamala Okayed". *India Times*. Available at https://www.indiatimes.com/news/india/despite-fears-of-threat-to-krishna-river-tiger-reserve-uranium-mining-in-nallamala-okayed-371816.html
21. Amlan Home Chowdhury. (2019, January 06). "Cancers, Abortions, Deformed Children are the High Cost of 'Clean' Nuclear Energy in Jharkhand". *The Citizen*. Available at https://www.thecitizen.in/index.php/en/NewsDetail/index/9/15948/Cancers-Abortions-Deformed-Children-are-the-High-Cost-of-Clean-Nuclear-Energy-in-Jharkhand
22. Interview with Dr K Babu Rao, a retired senior scientist from the Indian Institute of Chemical Technology (IICT) on 27 August 2019.
23. Arnab Pratim Dutta. (2015, July 04). "Uranium Spill". *Down to Earth Magazine*. Centre for Science and Environment. Available at https://www.downtoearth.org.in/news/uranium-spill-5001
24. Chinky Shukla. (2013). "Jadugoda: The Nuclear Graveyard". Hindustan Times. Available at https://www.hindustantimes.com/static/groundglass/jadugoda-the-nuclear-graveyard.html
25. Amita Bhaduri. (2016, August 04). "Mines Radiate Disaster". India Water Portal. Available at https://www.indiawaterportal.org/articles/mines-radiate-disaster
26. Sagar. (2018, January 03). "Endorsed by Courts and the Government, Uranium Mining Continues to Create Health Hazards in Jadugoda as the UCIL Expands Its Operations". *The Caravan*. Available at https://caravanmagazine.in/vantage/jadugoda-uranium-mining-endorsed-courts-government-ucil-expands-operations
27. "Panel to study uranium contamination in A.P.'s Kadapa district". (2019, August 31). *The Hindu*. https://www.thehindu.com/news/national/andhra-pradesh/panel-to-study-uranium-contamination-in-aps-kadapa-district/article29310460.ece
28. Sandeep Raghavan. (2019, September 10). "Uranium Mining: Expert Team Inspects Kadapa Project Site". *The Times of India*. https://timesofindia.indiatimes.com/city/vijayawada/uranium-mining-expert-team-inspects-kadapa-project-site/articleshow/71061369.cms

Nuclear power, politics, and the odyssey of former US NRC chair Gregory Jaczko

Author: John H. Perkins, PhD

Gregory Jaczko is probably not a familiar name to anyone except those deeply steeped in the convoluted and contentious politics of nuclear power in the United States. These politics began at the end of World War II, shortly after the newly discovered processes of nuclear fission powered the nuclear bombs exploded over Japan in 1945. From 1946 to 1975, the US Atomic Energy Commission (AEC) governed and promoted both weapons and the emerging technology of nuclear power amidst constant debates about both. Controversy over safety forced the dissolution of the AEC, and its regulatory functions were picked up by the newly formed US Nuclear Regulatory Commission (NRC) in 1975. The theory behind NRC was that it would be divorced from the task of promoting nuclear power and serve strictly to regulate it. Nevertheless, the political squabbles over regulations moved directly from AEC to NRC and have endured to the present day.[1]

For some, Jaczko's involvement with the NRC may seem like ancient history. His appointment as a Commissioner on the NRC began in 2005, and President Obama elevated him to chairman of NRC in 2009. During Jaczko's tenure, many controversies over safety continued, exacerbated by the immense financial investments in the technology. In addition, Jaczko's personality and leadership style aggravated disagreements between him and the other four commissioners and between Jaczko and industrial and political forces committed to preserving and expanding nuclear power. He led NRC for three years before resigning under pressure in 2012.[2]

Now Dr. Jaczko has written a memoir telling his side of the story, *Confessions of a Rogue Nuclear Regulator* (2019),[3] and the book provides one perspective about the future of energy and the global efforts to mitigate climate warming. These issues provide insights important for the strategic campaigns of anti-nuclear activists.

Jaczko's book can best be understood as two learning episodes. First, he had a tutorial under fire about the heated politics of nuclear power in Washington. Second, his conclusions about the safety of nuclear power (better put, the lack of safety) evolved during his service on the NRC.

Jaczko's political education in Washington

Jaczko realized as a graduate student in physics (University of Wisconsin, Madison) that he wanted to pursue a career different from an academic or research career in physics. He won a Science and Technology Policy Fellowship, sponsored by the American Institute of Physics and administered through the American Association for the Advancement of Science.[4] These prestigious fellowships open the door for newly minted scientists to learn how to apply their academic expertise to real life political challenges by working for Members of Congress, and they often lead recipients to interesting careers in the policy and political worlds of Washington.

Jaczko arrived in Washington in August, 1999, but he did not arrive with anti-nuclear sentiments. He had never heard of the NRC,[5] and his attitude towards nuclear power was one of marvel at the technological achievement of nuclear power but tempered by awareness of its safety issues.[6]

Jaczko first served on the staff of Representative Edward Markey (D, MA). Markey was a strong proponent of controlling nuclear arms and ensuring the safety of nuclear power plants.[7] In March, 2001, he joined the staff of Senator Harry Reid (D, NV). Reid, the Democratic whip, later to become Senate Majority Leader, was focused on thwarting the 2002 law designating Yucca Mountain in Nevada as the repository for nuclear wastes.[8] This law had ended a prolonged stalemate about exactly where the US would dispose of high level nuclear wastes and spent fuel rods from nuclear power plants, and it passed despite strong, formal opposition by the Governor of Nevada.

In 2003, Reid asked Jaczko to help find possible nominees for vacancies on the NRC, but then asked Jaczko if he, Jaczko, wanted to be a Commissioner. Confirmation of Jaczko's nomination took two years, and in 2005 he took his seat as one of the Democratic members of the NRC. His service on the staffs of Representative Markey and Senator Reid had marked him, in the eyes of the nuclear industry, as a potential problem, so he began his duties already known as potentially a different kind of Commissioner.[9]

Jaczko says very little about his service as a Commissioner from 2005 to 2009. Nevertheless, he describes this time as one of learning the supreme importance and power of the electric utility industry and other owners of nuclear power plants.[10] Literally billions of dollars were invested in these machines, and their economic viability was at risk from regulatory changes issued by the NRC. Understandably, therefore, the nuclear industry wanted commissioners who believed in the industry and wanted nuclear power to be a commercial success.

The many companies comprising the industry had formed the Nuclear Energy Institute (NEI) in 1994 by consolidating older organizations dating to 1953. NEI currently has hundreds of members and is the trade association lobbying for the nuclear industry, including owners and operators of nuclear reactors plus firms designing, building, and providing fuel. In addition, NEI members also include supporting institutions such as universities, government research laboratories, consulting firms, nuclear medical producers, law firms, and others.[11] As of 2019, a 55-member Board of Directors, representing the broad membership, governs NEI.[12]

From Jaczko's point of view:[13]

". . . NEI members have a history of acting as one. This solidarity gives them tremendous influence with Congress. NEI also has a huge impact on the decisions of the Nuclear Regulatory Commission. . . Killing regulations, or even modifying them slightly, can produce savings of millions of dollars per year in operating costs, equipment purchases, and technical analysis. . .NEI shapes every NRC regulation, guidance, and policy. . . In any given month, I could be visited by as many representatives of the industry as I would be by public interest groups across my entire seven and a half years on the commission."

Jaczko knew that the NEI did not want him as chairman of NRC, but his truly formative lesson on Washington politics came when he went to the White House for a final interview before his elevation to be chair of the NRC. His interview with President Obama's chief of staff showed just how contentious his appointment was, and he left the interview with firm understanding: nobody wanted him to be chair except Reid, and in blunt, colorful language Jaczko learned that he was not to make any problems for the President!

Obama's motives were multiple. He had come into office with two major goals, health care and climate change, and he saw nuclear power as an aid to his larger goal of reducing CO_2 emissions.[14] Moreover, Obama had been a Senator from Illinois, a state deriving about 61 percent of its electricity from nuclear power (May, 2019).[15] Thus as a Senator, he was anything but anti-nuclear, and he had probably come to know the lobbyists from NEI.

For his part, Harry Reid, Senate Majority Leader from 2007 to 2015, wanted Jaczko to be chair, probably based on Reid's perception that Jaczko would help oppose construction of the nuclear waste repository at Yucca Mountain. Reid had also maneuvered Obama into opposing the construction of the site, despite Obama's acceptance of nuclear power.[16]

Thus, from the very beginning of his tenure as chair, Jaczko was caught in a three-way pincer: NEI opposed him, Obama wanted nuclear electrical generation to continue, ignoring for the moment the dangerous spent fuel rods piling up at nuclear power plants. Reid, Jaczko's patron, did not want the waste repository in Nevada, period, so block construction at Yucca Mountain. How to deal with climate change and the debris from existing nuclear power plants were separate problems. Welcome to the competing interests and long knives of Washington, Dr. Jaczko, and good luck.

Jaczko's absorption of the political lessons of Washington were clear at the outset of his tenure as chairman of NRC, and Yucca Mountain quickly reinforced his understanding of exactly how treacherous nuclear politics could be. The US Department of Energy (DOE) owned the site, and during the George W. Bush administration had initiated the request for a license from NRC to dispose of spent fuel at Yucca Mountain. President Obama, however, honored his campaign promise and gave the orders to shut down construction, over the objections of his own DOE.

Legal issues at NRC tangled the request to withdraw the license request, and Jaczko emerged with scars based on his support for stopping NRC consideration of the project.[17] Ultimately, the choice of continuing with the project was the responsibility of the Obama administration, but nevertheless Jaczko had engaged in the first of several battles and begun to acquire enemies who wished him out of his job. But even more ferocious battles were yet to come.

Jaczko's evolving views on safety and nuclear power

The second factor shaping of Jaczko's judgements about nuclear power began with the accident at a Japanese nuclear power plant, Fukushima Dai-ichi, on 11 March 2011. On that fateful day, a magnitude 9.0 earthquake struck just off the east coast of Japan, west of Fukushima Prefecture and northeast of Tokyo. The four reactors operating at Dai-ichi automatically shut down, and electric power from the grid to the plant was also lost. Thus, the electric power that normally provides needed cooling water to the reactors was lost.

Emergency diesel engines automatically switched on to provide power to continue cooling the reactors and storage areas for spent fuel rods. About 40 minutes later, a 14-meter (45-feet) high tidal wave swept ashore, destroying towns, killing many, and disabling the emergency generators for units 1, 2, 3, and 4 at Dai-ichi. Secondary emergency generation kick in, but after about a day they were exhausted. Hydrogen built up inside units 1, 2, and 4, and they exploded a few days later.[18] The accident was classified as a category 7 event, the most serious because it meant a major release of radioactive debris.[19] The situations at Fukushima (2011) and Chernobyl (1986) are the only two accidents to date so categorized.

An ordinary commissioner on the NRC would have no special duties to deal with an accident in a foreign country, but the chair, as head of the agency and spokesperson for it, was immediately in the spotlight as an authoritative voice about the dangers to US citizens in Japan and in the United States. He was also responsible for assisting the Japanese as requested. Furthermore, the plants in Japan had been designed in the US and were very similar to many operating US reactors. After 2011, Jaczko spent a substantial amount of his time dealing with the aftermath of the events at Fukushima Dai-ichi,[20] and his subsequent troubles stemmed from the ways his mind-set had been changed by events in Japan.

I'll return to the ways in which Fukushima led to Jaczko's departure from NRC in a moment, but it's important to realize that the fact of other accidents and near accidents also shaped his changing attitudes toward safety and nuclear power. In the book, he summarizes events at Browns Ferry (Tennessee, 1975), Three Mile Island (Pennsylvania, 1979), Chernobyl (USSR, now Ukraine, 1986), and Davis-Besse (Ohio, 2002).[21]

Jaczko also devotes an entire chapter to the serious threats from natural disasters that threatened US nuclear plants but did not result in radiation releases. In Spring, 2011, floods on the Missouri River threatened Fort Calhoun (near Omaha, Nebraska), and in August of that year, an earthquake rocked North Anna (in Virginia, near Washington, DC). Fortunately, neither the earthquake nor the floods resulted in an accident, but Jaczko's discussion of them shows how he clearly believed "no accident" was more a sign of luck than intrinsic safety of the machines or the skill of operators in making their machines as safe as possible.[22]

Jaczko devotes a chapter to threats from natural disasters.
Pictured is the Fort Calhoun nuclear reactor in Nebraska, flooded in 2011.

Jaczko's discussion of safety planning at these two plants provided him the opportunity to explore the intricacies of two different engineering approaches that shaped the construction and operation of nuclear plants.[23] Both Fort Calhoun (construction began 1966) and North Anna (construction began 1971) had been designed and built with engineering of safety based on deterministic methods. Under this concept, engineers predicted the hazards under both normal operations and under the most severe natural phenomena that could be imagined. They then designed the plant to more than withstand those threats. Deterministic methods could not provide a complete safety model of a plant, but they guided engineers to specific threats and remedies, and they were easier to explain to the public.

A method of safety analysis developed after these two plants were constructed, probabilistic risk assessment (PRA), started with a series of postulated events in the plant and then calculated the probability of the failure of safety equipment to control the event. One view of PRA was that it failed its primary purpose, which was to make a convincing, argument to the public that nuclear power was more than safe enough, even though PRA was an advance in understanding reactors and what could go wrong.[24] Another view was that PRA was a technical success in opening new ways of managing nuclear reactors.[25]

Whatever the motivations for inventing PRA, the method entered NRC's regulatory schemes in 2004.[26] PRA-based regulations could be more flexible than deterministic methods, but they also invited industry resistance to plant modifications. Managers could invoke cost-benefit considerations and ask why they had to make expensive changes based on accidents with extremely low calculated probabilities of occurrence.[27] In addition, probabilistic methods were more difficult to explain to the public and were controversial among scientists and engineers.[28]

Jaczko, Fukushima, and his departure from NRC

Events at Fukushima shaped the remainder of Jaczko's contentious tenure as NRC chair. First, he appointed a task force to quickly outline the lessons that Fukushima should impart to the NRC and other national nuclear regulators. This group began work in March, 2011, and completed their assignment in July. Their conclusions focused on general improvements in NRC regulatory policy and some changes specifically aimed at the boiling water reactors operating in the United States that resembled those that exploded at Fukushima.[29]

Reverberations of the task force's report began almost immediately, but the effects were powerfully shaped by the history of nuclear power dating to 1954. In that year, the US Congress had opened development of nuclear power to private industry, which over the next two decades launched efforts by many private firms to build and operate nuclear power plants. The federal government would regulate safety, primarily through issuances of, first, a construction permit, and, second, after construction was complete, an operating license.[30] The basic thought behind Congress' actions were to bring in the supposed efficiency and innovation that private industry had exhibited elsewhere.

For various reasons, however, private industry turned out to be, at best, of mixed competence in nuclear power. Plant construction time-schedules and costs proved difficult to control, and by 1978, the nuclear industry stopped asking for new construction permits.[31] The anticipated launching of a nuclear-powered USA[32] ground to a halt, and no further new applications for licenses to construct and operate came for three decades.

In 1992, the Congress began a series of reforms aimed at restarting the nuclear industry, and they changed the licensing from a two-step to a one-step process. The applicant could apply for a combined construction and operating license for a reactor of approved design. If building was to the approved specifications, the company could begin operating it without a second application.[33]

Unfortunately for those advocating more nuclear power, combined construction-operating licenses alone did not sway industry decision-making. It turned out that the real block to building new reactors was financing, not just the licensing procedures. In 2005, Congress approved several programs to help companies financially, the most important of which were Federal loan guarantees. Banks would loan to nuclear companies if the bank was guaranteed not to lose money. (In addition, some States allowed charging ratepayers for Construction While In Progress (CWIP), an alternative way of obtaining financing for building new reactors.[34])

The Southern Company was the first applicant to receive a loan guarantee, of $8.3 billion, in 2010 from the Obama administration. The Company was ready to apply for its combined license in 2011, and, just a few weeks after Fukushima, Jaczko proposed to the other commissioners that NRC delay the licensing procedures. This resulted in a "no," so the Southern application went to a required public hearing in the Fall of 2011.[35]

It was here that Jaczko's growing concerns about safety met in a head-on collision with the power of immense amounts of money and thousands of construction jobs at stake. As he phrased the title of Chapter 9, it was an "Express Lane: The Nuclear Industry Licensing Juggernaut." Jaczko tried various ways to put the Southern Company on notice for safety improvements, but his efforts could not win the support of the other commissioners or the NRC staff. Ultimately, he voted no on issuing the license, but no other commissioners joined him.[36]

The aftermath of his failed attempt to slow down the first licensing procedures in over three decades launched Jaczko into a downward spiral, which ended in Harry Reid telling him that he would resign in May, 2012.[37] Jaczko's described his "mistake" in the following way:

"There are significant safety enhancements that have already been recommended as a result of learning the lessons from Fukushima, and there's still more work ahead of us. Knowing this, I cannot support issuing this license as if Fukushima had never happened. But without this license condition, in my view, that is what we are doing."[38]

Jaczko, indeed, had been a different kind of commissioner and especially a different kind of chair of the NRC. He is probably the only person to have occupied those positions who developed a full-blown skepticism about the wisdom and necessity for continuing to encourage expansion of the industry, even though he acknowledged that existing nuclear plants in the US would continue operation for many years. Nevertheless, he believed that renewable energy especially offered many opportunities for safer and cheaper generation of electricity.[39]

Lessons from the Jaczko experience for anti-nuclear activists

I draw three lessons from Jaczko's memoirs. First, it is unrealistic to see the NRC as the engine that will close the nuclear industry in the United States. People with the expert knowledge to serve as commissioners will almost certainly come from training programs and experiences leading them to favor the technology. Jaczko was the exception proving the rule. Activist organizations can sue the NRC if they think it has violated one of its own rules, but that's about the extent of usefulness of direct interaction with the NRC itself. Instead, focus on persuading a majority in Congress that nuclear power's susceptibility to low-probability-but-high-consequence accidents makes it unsuitable as an energy source.

Second, nuclear power's weakest feature is its expense. The huge up-front capital expenditures needed to build a new plant, plus its long history of not building them on schedule, led to skepticism of the industry by financial institutions. Activists can work on Congress not to guarantee loans to the industry or insure lenders against delays in construction. Activists can also work with federal and state regulators of electricity markets not to allow higher rates for nuclear electricity or for rates funding Construction While in Progress. Starved of financing and subsidies, nuclear power will eventually disappear.

Finally, the plea that nuclear power is a good solution for climate change is refuted by calculating the costs and lengths of time nuclear plants need for construction, combined with the number of plants needed to make a dent in CO_2 emissions. Point also to the opportunity costs of nuclear power: what could similar amounts of capital do to fully build out an energy economy based on renewable energy used efficiently? Renewable energy is not without its own challenges, but those pale in comparison with the intrinsic financial and safety weaknesses of nuclear power.[40]

John Perkins' latest book, Changing Energy: The Transition to a Sustainable Future, was published by the University of California Press in 2017. He's currently writing a new book on the prospects for a timely and complete transition to energy economies without fossil fuels and uranium (nuclear power). He has previously worked at the School of Interdisciplinary Studies at Miami University (Ohio) and The Evergreen State College (Washington State). Perkins has published over 50 articles, book chapters, and reports on topics of energy, environment, and agriculture. He has an AB (Amherst College) and PhD (Harvard University) in biology.

References:

1. J. Samuel Walker and Thomas R. Wellock, *A Short History of Nuclear Regulation, 1946 – 2009* (Washington: United States Nuclear Regulatory Commission, NUREG/BR-0175, Rev. 2, October 2010), 1 – 49.
2. John M. Broder and Matthew L. Wald, Chairman of N.R.C. to Resign Under Fire, *New York Times*, May 21, 2012, found at https://www.nytimes.com/2012/05/22/us/gregory-jaczko-to-resign-as-nrc-chairman-after-stormy-tenure.html?searchResultPosition=7, 24 August 2019.
3. Gregory B. Jaczko, *Confessions of a Rogue Nuclear Regulator* (New York: Simon & Schuster, 2019), 196 pp.
4. Meghan Anzelc, Gregory Jaczko, Ph.D. Physics, Commissioner, U.S. Nuclear Regulatory Commission (APS Physics, Forum on Graduate Student Affairs), found at https://www.aps.org/units/fgsa/careers/non-traditional/jaczko.cfm, 19 August 2019.
5. Jaczko, *Confessions*, p. vii.

6. Jaczko, *Confessions*, p. 7.
7. Jaczko, *Confessions*, p. 4.
8. US Congress, "H.J.Res. 87 — 107th Congress: Yucca Mountain Development resolution." www.GovTrack.us. 2002, found at https://www.govtrack.us/congress/bills/107/hjres87, August 20, 2019.
9. Jaczko, *Confessions*, pp. 3 – 9.
10. Jaczko, *Confessions*, pp. 10 – 13.
11. Nuclear Energy Institute, About NEI, https://www.nei.org/about-nei, 21 August 2019
12. Nuclear Energy Institute, NEI Board of Directors and Executive Committee, https://www.nei.org/CorporateSite/media/filefolder/Membership/board-list.pdf, 21 August 2019.
13. Jaczko, *Confessions*, pp. 12 – 13.
14. Jaczko, *Confessions*, pp. 14 – 17.
15. Energy Information Administration, Illinois net electricity generation by source, May. 2019, https://www.eia.gov/state/?sid=IL#tabs-4, 21 August 2019. Percent calculated by author.
16. Jaczko, *Confessions*, pp. 57 – 58.
17. Jaczko, *Confessions*, pp. 67 – 68.
18. USNRC, Backgrounder on NRC response to lessons learned from Fukushima, September 17, 2018, found at https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/japan-events.html, 21 August 2019.
19. International Atomic Energy Agency, International nuclear and radiological event scale (INES), found at https://www.iaea.org/topics/emergency-preparedness-and-response-epr/international-nuclear-radiological-event-scale-ines, 21 August 2019.
20. Jaczko, *Confessions*, pp. 70 – 95.
21. Jaczko, *Confessions*, pp. 23 – 40.
22. Jaczko, *Confessions*, pp. 104 – 115.
23. Jaczko, *Confessions*, pp. 45 – 48.
24. John H. Perkins, Development of risk assessment for nuclear power, *Journal of Environmental Studies and Sciences* 4 (2014): 273 – 287.
25. Thomas R. Wellock, A figure of merit: quantifying the probability of a nuclear reactor accident, *Technology and Culture* 58 (July 2017): 678 – 721.
26. Jaczko, *Confessions*, p. 48.
27. Jaczko, *Confessions*, pp. 126 – 127.
28. Perkins, Development of risk assessment.
29. Charles Miller, Amy Cubbage, Daniel Dorman, Jack Grobe, Gary Holahan, and Nathan Sanfilippo, *Recommendations for Enhancing Reactor Safety in the 21st Century* (Washington: U.S.NRC, 2011), 83 pp.
30. Kathleen M. Saul and John H. Perkins, Nuclear power: is it worth the risks? In *Green Energy Economies: The Search for Clean and Renewable Energy*, ed. John Byrne and Young-Doo Wang (Transaction Publications, 2014): 276 – 295.
31. Irvin C. Bupp and Jean-Claude Darian, *The Failed Promise of Nuclear Power: How the Nuclear Dream Dissolved* (New York: Basic Books, 1978), 241 pp.
32. U.S. Atomic Energy Commission, *Civilian Nuclear Power: A Report to the President 1962* (Washington: U.S. Atomic Energy Commission, 1962), 67 pp.
33. Saul and Perkins, Nuclear power.
34. Saul and Perkins, Nuclear power.
35. Jaczko, *Confessions*, pp. 135 – 138.
36. Jaczko, *Confessions*, pp. 132 – 143.
37. Jaczko, *Confessions*, p. 160.
38. Jaczko, *Confessions*, pp. 157 – 158.
39. Jaczko, *Confessions*, pp. 161 – 168.
40. John H. Perkins, *Changing Energy: The Transition to a Sustainable Future* (Oakland: University of California, Press, 2017), 232 – 237.

Aging nuclear plants, cost-cutting, and reduced safety oversight

Dr Edwin Lyman, senior scientist at the Union of Concerned Scientists, writes in the *Bulletin of the Atomic Scientists*:

After the 2011 Fukushima nuclear disaster in Japan, the US Nuclear Regulatory Commission (NRC) set up a task force to assess whether there were deficiencies in its oversight of nuclear reactor safety. The task force came back with twelve major areas for improvement. Its top recommendation: The agency needed to strengthen its fundamental regulatory framework to reduce the risk that a Fukushima-scale accident could happen in the US. But after dragging their feet for years, the NRC commissioners finally rejected the proposal in March 2016, with then-Commissioner William Ostendorff concluding that "the current regulatory approach has served the Commission and the public well."

Yet only a few years later, the NRC has reversed course. The agency now says it urgently needs to transform its regulatory framework, its culture and its infrastructure – but in ways that would weaken, rather than strengthen, safety and security oversight. A key aspect of that transformation is an overhaul (or what the NRC euphemistically calls an "enhancement") of the Reactor Oversight Process, the NRC's highly complex system for determining how it inspects nuclear power reactors, measures performance, assesses the significance of inspection findings, and responds to violations. Overall, these changes – many of which are being pushed by the nuclear industry – could make it harder for the NRC to uncover problems and mandate timely fixes before they jeopardize public health and safety. ...

At this time, the four sitting commissioners (there is one vacancy) have not all voted on the proposed reactor oversight changes, but the outcome isn't in much doubt. The Republican majority, under the direction of Chairman Kristine Svinicki, has already weakened the NRC's regulatory authority in other areas. For example, in a 3-2 vote in January 2019, the majority gutted the staff's proposed final rule for protection against Fukushima-scale natural disasters by eliminating the requirement that reactors be able to withstand current flooding and seismic hazards.

The full article is online:

Edwin Lyman, 29 Aug 2019, 'Aging nuclear plants, industry cost-cutting, and reduced safety oversight: a dangerous mix', https://thebulletin.org/2019/08/aging-nuclear-plants-industry-cost-cutting-and-reduced-safety-oversight-a-dangerous-mix/

Big claims about small nuclear reactor costs

Author: Jim Green – Nuclear Monitor editor

The 'inquiry into the prerequisites for nuclear energy in Australia' being run by Federal Parliament's Environment and Energy Committee has finished receiving submissions and is gradually making them publicly available.[1]

The inquiry is particularly interested in 'small modular reactors' (SMRs) and thus one point of interest is how enthusiasts spin the economic debate given that previous history with small reactors has shown them to be expensive[2]; the cost of the handful of SMRs under construction is exorbitant[3]; and both the private sector and governments around the world have been unwilling to invest the billions of dollars required to get high-risk SMR demonstration reactors built.[4]

To provide a reality-check before we get to the corporate spin, a submission to the inquiry by the Institute for Energy Economics and Financial Analysis notes that SMRs have been as successful as cold fusion – i.e., not at all.[5] The submission states:

"The construction of nuclear power plants globally has proven to be an ongoing financial disaster for private industry and governments alike, with extraordinary cost and construction time blow-outs, while being a massive waste of public monies due to the ongoing reliance on government financial subsidies. ... Governments have repeatedly failed to comprehend that nuclear construction timelines and cost estimates put forward by many corporates (with vested interests) have proven disastrously flawed and wrong."

The Institute is equally sceptical about SMRs:[5]

"For all the hype in certain quarters, commercial deployment of small modular reactors (SMRs) have to-date been as successful as hypothesized cold fusion – that is, not at all. Even assuming massive ongoing taxpayer subsidies, SMR proponents do not expect to make a commercial deployment at scale any time soon, if at all, and more likely in a decade from now if historic delays to proposed timetables are acknowledged."

Thus the Institute adds its voice to the chorus of informed scepticism about SMRs[6], such as the 2017 Lloyd's Register survey of 600 industry professionals and experts who predicted that SMRs have a "low likelihood of eventual take-up, and will have a minimal impact when they do arrive".[7]

Corporate spin #1: Minerals Council of Australia

The Minerals Council of Australia claims in its submission to the federal inquiry that SMRs could generate electricity for as little as $60 per megawatt-hour (MWh).[8] That claim is based on a report by the Economic and Finance Working Group (EFWG) of the Canadian government-industry 'SMR Roadmap' initiative.[9]

The Canadian EFWG gives lots of possible SMR costs and the Minerals Council's use of its lowest figure is nothing if not selective. The figure cited by the Minerals Council assumes near-term deployment from a standing start (with no-one offering to risk billions of dollars to build demonstration reactors), plus extraordinary learning rates in an industry notorious for its negative learning rates.

Dr. Ziggy Switkowski – the head of a government-commissioned nuclear review in 2006 – noted in his evidence to the federal inquiry that "nuclear power has got more expensive, rather than less expensive".[10] Yet the EFWG paper takes a made-up learning rate and subjects SMR cost estimates to eight 'cumulative doublings' based on the learning rate.

That's creative accounting and one can only wonder why the Minerals Council would present it as a credible estimate.

Here are the first-of-a-kind SMR cost estimates from the EFWG paper, all of them far higher than the figure cited by the Minerals Council:

300-megawatt (MW) on-grid SMR:	C$162.67 (US$123) / MWh
125-MW off-grid heavy industry:	C$178.01 (US$134) / MWh
20-MW off-grid remote mining:	C$344.62 (US$260) / MWh
3-MW off-grid remote community:	C$894.05 (US$674) / MWh

The government and industry members on the Canadian EFWG are in no doubt that SMRs won't be built without public subsidies:

"The federal and provincial governments should, in partnership with industry, investigate ways to best risk-share through policy mechanisms to reduce the cost of capital. This is especially true for the first units deployed, which would likely have a substantially higher cost of capital than a commercially mature SMR."

The EFWG paper used a range of estimates from the literature and vendors. It notes problems with its inputs, such as the fact that many of the vendor estimates have not been independently vetted, and "the wide variation in costs provided by expert analysts". Thus, the EFWG qualifies its findings by noting that "actual costs could be higher or lower depending on a number of eventualities".

Corporate spin #2: NuScale Power

US company NuScale Power has put in a submission to the federal nuclear inquiry, estimating a first-of-a-kind cost for its SMR design of US$4.35 billion / gigawatt (GW) and an nth-of-a-kind cost of US$3.6 billion / GW.[11]

NuScale doesn't provide a $/MWh estimate in its submission, but the company has previously said it is targeting a cost of US$65/MWh for its first SMR plant.[12] That is 2.4 lower than the US$155/MWh estimate based on the NuScale design in a report by WSP / Parsons Brinckerhoff prepared for the South Australian Nuclear Fuel Cycle Royal Commission.[13]

NuScale's cost estimates should be regarded as promotional and will continue to drop – unless and until the company actually builds an SMR. The estimated cost of power from NuScale's non-existent SMRs fell from US$98-$108/MWh in 2015[14] to US$65/MWh by mid-2018.[12] The company announced with some fanfare in 2018 that it had worked out how to make its SMRs almost 20% cheaper – by making them almost 20% bigger!

Lazard estimates costs of US$112-189/MWh for electricity from large nuclear plants.[15] NuScale's claim that its electricity will be 2-3 times cheaper than that from large nuclear plants is implausible. And even if NuScale achieved costs of US$65/MWh, that would still be higher than Lazard's figures for wind power (US$29-56) and utility-scale solar (US$36-46).

Likewise, NuScale's construction cost estimate of US$4.35 billion / GW is implausible. The latest cost estimate for the two AP1000 reactors under construction in the US state of Georgia (the only reactors under construction in the US) is US$12.3-13.6 billion / GW.[16] NuScale's target is just one-third of that cost – despite the unavoidable diseconomies of scale and despite the fact that every independent assessment concludes that SMRs will be more expensive to build (per GW) than large reactors.

Further, the modular factory-line production techniques now being championed by NuScale were trialed with the AP1000 reactor project in South Carolina – a project that was abandoned in 2017 after the expenditure of at least US$9 billion.

Corporate spin #3: Australian company SMR Nuclear Technology

In support of its claim that "it is likely that SMRs will be Australia's lowest-cost generation source", Australian company SMR Nuclear Technology Pty Ltd cites in its submission[17] to the federal nuclear inquiry a 2017 report by the US Energy Innovation Reform Project (EIRP).[18]

According to SMR Nuclear Technology, the EIRP study "found that the average levelised cost of electricity (LCOE) from advanced reactors was US$60/MWh."

However the cost figures used in the EIRP report are nothing more than the optimistic estimates of companies hoping to get 'advanced' reactor designs off the ground. Therefore the EIRP authors heavily qualified the report's findings:[18]

"There is inherent and significant uncertainty in projecting NOAK [nth-of-a-kind] costs from a group of companies that have not yet built a single commercial-scale demonstration reactor, let alone a first commercial plant. Without a commercial-scale plant as a reference, it is difficult to reliably estimate the costs of building out the manufacturing capacity needed to achieve the NOAK costs being reported; many questions still remain unanswered – what scale of investments will be needed to launch the supply chain; what type of capacity building will be needed for the supply chain, and so forth."

SMR Nuclear Technology's conclusions – that "it is likely that SMRs will be Australia's lowest-cost generation source" and that low costs are "likely to make them a game-changer in Australia" – have no more credibility than the company estimates used in the EIRP paper.

SMR Nuclear Technology's submission does not note that the EIRP inputs were merely company estimates and that the EIRP authors heavily qualified the report's findings.

The US$60/MWh figure cited by SMR Nuclear Technology is far lower than all independent estimates for SMRs:

- The 2015/16 South Australian Nuclear Fuel Cycle Royal Commission estimated costs of A$180-184/MWh for large light-water reactors, compared to A$225 for an SMR based on the NuScale design (and a slightly lower figure for the 'mPower' SMR design that was abandoned in 2017 by Bechtel and Babcock & Wilcox).[13]
- A December 2018 report by the Commonwealth Scientific and Industrial Research Organisation and the Australian Energy Market Operator found that electricity from SMRs would be more than twice as expensive as that from wind or solar power with some storage costs included (two hours of battery storage or six hours of pumped hydro storage).[19]
- A report by the consultancy firm Atkins for the UK Department for Business, Energy and Industrial Strategy found that electricity from the first SMR in the UK would be 30% more expensive than that from large reactors, because of diseconomies of scale and the costs of deploying first-of-a-kind technology.[20] Its optimistic SMR cost estimate is US$107–155 / MWh.
- The Canadian SMR Roadmap estimate of US$123 / MWh for a first-of-a-kind 300-MW on-grid SMR.[9]
- A 2015 report by the International Energy Agency and the OECD Nuclear Energy Agency predicted that electricity from SMRs will be 50−100% more expensive than that from large reactors, although it holds out some hope that large-volume factory production could reduce costs.[21]

The CAREM SMR under construction in Argentina illustrates the gap between SMR rhetoric and reality. Costs have ballooned to US$21.9 billion / gigawatt.

- An article by four pro-nuclear researchers from Carnegie Mellon University's Department of Engineering and Public Policy, published in 2018 in the *Proceedings of the National Academy of Science*, concluded than an SMR industry would only be viable in the US if it received "several hundred billion dollars of direct and indirect subsidies" over the next several decades.[22]

SMR Nuclear Technology's assertion that "nuclear costs are coming down due to simpler and standardised design; factory-based manufacturing; modularisation; shorter construction time and enhanced financing techniques" is at odds with all available evidence[23] and it is at odds with Dr. Ziggy Switkowski's observation in a public hearing of the federal inquiry that nuclear "costs per kilowatt hour appear to grow with each new generation of technology".[10]

References:

1. https://www.aph.gov.au/Parliamentary_Business/Committees/House/Environment_and_Energy/Nuclearenergy/Submissions
2. https://spectrum.ieee.org/tech-history/heroic-failures/the-forgotten-history-of-small-nuclear-reactors
3. https://wiseinternational.org/nuclear-monitor/872-873/smr-cost-estimates-and-costs-smrs-under-construction
4. https://wiseinternational.org/nuclear-monitor/872-873/no-one-wants-pay-smrs-us-and-uk-case-studies
5. https://www.aph.gov.au/DocumentStore.ashx?id=8297e6ba-e3d4-478e-ac62-a97d75660248&subId=669740
6. https://wiseinternational.org/nuclear-monitor/872-873/small-modular-reactors-introduction-and-obituary
7. http://www.world-nuclear-news.org/EE-Nuclear-more-competitive-than-fossil-fuels-report-09021702.html
8. https://www.afr.com/companies/energy/mining-industry-predicts-nuclear-will-be-cheapest-power-20190913-p52r29
9. https://smrroadmap.ca/wp-content/uploads/2018/12/Economics-Finance-WG.pdf
10. https://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22committees%2Fcommrep%2F3abfb90c-9215-4b65-a5d2-32d112e8cd46%2F0000%22
11. https://www.aph.gov.au/DocumentStore.ashx?id=fd9e29d3-f810-4bcd-9487-ba21f12e01aa&subId=669307
12. https://www.powermag.com/nuscale-boosts-smr-capacity-making-it-cost-competitive-with-other-technologies/?printmode=1
13. A$225/MWh http://nuclearrc.sa.gov.au/app/uploads/2016/05/WSP-Parsons-Brinckerhoff-Report.pdf
14. https://newsroom.nuscalepower.com/sites/nuscalepower.newshq.businesswire.com/files/press_release/additional/Jay_Surina_-_NuScale_Financial_Breakout_Session_0.pdf
15. https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf
16. https://www.wiseinternational.org/nuclear-monitor/867/vogtles-reprieve-snatching-defeat-jaws-defeat
17. https://www.aph.gov.au/DocumentStore.ashx?id=7b830b3b-0a69-4850-aaf7-a1d8b9884bcb&subId=669049
18. https://www.innovationreform.org/wp-content/uploads/2018/01/Advanced-Nuclear-Reactors-Cost-Study.pdf
19. https://www.csiro.au/~/media/News-releases/2018/renewables-cheapest-new-power/GenCost2018.pdf
20. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/665197/TEA_Project_1_Vol_1_-_Comprehensive_Analysis_and_Assessment_SMRs.pdf
21. https://webstore.iea.org/projected-costs-of-generating-electricity-2015
22. https://www.pnas.org/content/115/28/7184
23. https://nuclear.foe.org.au/wp-content/uploads/Nuclear-power-economic-crisis-July-2019-FoE-Aust.pdf

South Korea's corrupt and dangerous nuclear industry

Author: Jim Green – Nuclear Monitor editor

Systemic corruption … cartel behavior … a secret military side-agreement to the UAE reactor contract … serious nuclear safety problems still evident in 2019 … plans to sell reactor technology to Saudi Arabia and thus to facilitate the Kingdom's weapons ambitions … what's not to like about South Korea's nuclear industry?

We covered South Korea's nuclear corruption scandals in *Nuclear Monitor* in May 2017[1] and this article updates and expands upon the previous one.

In May 2012, five engineers were charged with covering up a potentially dangerous power failure at South Korea's Kori-1 reactor which led to a rapid rise in the reactor core temperature.[2] The accident occurred because of a failure to follow safety procedures. A manager decided to conceal the incident and to delete records, despite a legal obligation to notify the Nuclear Safety and Security Commission.

Around the same time, a much bigger and broader scandal emerged involving fake safety certifications for reactor parts, sub-standard reactor parts, cartel behavior and bribery.[1-3] The corrupt practices stretched back to 2004 if not earlier.[4]

The Korea Institute of Nuclear Safety reported:[5]

- A total of 2,114 test reports were falsified: 247 test reports in relation to replaced parts for 23 reactors, an additional 944 falsifications in relation to 'items' for three recently commissioned reactors, and 923 falsifications in relation to 'items' for five reactors under construction.
- Results were 'unidentified' for an additional 3,408 test reports – presumably it was impossible to assess whether or not the reports were falsified.
- Twenty-nine of the forgeries concerned 'seismic qualification', and the legitimacy of a further 43 seismic reports was 'unclear'.
- Over 7,500 reactor parts were replaced in the aftermath of the scandal.

Safety-related equipment was installed on the basis of falsified documentation. For example, equipment failed under Loss-Of-Coolant-Accident conditions during at least one concealed test, according to a whistleblower.[6] Other examples include the substandard, uncertified cabling that was found to be defective when it triggered shutdowns at two nuclear plants.[4]

The situation in South Korea mirrors that in Japan prior to the Fukushima disaster – i.e. systemic corruption – except that Japan's corrupt nuclear establishment is known as the 'nuclear village' whereas South Korea's corrupt nuclear establishment is known as the 'nuclear mafia'.[7]

A 2014 parliamentary audit revealed that the temporary suspension of the operation of nuclear power plants after the scandal emerged caused the loss of 10 trillion won (US$8.4 billion).[8] It also led to power shortages.

Nuclear power advocate Will Davis wrote this summary of the scandals in 2014:[4]

"Electing for brevity, suffice it to say that various schemes to advance the position of persons or companies in the South Korean nuclear industry have resulted in substandard parts being employed (particularly cable supplied by JS Cable, a company that is presently being liquidated), false quality assurance certificates being filed, and various collusion/bribery schemes among varied personnel at contractors and in the KHNP universe of subsidiaries – with involvement reaching even to the highest (former) executives.

"While the true extent and nature of these corrupt activities began to be illuminated only at the end of 2011, in fact the activities stretched far prior; a recent article in the Korea Herald noted that JS Cable failed to obtain certification for nuclear parts for its product twice in 2004, and then somehow immediately made a sale of such equipment for a total of 5.5 billion won (US$5.06 million). That cabling was eventually found to be defective when it triggered shutdowns at two nuclear plants, in May 2013. Many corporate offices (including those of KHNP) were raided throughout the summer, and many arrests made – arrests that included a former president of KHNP.

"Much more than cable from one company has been implicated; implicated parts (questionable parts, or questionable certifications, or both) were thought to possibly be in service at as many as 11 nuclear plants in South Korea."

The corruption also affected South Korea's reactor construction project in the UAE.[9] Hyundai Heavy Industries employees offered bribes to KHNP officials in charge of the supply of parts for reactors to be exported to the UAE.

More fundamental changes needed

The *New York Times* reported in August 2013 that despite the government's pledge to ban parts suppliers found to have falsified documents from bidding again for 10 years, KHNP imposed only a six-month penalty for such suppliers.[10] The *New York Times* continued:

"And nuclear opponents say that more fundamental changes are needed in the regulatory system, pointing out that one of the government's main regulating arms, the Korea Institute of Nuclear Safety, gets 60 percent of its annual budget from Korea Hydro."

Worse still, a 2014 parliamentary audit revealed that some officials fired from KEPCO E&C (Korea Electric Power Corporation Engineering and Construction) over the scandals were rehired.[11]

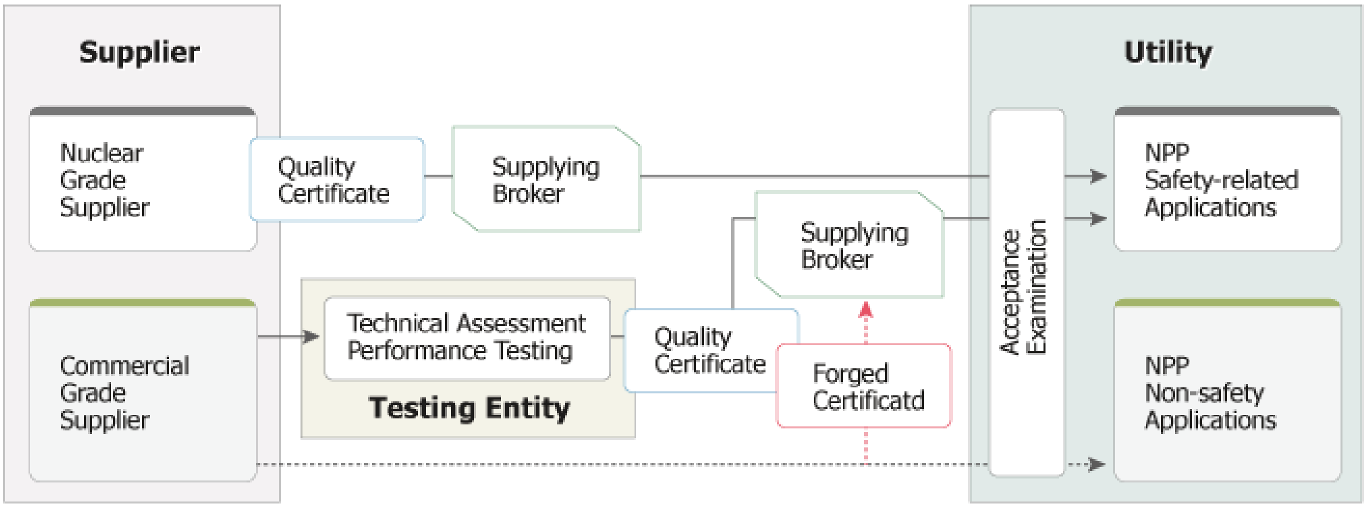

Chart by the Korea Institute of Nuclear Safety.

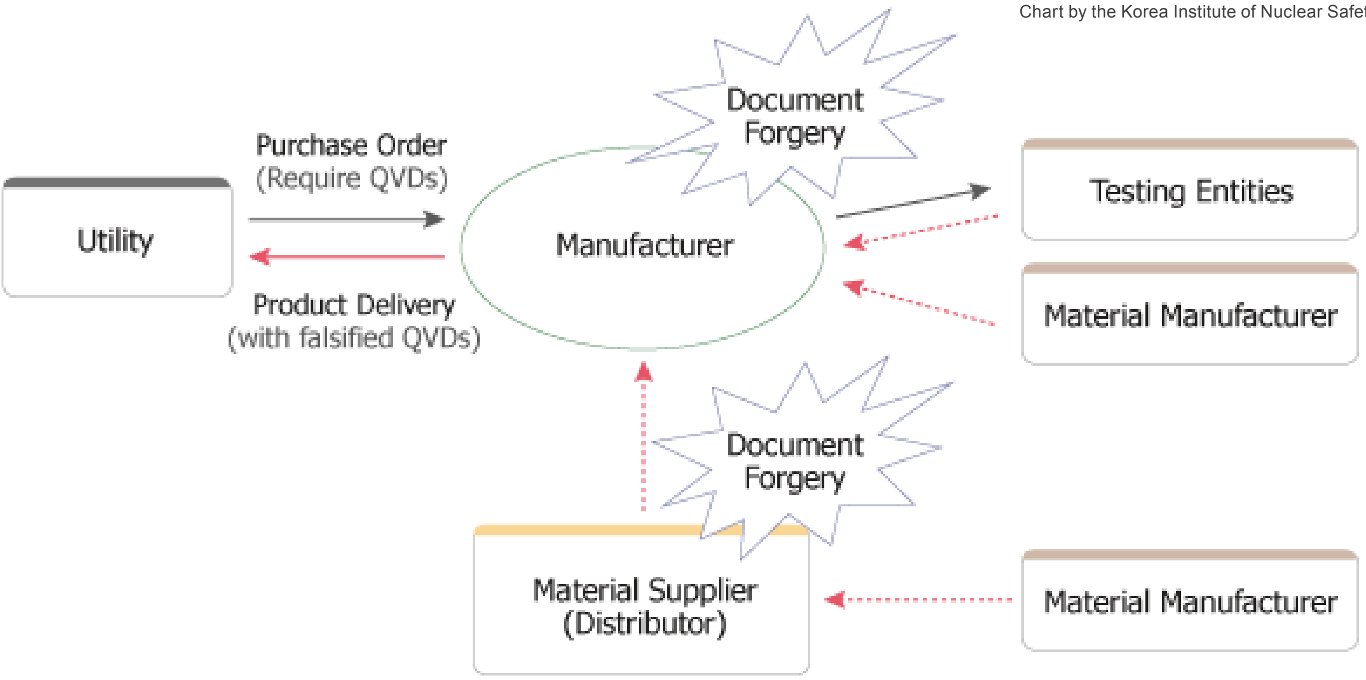

Chart by the Korea Institute of Nuclear Safety.

The scandal was still on the boil in 2014. *Korea Times* reported on 25 June 2014:[7]

"The government has discovered irregularities yet again that could threaten the safety of nuclear reactors. This time, the perpetrators are parts suppliers that presented fake quality certificates in the course of replacing antiquated parts used in nuclear power plants. Six state testing facilities were also found to have failed to conduct adequate tests before issuing certificates. A two-month audit of the six testing facilities by the Ministry of Trade, Industry and Energy showed that 39 quality certificates presented by 24 companies were fabricated. ...

"Most disheartening in the latest revelation of irregularities is that the state-run certifiers failed to detect fabrications by skipping the required double-testing. ... Given the magnitude of corruption in the nuclear industry arising from its intrinsic nature of being closed, the first step toward safety should be to break the deep-seated food chain created by the so-called nuclear mafia, which will help enhance transparency ultimately. With the prosecution set to investigate the suppliers, the certifiers will face business suspension. But it's imperative to toughen penalties for them, considering that light punitive measures have stood behind the lingering corruption in the nuclear industry."

Opposition to South Korea's corrupt 'nuclear mafia' feeds into broader concerns about corruption. *Japan Times* reported in May 2017:[12]

"Opinion polls taken just before the election showed that the top concern for the country's voters was "deep-rooted corruption" and a desire to promote reform; second on that list was economic revival. If Moon is to succeed in those tasks, he must tackle the chaebol, the huge industrial conglomerates that dominate the South Korean economy and have outsized influence in its politics."

Japan's corrupt 'nuclear village' survived the political fallout from the Fukushima disaster and is back in charge.[13] It would be naïve to imagine that the tepid response to South Korea's scandals has done away with the 'nuclear mafia' once and for all. There were another six arrests related to nuclear corruption in 2018 – an outcome that only scratched the surface of the corruption according to a whistleblower.[14]

Rock-paper-scissors

An April 2019 article in *MIT Technology Review* provides further detail and an update on the corruption scandals:[14]

"On September 21, 2012, officials at KHNP had received an outside tip about illegal activity among the company's parts suppliers. By the time President Park had taken office, an internal probe had become a full-blown criminal investigation. Prosecutors discovered that thousands of counterfeit parts had made their way into nuclear reactors across the country, backed up with forged safety documents. KHNP insisted the reactors were still safe, but the question remained: was corner-cutting the real reason they were so cheap?

"Park Jong-woon, a former manager who worked on reactors at Kepco and KHNP until the early 2000s, believed so. He had seen that taking shortcuts was precisely how South Korea's headline reactor, the APR1400, had been built.

"After the Chernobyl disaster in 1986, most reactor builders had tacked on a slew of new safety features. KHNP followed suit but later realized that the astronomical cost of these features would make the APR1400 much too expensive to attract foreign clients. They eventually removed most of them," says Park, who now teaches nuclear engineering at Dongguk University. "Only about 10% to 20% of the original safety additions were kept."

"Most significant was the decision to abandon adding an extra wall in the reactor containment building – a feature designed to increase protection against radiation in the event of an accident. "They packaged the APR1400 as 'new' and safer, but the so-called optimization was essentially a regression to older standards," says Park. "Because there were so few design changes compared to previous models, [KHNP] was able to build so many of them so quickly."

"Having shed most of the costly additional safety features, Kepco was able to dramatically undercut its competition in the UAE bid, a strategy that hadn't gone unnoticed. After losing Barakah to Kepco, Areva CEO Anne Lauvergeon likened the Korean unit to a car without airbags and seat belts. When I told Park this, he snorted in agreement. "Objectively speaking, if it's twice as expensive, it's going to be about twice as safe," he said. At the time, however, Lauvergeon's comments were dismissed as sour words from a struggling rival.

"By the time it was completed in 2014, the KHNP inquiry had escalated into a far-reaching investigation of graft, collusion, and warranty forgery; in total, 68 people were sentenced and the courts dispensed a cumulative 253 years of jail time. Guilty parties included KHNP president Kim Jong-shin, a Kepco lifer, and President Lee Myung-bak's close aide Park Young-joon, whom Kim had bribed in exchange for "favorable treatment" from the government.

"Several faulty parts had also found their way into the UAE plants, angering Emirati officials. "It's still creating a problem to this day," Neilson-Sewell, the Canadian advisor to Barakah, told me. "They lost complete faith in the Korean supply chain."

"The scandals, however, were not over. Earlier this year, at a small bakery in Seoul, I met Kim Min-kyu. A slight 44-year-old man with earnest, youthful eyes, Kim used to be a senior sales manager at Hyosung Heavy Industries, a manufacturer of reactor parts. In 2010, he was put in charge of selling to KHNP and quickly discovered that double-dealing was as routine as paperwork.

""Suppliers who were supposed to be competing with one another colluded to decide who would win [KHNP bids]," Kim told me. "You'd have a group of white-haired executives from competing firms sitting across from each other, playing rock-paper-scissors to decide who would take certain contracts." Dummy bids would then be supported by fake documents, doctored to ensure that the designated loser would fail. On one occasion, he says, an irate KHNP procurement manager called him to point out an amateurish forgery in a fake bidding document – and demanded he do it again, properly.

"Some of these practices constituted serious lapses in safety. In May 2014, Kim oversaw the delivery of 11 load center transformers bound for the Hanul Nuclear Power Plant in North Gyeongsang province, only to discover that their safety licenses hadn't been renewed. Load center transformers manage the flow of power to key emergency functions at reactors; any malfunction, Kim told me, would be "like a hurtling car suddenly stalling."

"Yet a secret agreement between Hyosung and competitors had designated it the winner, and the transformers were installed into two reactors, their integrity unquestioned. "I personally knew of around 300 cases where those transformers caught on fire. They're incredibly unstable," says Kim, his brow furrowed. "My hometown is actually just a few kilometers from those reactors, and an accident there could endanger my relatives who live nearby."

"In 2015, fearing a Fukushima-like accident, Kim decided to report the corruption through his company's internal whistleblowing system. The only result was that he was fired.

""How naïve I was," he says, flashing a rueful grin. He eventually went to the country's competition regulator, which referred the case to prosecutors. In 2018, he took his story to the media. A few months later, on the basis of tips from Kim, prosecutors charged six employees from Hyosung and co-conspirator LS Industrial Systems with collusion – an outcome that Kim believes only scratches the surface of the corruption.

"More untruths soon came to light. In 2018, after years of government denial, former defense minister Kim Taeyoung admitted that the rumors about the military side agreement with the UAE were, in fact, true: he had overseen it himself in a desperate attempt to seal the Barakah deal. "There was low risk of a dangerous situation arising, and even if it did, we believed that our response could be flexible," he told South Korean media. "In the event of an actual conflict, I figured that we would ask for parliamentary ratification then." ...

"On principle, I don't trust anything that KHNP built," says Kim Min-kyu, the corruption whistleblower. More and more South Koreans have developed a general mistrust of what they refer to as "the nuclear mafia" – the close-knit pro-nuclear complex spanning KHNP, academia, government, and monied interests. Meanwhile the government watchdog, the Nuclear Safety and Security Commission, has been accused of revolving door appointments, back-scratching, and a disregard for the safety regulations it is meant to enforce."

The secret military side-agreement to the Korea/UAE reactor contract has led to debate as to whether the Lee government violated the constitution when it signed the agreement without the approval of the National Assembly.[15] A confidential US briefing leaked by Wikileaks said the military side-agreement covered defense industry technology exchanges, cooperation on military training and support, and exchanges of high-ranking military officials.[16]

Kim Tae-young, who served as Defense Minister under the Lee administration from September 2009 to December 2010, said:[15]

"At the time, France had nearly clinched the UAE nuclear reactor deal. South Korea needed to show it was fully committed to the UAE. We signed an agreement for the South Korean military to intervene if the UAE runs into military trouble."

Inadequate nuclear safety standards

Clearly inadequate nuclear safety standards are still in evidence in 2019. A case in point was an incident at the Hanbit 1 reactor on 10 May 2019. The reactor's thermal output exceeded safety limits but was kept running for nearly 12 hours when it should have been shut down manually at once.[17] The thermal output rose from 0% to 18% in one minute, far exceeding the 5% threshold that should have triggered a manual shutdown.

The Nuclear Safety and Security Commission (NSSC) ordered the suspension of operation of the nuclear power plant and dispatched a team of special judiciary police officers to carry out a special inspection.[18] The NSSC said in a May 20 statement:[18]

"The NSSC confirmed that the KHNP did not immediately stop the reactor even though the thermal output of the reactor exceeded the limit during the Control Element Reactivity Measurement Test and that the control rod was operated by a person who does not have a Reactor Operator's license (RO). The NSSC said that negligence of the person having a Senior Reactor Operator's license (SRO) in supervising and directing the operation is suspected, and therefore there is a possibility of violating the Nuclear Safety Act."

The NSSC said on June 25:[19]

"According to the midterm results of the special investigation on the Hanbit Unit 1, which was released on June 24th, the event happened because the licensee (the Korea Hydro and Nuclear Power) did not abide by the Nuclear Safety Act, Technical Specifications and internal procedures".

The Hanbit-1 incident was one of three occasions in 2019 alone when a reactor was shut down soon after being reactivated. The *Hankyoreh* newspaper editorialized on 9 September 2019:[20]

"South Korean nuclear power plants that have reopened following government approval have faced a string of malfunctions, bringing their operations to a halt. These accidents raise worrying questions about the safety of nuclear energy. There's an urgent need for nuclear energy regulators to carry out thorough inspections and to prevent such accidents from reoccurring. ... Another question that must be asked is whether regulators have been too hasty in authorizing the reactors' reactivation."

References:

1. Nuclear Monitor #844, 25 May 2017, 'South Korea's 'nuclear mafia'', https://www.wiseinternational.org/nuclear-monitor/844/south-koreas-nuclear-mafia
2. Nuclear Monitor #765, 1 Aug 2013, 'South Korea: Nuclear scandal widens', www.wiseinternational.org/nuclear-monitor/765/nuclear-news
3. Nuclear Monitor #771, 2 Nov 2013, 'South Korea indicts 100 people over safety scandals', www.wiseinternational.org/nuclear-monitor/771/south-korea-indicts-100-people-over-safety-scandals
4. Will Davis, 6 Feb 2014, 'South Korea nuclear power: Are the dark times over?', http://ansnuclearcafe.org/2014/02/06/south-korea-nuclear-power-are-the-dark-times-over/
5. Korea Institute of Nuclear Safety, www.kins.re.kr/en/ourwork/cfsi.jsp
6. Mycle Schneider, Antony Froggatt et al., 2016, World Nuclear Industry Status Report 2016, www.worldnuclearreport.org or direct download: www.worldnuclearreport.org/IMG/pdf/20160713MSC-WNISR2016V2-HR.pdf
7. Korea Times, 25 June 2016, 'Fake certificates again', http://koreatimes.co.kr/www/news/opinon/2014/06/137_159789.html
8. Se Young Jang, 8 Oct 2015, 'The Repercussions of South Korea's Pro-Nuclear Energy Policy', http://thediplomat.com/2015/10/the-repercussions-of-south-koreas-pro-nuclear-energy-policy/
9. Choi Kyong-ae, 12 Jan 2014, 'Hyundai Heavy vows to root out corruption', http://koreatimes.co.kr/www/news/biz/2014/01/602_149613.html
10. Choe Sang-hun, 3 Aug 2013, 'Scandal in South Korea Over Nuclear Revelations', www.nytimes.com/2013/08/04/world/asia/scandal-in-south-korea-over-nuclear-revelations.html
11. Se Young Jang, 8 Oct 2015, 'The Repercussions of South Korea's Pro-Nuclear Energy Policy', http://thediplomat.com/2015/10/the-repercussions-of-south-koreas-pro-nuclear-energy-policy/
12. Japan Times, 10 May 2017, 'The pendulum swings in South Korea', www.japantimes.co.jp/opinion/2017/05/10/editorials/pendulum-swings-south-korea/
13. Nuclear Monitor #800, 19 March 2015, 'Japan's 'nuclear village' reasserting control', www.wiseinternational.org/nuclear-monitor/800/japans-nuclear-village-reasserting-control
14. Max S. Kim, 22 April 2019, 'How greed and corruption blew up South Korea's nuclear industry', https://www.technologyreview.com/s/613325/how-greed-and-corruption-blew-up-south-koreas-nuclear-industry/
15. Lee Seung-jun, 10 Jan 2018, 'Secret military pact likely led to Blue House Chief of Staff's UAE visit', http://english.hani.co.kr/arti/english_edition/e_international/827153.html
16. 4 Jan 2010, 'ROK FM YU ON ROK'S COMPREHENSIVE DEAL WITH UAE', https://wikileaks.org/plusd/cables/10SEOUL2_a.html
17. Choi Ha-yan, 21 May 2019, 'Nuclear reactor kept running for 12 hours after it should have been shut down', http://english.hani.co.kr/arti/english_edition/e_business/894763.html
18. Nuclear Safety and Security Commission, 20 May 2019, 'The NSSC to Expand the Special Inspection on Manual Shutdown of Hanbit Unit 1', http://www.nssc.go.kr/nssc/en/c5/sub1.jsp?mode=view&article_no=45431&pager.offset=30&board_no=501
19. Nuclear Safety and Security Commission, 25 June 2019, 'Comments on the news article: Event at Hanbit Unit 1 was caused by a violation of the law and human error and irrelevant to the energy transition policy', http://www.nssc.go.kr/nssc/en/c5/sub1.jsp?mode=view&article_no=45520&pager.offset=20&board_no=501
20. Editorial – Hankyoreh, 9 Sept 2019, 'Nuclear energy regulators need to be more vigilant in inspections than ever', http://english.hani.co.kr/arti/english_edition/e_editorial/909073.html