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Dear readers of the WISE/NIRS Nuclear Monitor,
In this issue of the Monitor:

- With Japan finally pulling the plug on the Monju fast breeder reactor, we write about the decline of fast reactor programs around the world.
- Gloria Kuang-Jung Hsu writes about the events leading up to the Taiwanese government's decision to phase out nuclear power by 2025.
- We write about South Africa's scandal-plagued nuclear power program.

The Nuclear News section has reports on escalating nuclear liabilities in Europe, the AREVA / EdF safety scandal, Standard and Poor's downgrading of EdF in the wake of the Hinkley Point C agreement, and more.

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.

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Monitored this issue:

The slow death of fast reactors – Jim Green	1
Taiwan's nuclear power phase-out – Gloria Kuang-Jung Hsu	5
South Africa's nuclear program lurches from scandal to scandal – Jim Green	7
Nuclear News	9
– Pensioner holds up transportation of nuclear warheads	
– S&P warns European utilities' nuclear liabilities have "shot up"	
– Nuclear Power: Game Over	
– AREVA / EdF safety scandal escalates	
– Standard and Poor downgrade EdF over Hinkley	

The slow death of fast reactors

Author: *Jim Green* – Nuclear Monitor editor

NM831.4587 Fast neutron reactors are "poised to become mainstream" according to the World Nuclear Association.¹ The Association lists eight "current" fast reactors although three of them – India's Prototype Fast Breeder Reactor, and the Joyo and Monju reactors in Japan – are not operating. That leaves just five fast reactors, three of them experimental.

Nuclear physicist Thomas Cochran summarizes the unhappy history of fast reactors: "Fast reactor development programs failed in the: 1) United States; 2) France; 3) United Kingdom; 4) Germany; 5) Japan; 6) Italy; 7) Soviet Union/Russia 8) U.S. Navy and 9) the Soviet Navy. The program in India is showing no signs of success and the program in China is only at a very early stage of development."²

The latest setback was the decision of the Japanese government at an extraordinary Cabinet meeting on September 21 to abandon plans to restart the Monju fast breeder reactor.³ A formal announcement of the decision is likely to be made by the end of the year, government officials said.⁴ After the Cabinet meeting,

Chief Cabinet Secretary Yoshihide Suga said the government will set up an expert panel that will "carry out an overall revision of the Monju project, including its decommissioning" by the end of this year.³

Monju won't be missed. The *Japan Times* reported: "Monju not only absorbed fistfuls of taxpayer money, but also suffered repeated accidents and mismanagement while only going live for a few months during its three-decade existence."³

Likewise, the *Mainichi Japan* editorialized on June 6: "Many other rich industrialized nations have given up on fast-breeder reactor development because of its technical and cost hurdles. The fuel cycle project is effectively broken beyond repair. ... It's time for the government to decide, not on how Monju will continue, but on how it will be shut down for good."⁵

Monju reached criticality in 1994 but was shut down in December 1995 after a sodium coolant leak and fire. The reactor didn't restart until May 2010, and it was shut down again three months later after a fuel handling



Monju fast breeder reactor.

machine was accidentally dropped in the reactor during a refuelling outage. In November 2012, it was revealed that Japan Atomic Energy Agency had failed to conduct regular inspections of almost 10,000 out of a total 39,000 pieces of equipment at Monju, including safety-critical equipment.

In November 2015, the Nuclear Regulation Authority declared that the Japan Atomic Energy Agency was “not qualified as an entity to safely operate” Monju. Education minister Hirokazu Matsuno said on 21 September 2016 that attempts to find an alternative operator have been unsuccessful.³

On 15 August 2016, less than a week before the extraordinary Cabinet meeting, the Nuclear Regulation Authority rejected a request to lift a ban on operating Monju, imposed in 2013 after the revelation that safety inspections of thousands of components had not been carried out.⁶

The government has already spent 1.2 trillion yen (US\$12bn; €10.8bn) on Monju.⁷ The government calculated that it would cost another 600 billion yen (US\$6bn; €5.3bn) to restart Monju and keep it operating for another 10 years.⁷ Offline maintenance costs amount to around 20 billion yen a year (US\$200m; €177m).^{4,7}

Decommissioning also has a hefty price-tag – far more than for conventional light-water reactors. According to a 2012 estimate by the Japan Atomic Energy Agency, decommissioning Monju will cost an estimated 300 billion yen (US\$3bn; €2.7bn), comprising 130 billion yen to dismantle the facility, 20 billion yen to remove spent nuclear fuel, and 150 billion yen for maintenance and management costs such as electricity and labor.⁸

Reprocessing in Japan

Logically, the decision to scrap Monju should be followed by a decision to scrap the partially-built

Rokkasho reprocessing plant. Providing plutonium fuel to Monju – and, in time, other fast reactors – was one of the main justifications for Rokkasho. Moreover, Japan already has an astronomical stockpile of 48 tonnes of separated plutonium from the reprocessing of Japanese spent fuel in European reprocessing plants. Rokkasho would result in an additional 8–9 tonnes of separated plutonium annually.

But the government seems determined to proceed with Rokkasho, which is due to start up in 2018. The reprocessing plant’s scheduled completion in 1997 has been delayed by more than 20 times due to a series of technical glitches and other problems, and its construction cost is now estimated at 2.2 trillion yen (US\$22bn; €19.5bn) – three times the original cost estimate.⁹

How to justify continuing with Rokkasho without a fast breeder program? The Japanese government says that it will continue research and development into fast breeder reactors. At the extraordinary Cabinet meeting on September 21, the government decided to commission a road map for developing “demonstration fast reactors” by the end of the year.³ One option is to attempt to restart the Joyo experimental fast reactor in Ibaraki Prefecture (shut down since 2007 due to damage to some core components – the World Nuclear Association says its future is “uncertain”¹), or Japan may pursue joint research with France (specifically, France’s plans to develop a demonstration fast reactor called ASTRID).^{3,10}

Operating a massive reprocessing plant in support of a small, experimental fast reactor program makes no sense, especially given the existing plutonium stockpile. Another rationale for Rokkasho – separating plutonium to be incorporated into MOX fuel for light-water reactors – is just as illogical. Only one operating reactor – Ikata 3 in Ehime Prefecture – uses MOX fuel.

Perhaps sense will prevail and Japan will abandon both fast reactors and reprocessing – but that isn't seen as a likely outcome. Masafumi Takubo and Frank von Hippel noted in a recent article:¹¹

“According to a 2011 estimate by Japan’s Atomic Energy Commission, operating the RRP [Rokkasho Reprocessing Plant] will cost about ¥200 billion (~US\$2 billion) per year to produce plutonium with a fuel value that is less than the cost of fabricating it into fuel. The economics of reprocessing in France are similarly irrational. One therefore needs to find other explanations than those stated for the persistence of reprocessing in France and Japan. Partial explanations include:

- *The thousands of jobs and government subsidies to local and regional governments associated with reprocessing and related facilities have become important to the rural areas where they are located;*
- *Abandoning the pursuit of a plutonium economy would be seen by elite nuclear technocrats as an admission that they had wasted the equivalents of tens of billions of taxpayers’ dollars;*
- *Reprocessing is government policy and therefore not responsive to market economics; and*
- *In Japan, some see its reprocessing capability as providing a virtual nuclear deterrent.”*

India’s failed fast reactor program

India’s fast reactor program has been a failure. The budget for the Fast Breeder Test Reactor (FBTR) was approved in 1971 but the reactor was delayed repeatedly, attaining first criticality in 1985. It took until 1997 for the FBTR to start supplying a small amount of electricity to the grid. The FBTR’s operations have been marred by several accidents.¹²

Preliminary design work for a larger Prototype Fast Breeder Reactor (PFBR) began in 1985, expenditures on the reactor began in 1987/88 and construction began in 2004 – but the reactor still hasn’t started up. Construction has taken more than twice the expected period.¹² In July 2016, the Indian government announced yet another delay, and there is scepticism that the scheduled start-up in March 2017 will be realized. The PFBR’s cost estimate has gone up by 62%.¹³

India’s Department of Atomic Energy (DAE) has for decades projected the construction of hundreds of fast reactors – for example a 2004 DAE document projected 262.5 gigawatts (GW) of fast reactor capacity by 2050. But India has a track record of making absurd projections for both fast reactors and light-water reactors – and failing to meet those targets by orders of magnitude.¹²

Academic M.V. Ramana writes: “Breeder reactors have always underpinned the DAE’s claims about generating large quantities of electricity. Today, more than six decades after the grand plans for growth were first announced, that promise is yet to be fulfilled. The latest announcement about the delay in the PFBR is yet another reminder that breeder reactors in India, like elsewhere, are best regarded as a failed technology and that it is time to give up on them.”¹²

Russia’s snail-paced program

Three fast reactors are in operation in Russia – BOR-60 (start-up in 1969), BN-600 (1980) and BN-800 (2014).¹ There have been 27 sodium leaks in the BN-600 reactor, five of them in systems with radioactive sodium, and 14 leaks were accompanied by burning of sodium.¹⁴

The Russian government published a decree in August 2016 outlining plans to build 11 new reactors over the next 14 years. Of the 11 proposed new reactors, three are fast reactors: BREST-300 near Tomsk in Siberia, and two BN-1200 fast reactors near Ekaterinburg and Chelyabinsk, near the Ural mountains.¹⁵ However, like India, the Russian government has a track record of projecting rapid and substantial nuclear power expansion – and failing miserably to meet the targets.¹⁵

As Vladimir Slivyak recently noted in *Nuclear Monitor*: “While Russian plans looks big on paper, it’s unlikely that this program will be implemented. It’s very likely that the current economic crisis, the deepest in history since the USSR collapsed, will axe the most of new reactors.”

While the August 2016 decree signals new interest in reviving the BN-1200 reactor project, it was indefinitely suspended in 2014, with Rosatom citing the need to improve fuel for the reactor and amid speculation about the cost-effectiveness of the project.¹⁶

In 2014, Rosenergoatom spokesperson Andrey Timonov said the BN-800 reactor, which started up in 2014, “must answer questions about the economic viability of potential fast reactors because at the moment ‘fast’ technology essentially loses this indicator [when compared with] commercial VVER units.”¹⁶

Russian plans in the 1980’s to construct five BN-800s in the Ural region failed to materialize and, as the International Panel on Fissile Materials noted last December, plans to scale up fast reactor deployment to 14 GW by 2030 and 34 GW by 2050 do not seem realistic.¹⁷

OKBM – the Rosatom subsidiary that designed the BN-1200 reactor – previously anticipated that the first BN-1200 reactor would be commissioned in 2020, followed by eight more by 2030.¹⁸ The projection of nine BN-1200 reactors operating by 2030 was fanciful, and the latest plan for three new fast reactors by 2030 will not be realized either.

The BREST-300 fast reactor project is stretching Rosatom’s funds. Bellona’s Alexander Nikitin said in 2014 that Rosatom’s “Breakthrough” program to develop BREST-300 was only breaking Rosatom’s piggy-bank.¹⁹

China’s program going nowhere fast

Australian nuclear lobbyist Geoff Russell cites²⁰ the World Nuclear Association (WNA)²¹ in support of his claim that the Chinese expect fast reactors “to be dominating the market by about 2030 and they’ll be mass produced.”

Does the WNA reference support the claim? Not at all. China has a 20 MWe experimental fast reactor, which operated for a total of less than one month in the 63 months from criticality in July 2010 to October 2015.²¹ For every hour the reactor operated in 2015, it was offline for five hours, and there were three recorded reactor trips.²²

China also has plans to build a 600 MWe 'Demonstration Fast Reactor' and then a 1,000 MWe commercial-scale fast reactor.²¹ Whether the 600 MWe and 1,000 MWe reactors will be built remains uncertain – the projects have not been approved – and it would be another giant leap from a single commercial-scale fast reactor to a fleet of them.

According to the WNA, a decision to proceed with or cancel the 1,000 MW fast reactor will not be made until 2020, and if it proceeds, construction could begin in 2028 and operation could begin in about 2034.²³

So China might have one commercial-scale fast reactor by 2034 – but probably won't. Clearly Russell's claim that fast reactors will be "dominating the market by about 2030" is asinine hogwash.

According to the WNA, China envisages 40 GW of fast reactor capacity by 2050. A far more likely scenario is that China will have 0 GW of fast reactor capacity by 2050. And even if the 40 GW target was reached, it would still only represent around one-sixth of total nuclear capacity in China in 2050²³ – fast reactors still wouldn't be "dominating the market" even if the fanciful projections are realized.

Perhaps the travelling-wave fast reactor popularized by Bill Gates will come to the rescue? Or perhaps not. According to the WNA, China General Nuclear Power and Xiamen University are reported to be cooperating on R&D, but the Ministry of Science and Technology, China National Nuclear Corporation, and the State Nuclear Power Technology Company are all skeptical of the travelling-wave reactor concept.²³

Perhaps the 'integral fast reactor' (IFR) championed by James Hansen will come to the rescue? Or perhaps not. The UK and US governments have been considering building IFRs (specifically GE Hitachi's 'PRISM' design) for plutonium disposition – but it is almost certain that both countries will choose different methods to manage plutonium stockpiles.²⁴

In South Australia, nuclear lobbyists united behind a push for IFRs/PRISMs, and they would have expected to persuade a stridently pro-nuclear Royal Commission to endorse their ideas. But the Royal Commission completely rejected the proposal, noting in its May 2016 report that advanced fast reactors are unlikely to be feasible or viable in the foreseeable future; that the development of such a first-of-a-kind project would have high commercial and technical risk; that there is no licensed, commercially proven design and development to that point would require substantial capital investment; and that electricity generated from such reactors has not been demonstrated to be cost competitive with current light water reactor designs.²⁵

A future for fast reactors?

Just 400 reactor-years of worldwide experience have been gained with fast reactors.¹ There is 42 times more experience with conventional reactors (16,850 reactor-years²⁶). And most of the experience with fast reactors suggests they are more trouble than they are worth.

Apart from the countries mentioned above, there is very little interest in pursuing fast reactor technology. Germany, the UK and the US cancelled their prototype breeder reactors in the 1980s and 1990s.²⁷

France is considering building a fast reactor (ASTRID) despite the country's unhappy experience with the Phénix and Superphénix reactors. But a decision on whether to construct ASTRID will not be made until 2019/20.^{28,29}

The performance of the Superphénix reactor was as dismal as Monju. Superphénix was meant to be the world's first commercial fast reactor but in the 13 years of its miserable existence it rarely operated – its 'Energy Unavailability Factor' was 90.8% according to the IAEA.³⁰

A 2010 article in the *Bulletin of the Atomic Scientists* neatly summarized the worldwide failure of fast reactor technology:³¹

"After six decades and the expenditure of the equivalent of about \$100 billion, the promise of breeder reactors remains largely unfulfilled. ... The breeder reactor dream is not dead, but it has receded far into the future. In the 1970s, breeder advocates were predicting that the world would have thousands of breeder reactors operating this decade. Today, they are predicting commercialization by approximately 2050. In the meantime, the world has to deal with the hundreds of tons of separated weapons-usable plutonium that are the legacy of the breeder dream and more being separated each year by Britain, France, India, Japan, and Russia.

"In 1956, U.S. Navy Admiral Hyman Rickover summarized his experience with a sodium cooled reactor that powered early U.S. nuclear submarines by saying that such reactors are "expensive to build, complex to operate, susceptible to prolonged shutdown as a result of even minor malfunctions, and difficult and time-consuming to repair." More than 50 years later, this summary remains apt."

Allison MacFarlane, former chair of the US Nuclear Regulatory Commission, recently made this sarcastic assessment of fast reactor technology: "These turn out to be very expensive technologies to build. Many countries have tried over and over. What is truly impressive is that these many governments continue to fund a demonstrably failed technology."³²

While fast reactors face a bleak future, the rhetoric will persist. Australian academic Barry Brook wrote a puff-piece about fast reactors for the Murdoch press in 2009.³³ On the same day he said on his website that "although it's not made abundantly clear in the article", he expects conventional reactors to play the major role for the next two to three decades but chose to emphasise fast reactors "to try to hook the fresh fish".

So that's the game plan for nuclear lobbyists – making overblown claims about fast reactors and other Generation IV reactor concepts, pretending that they are near-term prospects, and being less than "abundantly clear" about the truth.

References:

1. World Nuclear Association, Sept 2016, 'Fast Neutron Reactors', www.world-nuclear.org/information-library/current-and-future-generation/fast-neutron-reactors.aspx
2. International Panel on Fissile Materials, 17 Feb 2010, 'History and status of fast breeder reactor programs worldwide', http://fissilematerials.org/blog/2010/02/history_and_status_of_fas.html
3. Reiji Yoshida, 21 Sept 2016, 'Japan to scrap troubled ¥1 trillion Monju fast-breeder reactor', www.japantimes.co.jp/news/2016/09/21/national/japans-cabinet-hold-meeting-decide-fate-monju-reactor/
4. Jack Loughran, 21 Sept 2016, 'Costly Japanese prototype nuclear reactor shuts down', <http://eandt.theiet.org/content/articles/2016/09/costly-japanese-prototype-nuclear-reactor-shuts-down/>
5. Mainichi Japan, 6 June 2016, 'Editorial: Time to permanently shut down Monju nuclear reactor', <http://mainichi.jp/english/articles/20160606/p2a/00m/0na/018000c>
6. 19 Aug 2016, 'Nuclear Regulators Keep Ban On Monju Reactor', www.japanbullet.com/news/nuclear-regulators-keep-ban-on-monju-reactor
7. Mainichi Japan, 29 Aug 2016, 'Running Monju reactor for 10 years would cost gov't 600 billion yen extra', <http://mainichi.jp/english/articles/20160829/p2a/00m/0na/017000c>
8. Mainichi Japan, 16 Feb 2016, 'Decommissioning of troubled fast-breeder reactor Monju would cost 300 billion yen', <http://mainichi.jp/english/articles/20160216/p2a/00m/0na/005000c>
9. 4 Sept 2016, 'Monju and the nuclear fuel cycle', www.japantimes.co.jp/opinion/2016/09/04/editorials/monju-nuclear-fuel-cycle/
10. 13 Sept 2016, 'Japan on verge of scrapping Monju fast-breeder reactor: sources', www.japantimes.co.jp/news/2016/09/13/national/japan-verge-scrapping-monju-fast-breeder-reactor-sources/
11. Masafumi Takubo and Frank von Hippel, 1 Sept. 2016, 'Future of Japan's Monju plutonium breeder reactor under review', http://fissilematerials.org/blog/2016/09/future_of_japans_monju_pl.html
12. M.V. Ramana, 16 Aug 2016, 'Fast breeder reactors and the slow progress of India's nuclear programme', www.ideasforindia.in/article.aspx?article_id=1677
13. Mycle Schneider, Antony Froggatt et al., 2016, World Nuclear Industry Status Report 2016, www.worldnuclearreport.org/IMG/pdf/20160713MSC-WNISR2016V2-HR.pdf
14. Vladimir Sliviyak, December 2014, 'Russian Nuclear Industry Overview', <http://earthlife.org.za/www/wp-content/uploads/2014/12/russian-nuc-ind-overview.pdf>
15. WNN, 10 Aug 2016, 'Russia to build 11 new nuclear reactors by 2030', www.world-nuclear-news.org/NP-Russia-to-build-11-new-nuclear-reactors-by-2030-10081602.html
16. World Nuclear News, 16 April 2015, 'Russia postpones BN-1200 in order to improve fuel design', www.world-nuclear-news.org/NN-Russia-postpones-BN-1200-in-order-to-improve-fuel-design-16041502.html
17. Shaun Burnie, 15 Dec 2015, 'Russian BN-800 fast breeder reactor connected to grid', http://fissilematerials.org/blog/2015/12/russian_bn-800_fast_breed.html
18. www.world-nuclear.org/info/Country-Profiles/Countries-O-S/Russia--Nuclear-Power/
19. Alexander Nikitin, 5 May 2015, 'In a perpetual search for perpetuum mobile', <http://bellona.org/news/uncategorized/2015-05-perpetual-search-perpetuum-mobile>
20. <https://bravenewclimate.com/2015/06/18/complaint-about-misleading-helen-caldicott-article-in-the-saturday-paper/>
21. www.world-nuclear.org/info/country-profiles/countries-a-f/china--nuclear-power/
22. Zhang Donghui / China Institute of Atomic Energy, 2016, 'Nuclear energy and Fast Reactor development in China', www.iaea.org/NuclearPower/Downloadable/Meetings/2016/2016-05-16-05-20-NPES/3.1_China_49th_TWG-FR.pdf
23. www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-fuel-cycle.aspx
24. Jim Green, 9 Sept 2015, 'Diminishing prospects for MOX and integral fast reactors', Nuclear Monitor #810, www.wiseinternational.org/nuclear-monitor/810/diminishing-prospects-mox-and-integral-fast-reactors
25. Nuclear Fuel Cycle Royal Commission, Final Report, 2016, http://yoursay.sa.gov.au/system/NFCRC_Final_Report_Web.pdf
26. www.iaea.org/pris/
27. Thomas B. Cochran et al., 2010, 'Fast Breeder Reactor Programs: History and Status', <http://fissilematerials.org/library/rr08.pdf>
28. www.iaea.org/NuclearPower/Downloadable/Meetings/2015/2015-05-25-05-29-NPTDS/Country/7_ASTRID_project_TWG_FR_MAY_2015.pdf
29. www.nucnet.org/all-the-news/2014/05/16/france-plans-introduction-of-commercial-fast-neutron-reactors-in-2040
30. www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=178
31. Thomas Cochran et al., May/June 2010, 'It's time to give up on breeder reactors', http://ipfmlibrary.org/Breeders_BAS_May_June_2010.pdf
32. Stephen Stapczynski and Emi Urabe, 1 June 2016, 'Japan's Nuclear Holy Grail Slips Away With Operator Elusive', <http://washpost.bloomberg.com/Story?docId=1376-O7Q3JD6JIV801-5DS75Q6VPR85E6K1V77TLR120J>
33. <http://bravenewclimate.com/2009/12/04/clean-future-in-nuclear-power/>

Taiwan's nuclear power phase-out

NM831.4588 *With the election of the Democratic Progressive Party to govern Taiwan in January, plans are being progressed to phase out nuclear power by 2025 and to expand renewables. "There is no room for discussion. When 2025 comes, nuclear power will be abandoned," Economics Minister Lee Shih-guang said on 26 May 2016.*

Three operating nuclear plants (six reactors) supply around 15% of Taiwan's electricity. Construction of the two-reactor Lungmen nuclear plant was suspended in 2014. Taiwan aims to increase the ratio of electrical power generated by renewables from 3% to 20% by 2025.

Here we reprint an excerpt from a detailed 2015 article by Gloria Kuang-Jung Hsu, professor in the Department of Atmospheric Sciences, National Taiwan University.

The problematic history of the Lungmen nuclear power plant (LMNP)

Construction of the fourth nuclear power plant at Lungmen reveals the strained relationship between the regulator (the Atomic Energy Council – AEC), and the operator, Taipower. The existing three nuclear power plants were completed under the supervision of two US consulting firms, Ebasco and Bechtel. LMNP construction was undertaken by Taipower, which had little experience and oversaw the whole process using GE blueprints. The equally inexperienced AEC set up a regulatory committee in January 1997 to monitor the LMNP's quality and progress. The AEC began publishing short monthly monitoring reports in 2002, when the real work started. Many of the flaws identified during the early stages of construction were soon corrected. The first major discovery was triggered by

anonymous tips, indicating that lower than required strength welding was applied in the reactor base frame. Follow-up by the AEC in April 2002 confirmed the problem, so the base frame was rebuilt.

The AEC identified an increasing number of flaws as construction progressed. Major problems listed in the AEC's reports included reinforced tendons for the containment anchor being accidentally cut and careless contractors repeatedly setting working platforms directly on top of previously installed pipes and tubing, causing rust, obvious dents, and even punctures. Workers' logs were filled with apparent indications of work overload that would be impossible to finish in a single day. Moreover, many joints inside the LMNP reactor building were inadequately sealed with Teflon tape.

However, more serious allegations raised by an insider were categorized by the AEC as "not safety related". These included headline grabbing design alterations and the systematic cutting of corners on materials. It was found that Taipower had made 395 alterations to the LMNP design, including support for an emergency cooling system, without consulting the AEC or GE. In addition, Taipower knowingly accepted the use of Neoprene gaskets to replace carbon fiber ones in pull box and conduit fittings, despite the fact that the LMNP specification clearly precludes using such gaskets. The former can easily be ignited at 130°C, such as with a cigarette lighter, whereas the latter can endure temperatures of up to 1,000°C. It was also found that the hot dip—galvanized zinc steel, whose coating is twenty-five times thicker than zinc-electroplated steel and can last more than fifty years in coastal areas, nevertheless was replaced by the electroplated variety. In his reply to questions from journalists concerning these replacements, Taipower's LMNP site manager said that a nuclear power plant is not a humid environment, zinc electroplated steel is adequate, and Neoprene releases toxic fumes when it catches fire. Since no one can survive such high temperatures, who would care about toxins then?

The AEC imposed a fine of NT500,000 (about US\$16,700) on Taipower in April 2008 and insisted that Taipower re-evaluate the safety of altered items and make no more alterations without the AEC's consent. A couple months later, the AEC discovered that Taipower had made about 700 additional alterations without the AEC's knowledge. A total fine of NT3.5 million (about \$117,000) was imposed. Yet again, more alterations without authorization were discovered in mid-2011. This time, the AEC not only imposed a higher fine of NT15 million (\$500,000), it also announced that it would take culpable Taipower executives to criminal court. Apparently, Taipower holds little respect for the AEC.

Shared irresponsibility

Taipower Company is the state-owned utility monopoly, yet few government administrations had a real grasp of Taipower management. Magazine interviews of several Taipower executives in June 2008 revealed the rationales behind all the nuclear power plant alterations. They blamed "GE's over-conservative design of LMNP" for all the problems. The excessive GE design, the executives said, required "tens to thousands of times

more [materials] than LMNP really needed," making "construction difficult" and "inflat[ing] the costs." Taipower executives did not trust the GE design since the United States had not constructed a new nuclear power plant "in 30 years," during which "GE lost [a] major part of its nuclear capability." They claimed that Taipower had found "numerous contradictions" during construction, and therefore "had no choice but to make improvised changes in order not to delay the whole project".

The AEC had itself to blame for overlooking some important issues. In the short inspection reports in May and August 2007, the AEC lightly mentioned the poor cement jobs in both reactor containments. Reports described threaded steel, cigarette butts, and plastic bottles found in the wall of the reinforced concrete containment vessel, with no photos attached. Some places had steel bars partially exposed. Also found in the number one reactor building were workers chipping away at the newly built containment, with over forty tendon steel bars cut, to make room for the spent fuel pool. It was not until a picture showing plastic bottles in the containment wall leaked to the press in April 2013 that people began to realize how potentially catastrophic and dire the situation was.

According to the AEC, a fine of NT400,000 (about \$13,000) was imposed, plastic bottles were removed, and the holes were filled with equal-strength concrete. The AEC assured the public that the strength of both containments was better than required even after modifications. Less than two weeks later, however, reports were published of a failed integrated leak rate test (ILRT) and structure integral test (SIT) for reactor number one between February 26 and March 5, 2014. Leaks were substantial but difficult to locate. Suspected causes range from more unseen plastic bottles in containments, second-hand valves, and the cutting of corners on the penetration seal within the nuclear island. In addition, records showed that as many as 197 items had been moved from unit number two to reactor number one to replace broken parts, probably as a result of inadequate handling.

As LMNP construction began, scandals came to light from time to time, but public reaction was rather mild. Grid connection time was postponed repeatedly, from July 1999 to 2004, 2006, 2010, and finally 2014. Work nevertheless continued with the full intention of bringing the LMNP online.

LMNP's demise

The Fukushima disaster changed the situation. Suddenly, people realized how much Taiwan and Japan had in common, especially regarding seismic vulnerability. Many were bewildered as to how a prudent society with much advanced technology could become so helpless, and what would become of Taiwan in a similar situation. Immediate responses from the AEC deputy chair were anything but reassuring. Without any evaluation and just two days after the Fukushima disaster, he boasted that "all nuclear power plants in Taiwan are just as sturdy as Buddha sitting on his platform." Neighboring countries, such as the Philippines, Vietnam, and China, all had detected radioactive materials from Fukushima, but the AEC insisted that no materials

were detected until March 31, 2011. The sensitivity of the AEC's instruments was questioned by nongovernmental organizations and the public.

In February 2013, the KMT's premier proposed holding a referendum to settle the future of the LMNP. The current Referendum Act requires a more than 50 percent voter turnout, plus an absolute favorable majority vote, in order for the referendum to be legally binding. Since the law passed in 2006, six national referenda had been held and all were rejected because turnouts were between 26 and 45 percent. Under the current law, how the referendum question is framed determines the outcome. The KMT's proposal was as follows: "Do you agree that the construction of the Fourth Nuclear Power Plant [LMNP] should be halted and that it not become operational?" Having the intended ballot date set at the end of 2013, the administration calculated that few would come to vote solely for the referendum, thus legitimizing the LMNP project.

Meanwhile, the AEC requested the European Union to perform a Taiwan Stress Test, to be completed one month before the planned voting date. A well-received international assessment certainly would win more public support. Some concluded that the Taiwan Stress Test was a propaganda exercise and not really for nuclear safety. Non-governmental representatives discovered that geological information in a Taiwan

National Report was out of date. In the end, the AEC received a polite and lukewarm assessment report. But waves of demonstrations popped up nationwide, including one anti-nuclear protest on March 9, 2013, that drew more than 200,000 people.

Pressure from the electorate forced KMT legislators to withdraw the referendum proposal. But a controversial service trade agreement with China that KMT legislators passed in thirty seconds flat renewed widespread demonstrations in March 2014. On April 22, Lin Yihsiang, former DPP chair and a longtime antinuclear activist, went on a hunger strike calling for termination of the LMNP. Under all this pressure, President Ma Yingjeou reluctantly made compromises on the LMNP, including ceasing construction of unit number one and sealing it pending a later decision, and completely stopping construction of unit number two. The decision for the latter was made probably because the administration was clearly aware that the possibility of unit number two's becoming operational was very slim. Lin ended his hunger strike on April 30, 2014.

Kuang-Jung Hsum 2015, 'To Regulate or Not to Regulate: The Conundrum of Taiwan's Nuclear Power'. Asian Perspective: Oct-Dec 2015, Vol. 39, No. 4, pp. 637-666, <http://journals.rienner.com/doi/abs/10.5555/0258-9184-39.4.637>

South Africa's nuclear program lurches from scandal to scandal

Author: *Jim Green – Nuclear Monitor editor*

NM831.4589 South Africa's controversial plan to build 9.6 gigawatts of new nuclear power capacity is heading to court on December 13–14. This is the latest chapter in a protracted saga stemming from legal action initiated by Southern African Faith Communities' Environment Institute (SAFCEI) and Earthlife Africa Johannesburg (ELA).^{1,2}

In 2014, SAFCEI submitted several requests for information on the nuclear plans to the Department of Energy using the Promotion of Access to Information Act. Those requests were refused on unsatisfactory grounds. In October 2015, SAFCEI and ELA initiated legal action, challenging various aspects of the nuclear procurement process. They maintained that the government did not follow legal procedure in the procurement process and didn't meet the requirements of the constitution for a fair, equitable, transparent, competitive and cost-effective process.³

The government's response to the legal action, long delayed, revealed further inconsistencies. It was revealed that the Department of Energy gazetted a 2013 Section 34 Determination (which is required before a nuclear procurement process can go ahead) on 21 December 2015, after keeping it secret for two years. Moreover, the Department side-stepped the necessary Parliamentary approval and public participation process by tabling this determination under section 231.3 and not section 231.2 as was advised by the state law adviser.⁴

SAFCEI and ELA's lawyers submitted a supplementary affidavit in March 2016. The government delayed its response, missing three deadlines and compelling SAFCEI and ELA to issue a rule 30A notice, which gave the government until 31 May 2016 to respond. The government's answering affidavit was finally received, but it failed to include 10 documents that had been referenced in the affidavit. When lawyers requested these documents, the government refused.⁵

SAFCEI and ELA signed the last affidavit on September 15 and the dispute goes to court on December 13–14. The organizations contend that the case is about the requirements for lawful, procedurally fair, rational, statutory and constitutional decision making.⁶

SAFCEI and ELA allege that legal documents in their possession indicate that South Africa signed a binding nuclear deal with Russia to supply the reactors, and that the Russian agreement was entered into unlawfully. Russian nuclear firm Rosatom issued a press release in 2014 saying that it had been chosen to supply reactors, but quickly back-tracked.⁷

The *Mail & Guardian* editorialized in February 2015 that the bilateral agreement "is a lopsided, murky and legally fraught arrangement that hands most of the aces to Russia's state-owned nuclear company and carries significant risks for South Africa. ... Acting as if there

are no other possible vendors, the agreement is heavily tilted to feather Rosatom's bed and minimise its risk. The Russians are indemnified against nuclear accidents and promised a host of regulatory and tax concessions."⁸

Further evidence of the government's obsessive secrecy came with Energy Minister Tina Joemat-Pettersson's rejection of an appeal by the Open Democracy Advice Centre – acting on behalf of the *Business Day* newspaper – against her department's refusal to grant access to documents relating to government's nuclear procurement plans. The centre requested access to three reports – on nuclear procurement models, the cost of nuclear plants, and financing models.⁹

Delay

On September 7, Joemat-Pettersson said in Parliament that the government would issue the formal 'request for proposals' (RFP) on September 30, kicking off the tendering process. But the RFP was not issued on September 30. The *Rand Daily Mail* portrayed the delay as another indication of President Jacob Zuma's diminishing influence, and suggested that the nuclear project will be scaled down, if it goes ahead at all.¹⁰

There are divisions within the government regarding the scale of the nuclear new-build project, the timing, the cost, whether Zuma's preference for a deal with Rosatom should be allowed to prevail or whether a genuine tendering process should proceed, and whether the procurement should be led by the Department of Energy or energy utility Eskom. Until now the department has been the procuring agent while Eskom, which is the designated owner-operator of nuclear energy plants, watched from the sidelines.

The two leading opposition parties, the Democratic Alliance (DA) and the Economic Freedom Fighters, have expressed strong criticism of the planned nuclear build. Gordon Mackay, the DA's energy spokesperson, said the delay in issuing the RFP was linked to efforts to hand the procurement process to Eskom:¹¹

"This must be seen for what it is – a blatant attempt by the Zuma administration to: side-line parliamentary oversight of the nuclear new build programme; block public debate on the need for additional nuclear capacity; create a veil of secrecy around the procurement process which would now be subject to internal Eskom processes and procedures; give President Jacob Zuma greater control of the nuclear procurement process."

"Designating Eskom as the procuring agent of the state will fundamentally limit the role and capacity of Parliament to oversee the nuclear deal and, in doing so, increase the potential of corruption surrounding the trillion rand deal. The DA rejects any attempt to designate Eskom, headed by CEO and Gupta buddy, Brian Molefe, as the procuring agent for nuclear. Eskom has proven with Medupi and Kusile that it is unfit to manage mega-projects. It has also proven that its governance procedures are lax and the Supreme Court of Appeal has found its Board Tender Committee to be corrupt."

There is also speculation that the state-owned South African Nuclear Energy Corporation (NECSA) could play a greater role.¹² NECSA has been involved in two



court actions over allegations of corporate governance breaches over the past year.¹³ The Auditor-General found that NECSA incurred R128 million (US\$9.4m; €8.4m) in irregular expenditure in the 2015 financial year because it failed to comply with the government's procurement regulations. NECSA management and its board are currently being investigated by a taskforce appointed by the Energy Minister. The investigation relates to "serious mismanagement", the Auditor-General said.¹⁴

Who pays?

The lowest of the estimates of the capital cost of the 9.6 GW nuclear build is around US\$50 billion.¹⁵ South Africa is in no position to be stumping up that amount of capital. It's doubtful whether Rosatom would be able or willing to provide the capital under its Build-Own-Operate (BOO) model given Rosatom's other commitments at home and abroad.

The levelized cost of electricity for new nuclear is calculated to be R1,30 per kWh by EE Publishers, rising to R1,52 per kWh if fuel, operating and maintenance costs are included. That compares unfavorably with wind (R0,69 per kWh) and solar (R0,87 per kWh).¹⁵ Likewise, the Council for Scientific and Industrial Research estimated the levelized cost of electricity from nuclear power to be R1/kWh compared to R0.60/kWh for wind and R0.80/kWh from solar PV.¹⁶

While the nuclear program makes little economic sense for South Africa, it could be hugely profitable for corrupt politicians and corporate spivs. South Africa has been rocked by numerous corruption scandals, such as the payment of around US\$300 million in bribes associated with an Arms Procurement Deal. Andrew Feinstein, executive director of Corruption Watch UK (and a former ANC MP) said he feared the corruption associated with the nuclear deal "might dwarf the arms deal".¹⁷

The Right2Know Campaign said the nuclear program "commits us to a dangerous technology, and has all the hallmarks of the corrupt arms deal – the risk of massive corruption-prone foreign tenders that have the potential of indebting us to foreign companies and rob the country of funds for service delivery and job creation."¹⁸

An investigation by the *Rand Daily Mail* summed up the nuclear program: "Zuma has assumed personal control of the nuclear programme, and it has been characterised by: secret meetings; undisclosed documents and classified financial reports; deceit;

aggressive campaigning; damage control exercises; illegality; use of apartheid ('national key-point') legislation; sidestepping of Eskom's technical and financial oversight; destruction of oversight organs of state; disregarding of industry experts; refusal of public consultation; ignoring of the ANC's national executive committee (NEC) and ANC resolutions; and the removal

of any government opponents, the most notable of whom was [former Finance Minister Nhlanhla] Nene."¹⁷

Pro-nuclear commentator Dan Yurman's December 2014 warning has come to pass: "Almost no one believes that as long as Zuma is in power that anything remotely resembling an orderly procurement process is likely to take place."¹⁹

References:

1. SAFCEI, 13 Sept 2016, 'Court papers & press releases from SAFCEI/ELA court case', <http://nuclearcostssa.org/?p=3488>
2. SAFCEI, 14 Sept 2016, 'SAFCEI & ELA Jhb's Nuclear Campaign and Court Case', <http://nuclearcostssa.org/?p=3491>
3. SAFCEI, 15 Oct 2016, 'Press Release: Court Action', <http://safcei.org/press-release-court-action/>
4. SAFCEI, 30 March 2016, 'Court case exposes web of secrecy in government nuclear dealings', <http://nuclearcostssa.org/?p=3192>
5. SAFCEI and ELA, 18 Aug 2016, 'Nuclear court case – more missing documents requested', <http://nuclearcostssa.org/?p=3450>
6. SAFCEI, 16 Sept 2016, "See you in Court", <http://nuclearcostssa.org/?p=3504>
7. SAFCEI, 21 Sep 2016, 'Civil bodies a step closer in nuclear deal challenge', <http://nuclearcostssa.org/?p=3522>
8. Mail & Guardian, 13 Feb 2015, 'Editorial: 'Atomic Tina' blows SA away', <http://mg.co.za/article/2015-02-12-atomic-tina-blows-sa-away>
9. Linda Ensor, 22 March 2016, 'Access to nuclear documents denied once again', www.bdlive.co.za/business/energy/2016/03/22/access-to-nuclear-documents-denied-once-again
10. Ray Hartley, 30 Sept 2016, 'Signs of a great rift over Zuma's nuclear programme', www.rdm.co.za/politics/2016/09/30/politics-live-signs-of-a-great-rift-over-zuma-s-nuclear-programme
11. Gordon Mackay, 30 Sept 2016, 'South Africa: Nuke RFP Delayed in Order to Give Eskom Greater Say and Avoid Parliamentary Scrutiny', <http://allafrica.com/stories/201609300697.html>
12. 30 Sept 2016, 'South Africa: Nuclear Plan On Ice As Eskom May Take Ownership', <http://allafrica.com/stories/201609300935.html>
13. The Times Editorial, 28 Jan 2016, 'Step one: Sort out the mess at the nuclear corporation', www.timeslive.co.za/thetimes/2016/01/28/Step-one-Sort-out-the-mess-at-the-nuclear-corporation
14. Linda Ensor, 27 Sept 2016, 'Nuclear corporation's spending comes under scrutiny of Auditor-General', www.timeslive.co.za/local/2016/09/27/Nuclear-corporations-spending-comes-under-scrutiny-of-Auditor-General
15. Chris Yelland, 1 Aug 2016, 'Study of the capital costs and the cost of electricity from new-nuclear in SA', www.ee.co.za/article/study-capital-costs-cost-electricity-new-nuclear-sa.html
16. www.bdlive.co.za/business/energy/2015/07/29/revealed-real-price-of-nuclear-energy
17. Lily Gosam, 2 Feb 2016, 'Zuma, the Guptas and the Russians – the inside story', www.rdm.co.za/politics/2016/02/02/zuma-the-guptas-and-the-russians--the-inside-story
18. 26 Sept 2016, 'Nuclear deal 'has the hallmarks of the corrupt arms deal'', www.biznews.com/briefs/2014/09/26/nuclear-deal-hallmarks-corrupt-arms-deal/
19. Dan Yurman, 6 Dec 2014, 'China jumps into the action in South Africa', <http://neutronbytes.com/2014/12/06/china-makes-haste-to-develop-its-nuclear-energy-future/>

NUCLEAR NEWS

Pensioner holds up transportation of nuclear warheads

77-year-old anti-nuclear campaigner Brian Quail and his colleague Alasdair Ibbotson managed to hold up four trucks thought be carrying nuclear warheads on September 14, by simply flagging them down and then crawling underneath. The trucks had left the Atomic Weapons Establishment Burghfield near Reading, England before making their way to Scotland. But in Stirling, Scotland, Quail and Ibbotson managed to hold up the convoy for 15 minutes.

Quail, a retired teacher, has a successful track record when it comes to stopping convoys carrying warheads. In March this year he held up at least four 100 kiloton nuclear warheads being taken through Scotland using a pedestrian traffic crossing.

www.thenational.scot/news/anti-nuclear-pensioner-holds-up-transportation-of-nuclear-warheads-again.22439

S&P warns European utilities' nuclear liabilities have "shot up"

Standard & Poor's said on September 27 that European utilities' nuclear liabilities "shot up" over the past 18 months and have moved "well beyond" the €100bn (€86bn) mark.¹ The credit ratings agency warned that

long-term liabilities are becoming more short-term and sometimes carry immediate funding needs.

The situation could worsen if further weakness in power prices results in more reactor closures. "We think provisions are poised to increase to cover the costs of decommissioning works and disposing of nuclear waste," S&P Global ratings analyst Pierre Georges said.

It represents another problem for a sector which is already struggling with diminishing profitability and cash flow. S&P has six of Europe's main nuclear operators on a negative outlook, meaning they could be subject to future downgrades.

Meanwhile, EU plans for financing the decommissioning of nuclear plants in Bulgaria, Lithuania and Slovakia are inadequate and more resources need to be put aside, the European Court of Auditors said in a report.² The report criticized costly delays and warned of technical hurdles ahead. The EU's spending watchdog said the estimated cost of decommissioning the three Soviet-era plants, closed more than a decade ago, had risen 40% since 2010 to at least €5.7 billion euros. That figure doubles if the cost of final disposal of spent fuel is included.

According to EU Commission data, only three out of the 91 reactors shutdown in Europe have been fully dismantled. A working paper by the European

Commission, seen by Reuters in February, showed the bloc was short of more than €118 billion needed to dismantle its nuclear plants.

1. 27 Sept 2016, www.cityam.com/250169/sp-warns-european-utilities-nuclear-liabilities-have-shot

2. 20 Sept 2016, www.reuters.com/article/us-eu-nuclearpower-idUSKCN11Q12A

Nuclear Power: Game Over

Professor Derek Abbott, a physicist and electrical engineer at the University of Adelaide, Australia, shows why the pipe-dreams of the pro-nuclear propagandists are precisely that. Using a wealth of empirical data illustrating global trends, he ably debunks the pro-nuclear arguments. Beyond Nuclear summarizes some of Prof. Abbott's key points:

On China: "Nuclear apologists point to China as a role model that is actively building a number of NPPs. The fact is that China has built \$160 billion in overcapacity of coal plants that are unused. Will their NPPs [nuclear power plants], which are presently under construction, become similarly redundant? ... By contrast, in 2015, China invested five times more in renewables than nuclear power. Those nuclear projects will take many years to complete, whereas renewables are deployed and put to immediate use."

Getting uranium from seawater "is a fruitless suggestion as the uranium concentration is tiny, at 3.3 parts per billion. The energy it takes to lift a bucket of sea water 50 metres is equal to the energy you'd get from the uranium."

Nuclear vs. renewables: "Nuclear power is large and centralised, with enormous entry and exit costs. By contrast, renewables are made up of small modular units that yield a faster return on investment. The revolution we are witnessing is akin to the extinction of big powerful dinosaurs versus resilient swarms of small ants working in cooperation."

Nuclear can't solve renewable intermittency: "Generators designed for constant baseload operation are exactly what uncontrollable renewable generators don't need. Uncontrollable renewables need flexible controlled sources of power such as hydroelectric power, pumped hydro, waste biofuels, solar thermal, and solar generated hydrogen or syngas to provide power when generation from intermittent renewable sources is insufficient to meet demand. Nuclear power plants work best when they provide constant power output and they lack the agility to follow the variability of renewable generators."

Nuclear is not needed to solve grid instability: "First, nuclear power is not needed because controllable renewable sources ... already stabilise the grid. It is true that other renewable sources do give rise to grid management issues, but this is bread and butter for grid engineers. There are numerous research papers by grid engineers developing solutions for increased renewable penetration and none are suggesting the need for nuclear power."

The full article is online: Derek Abbott, Oct–Dec 2016, 'Nuclear Power: Game Over', Australian Quarterly, www.beyondnuclear.org/storage/publications/NuclearPower_GameOver_DerekAbbott.pdf

AREVA / EdF safety scandal escalates

Greenpeace reports:

Greenpeace France published a report on September 29 on the safety crisis affecting much of the EdF reactor fleet due to the AREVA carbon steel scandal. The report by consulting engineers Large & Associates of London, focuses on the Flamanville EPR, on steam generators installed in EdF reactors with carbon contents in excess of regulations and finally the anomalies and falsification at the AREVA le Creusot Forge.

After several months of investigation, the conclusion reveals the gravity of the situation: a total of 28 nuclear reactors are affected by the crisis, with at least 18 EdF reactors classified as operating at risk of major accident due to carbon anomalies in steam generators, for a total of 44% of French nuclear capacity under suspicion.

Large & Associates obtained documents from the IRSN (French Institute for Radio-protection and Nuclear Safety) that rejects AREVA/EdF's assurances that there is no safety risk from steam generators with excess carbon. The IRSN warned the ASN that there is a risk of rupture which could lead to a reactor core fuel melt.

"As a result of AREVA's failures, a significant share of the French nuclear reactor fleet is at increased risk of radiological accident, including fuel core meltdown," said John Large of Large & Associates. "However, there is no simple or quick fix to this problem. The testing and inspection regime currently underway by AREVA and EdF is incapable of detecting the extent of the carbon problem and cannot ensure against the risk of rapid component failure. It is most certain that the IRSN finding will equally apply to replacement steam generators exported by AREVA to overseas nuclear power plants around the world."

The report shows that the reactor pressure vessel heads of the Flamanville EPR, which are already installed, do not have a certificate of conformity issued by the French regulator, ASN. Large demonstrates that the only sure way to ensure Flamanville EPR complies with certification standards would be to remove the two heads and install replacements.

Shaun Burnie, nuclear specialist at Greenpeace Germany, said: "In addition to the reactors at clear risk of accident, EdF plans for new AREVA steam generators must be halted given the scale of what is being uncovered and the implications for nuclear safety. Quality control and compliance procedures have been thrown out the window by AREVA, leading to what we consider the largest ever crisis in the French nuclear industry, and with no end in sight."

Large & Associates, Sept. 2016, 'Review: Irregularities and Anomalies Relating to the Forged Components of Le Creusot Forge', www.greenpeace.org/france/PageFiles/266171/Note_LargeAndAssociates_EN_26092016.pdf

Oliver Tickell, 29 Sept 2016, 'Sizewell B and 27 other EDF nuclear plants 'at risk of catastrophic failure'', www.theecologist.org/News/news_analysis/2988175/sizewell_b_and_27_other_edf_nuclear_plants_at_risk_of_catastrophic_failure.html



Protesters converged on Pine Gap in late September. Pine Gap is a US spy and communications base in central Australia that ties Australia to US nuclear war-mongering. www.closepinegap.org

Standard and Poor downgrade EdF over Hinkley

EdF's credit rating has been downgraded after the UK government's decision to approve the Hinkley Point C reactor project. The heavily indebted French company, 85% owned by the French government, has had its rating chopped from A/A-1 to A-/A-2 by Standard & Poor's, the US ratings agency, leaving it four notches above junk status.¹ S&P believes that the risk of constructing the two-reactor plant is high and the huge investment will strain EdF's already overstretched balance sheet. However, S&P issued a "stable" outlook on the group, reflecting the French government's decision to help to stabilise its finances. That was an improvement on a previous "negative" outlook.

Moody's has also downgraded EdF credit ratings across a spectrum of credit instruments.² EdF's long-term issuer and senior unsecured ratings fell from A2 to A3 while perpetual junior subordinated debt ratings fell to Baa3 from Baa2. Moody's also downgraded to Prime-2 from Prime-1 the group's short-term ratings.

According to Moody's, "the rating downgrade reflects its view that the action plan announced by EdF in April 2016, which includes government support, will not be sufficient to fully offset the adverse impact of the incremental risks associated the Hinkley Point C (HPC) project on the group's credit profile. Moody's believes that the significant scale and complexity of the HPC project will affect the group's business and financial risk profiles. This is because the HPC project will expose EdF and its partner China General Nuclear Power Corporation (CGN, A3 negative) to significant construction risk as the plant will use the same European Pressurised reactor (EPR) technology that has been linked with material cost overruns and delays at Flamanville in France and Olkiluoto 3 in Finland. In addition, none of the four plants using the EPR technology currently constructed globally is operational yet."

1. www.thetimes.co.uk/edition/news/hinkley-cost-hits-edfs-credit-rating-9hvb7k

2. Oliver Tickell, 29 Sept 2016, 'Sizewell B and 27 other EDF nuclear plants 'at risk of catastrophic failure'', www.theecologist.org/News/news_analysis/2988175/sizewell_b_and_27_other_edf_nuclear_plants_at_risk_of_catastrophic_failure.html

WISE/NIRS Nuclear Monitor

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

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

WISE and NIRS joined forces in the year 2000, creating a worldwide network of information and resource centers for citizens and environmental organizations concerned about nuclear power, radioactive waste, proliferation, uranium, and sustainable energy issues.

The WISE / NIRS Nuclear Monitor publishes information in English 20 times a year. The magazine can be obtained both on paper and as an email (pdf format) version. Old issues are (after 2 months) available through the WISE homepage: www.wiseinternational.org

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