

# NUCLEAR MONITOR

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A PUBLICATION OF WORLD INFORMATION SERVICE ON ENERGY (WISE)  
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Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor:

- We discuss the fluid situation with energy policy in France following the election of Emmanuel Macron as President and his appointment of an environmental campaigner as environment minister;
- Jan Haverkamp discusses the European Commission's first attempt at an overview of national nuclear waste programmes in EU countries;
- We look at South Korea's nuclear program in detail, debunking claims by nuclear lobbyists that South Korea provides a model that other nations should follow;
- We summarize the systemic forgery and bribery scandal that has rocked South Korea's nuclear industry since 2012 and has led to a sharp decline in public and political support;
- David Elliot summarizes key themes in his new book, 'Nuclear Power: Past, Present and Future'.

The Nuclear News section has reports on an upcoming cross-country protest against dangerous reactors in Belgium, and a referendum in Switzerland which approved a nuclear power phase-out.

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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## France: energy policy in flux

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**NM844.4646** On May 17, incoming French President Emmanuel Macron appointed well-known environmentalist Nicolas Hulot as the new environment minister, with responsibilities including energy policy, sparking a 7% drop in the share price of nuclear utility EDF.<sup>1</sup> Hulot supported Macron's left-wing rival Jean-Luc Melenchon in the recent presidential election.

Interviewed in April, Hulot said: "While elsewhere the energy transition accelerates, EDF gets closer to Areva, overinvests in costly nuclear projects like Hinkley Point, and does not invest enough in renewables."<sup>2</sup> After his ministerial appointment, Hulot said that he would advance the 2015 legislation that calls for nuclear power's contribution to electricity supply to be reduced from 75% to 50% by 2025:



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"In 2025, the share of nuclear compared to what it was yesterday and not tomorrow must be 50 percent."<sup>3</sup>

President Macron has repeatedly stated his intention to support the expansion of renewables by simplifying authorization processes, initiating a tender for 26 gigawatts of new renewable energy capacity by 2022, encouraging research and investment into energy storage and smart grids, and other measures.<sup>4,5</sup>

However Macron's statements about nuclear power have been somewhat cryptic. In February, he said decisions on the reactor fleet will be made toward the end of 2018 or the beginning of 2019, once the nuclear safety authority ASN outlines its conditions for approving reactor lifespan extensions.<sup>6</sup>

In May, after the presidential election, Macron said he plans to pursue the 50% nuclear target by 2025 but “nobody knows, concretely, how to do this”.<sup>7</sup> (He could start with the April 2015 report by ADEME, a French government agency under the Ministries of Ecology and Research, which shows that 100% renewable electricity supply by 2050 in France is feasible and affordable.<sup>8</sup>)

In early May, a source close to the Macron campaign team told *Reuters* that the 2025 timeline to reduce nuclear to 50% might be delayed, only for an official spokesperson for Macron to reaffirm the 2025 timeline.<sup>2</sup>

Macron as Economy Minister oversaw EDF’s recapitalisation and its alliance with Areva, and he was a strong backer of the Hinkley Point project in the UK.<sup>9</sup> And he recently appointed Edouard Philippe as the new Prime Minister – Philippe worked for Areva from 2007 to 2010.<sup>1</sup>

Charlotte Mijeon from Sortir de Nucleaire, a federation of French anti-nuclear groups, said: “Macron’s government is not strictly anti-nuclear. During his time as the minister of economy Macron was pushing forward the construction of a nuclear plant in Great Britain. And Prime Minister Edouard Philippe worked as the Director of Public affairs in AREVA. So we can’t expect them to be favorable of energy transition.”<sup>10</sup>

Suzanne Dalle from Greenpeace France also expressed skepticism: “We feel like this nomination of Huloth might be an ecological oasis in a desert. We don’t know if he will get the power he needs to put in place interesting [policy measures] for the environment.”<sup>11</sup>

After National Assembly elections in June, Macron’s party will likely form a governing coalition and the make-up of that coalition will shape energy policy.

French BFM television reported on May 22 that it had an internal EDF document outlining the utility’s plan to extend the lifespan of the country’s reactors by 10–20 years, to delay the reduction of nuclear’s share of power supply to 50%, and to build 25 new power reactors.<sup>11</sup> EDF said on its official Twitter account that it denied the “malicious rumors about the existence of a secret plan which sets back the 50 percent nuclear target to 2050.”<sup>12</sup>

But it’s no secret that EDF is lobbying for a nuclear future. After Macron was elected, EDF’s Chief Financial Officer Xavier Girre said that EDF “was hoping to convince the Macron government to introduce state subsidies for new nuclear plants, modelled on the British “Contracts for Difference” (CfD) scheme under which EDF is planning to build two nuclear reactors in Hinkley Point, Britain.”<sup>9</sup>

*Reuters* reported on May 3, citing a “source close to the Macron campaign team”, that Macron is considering a CfD scheme.<sup>13</sup> EDF is also seeking many tens of billions of euros from taxpayers for reactor safety upgrades, lifespan extensions, decommissioning, waste management, paying for its share of the Hinkley Point project, contributing to the costs of the EDF/Areva restructuring, and perhaps one day paying off its €37 billion debt.

## Legal challenges

Greenpeace is filing a complaint with the European Commission arguing that the French government’s recapitalization of EDF amounts to illegal state aid

for the utility’s plan to build nuclear reactors at Hinkley Point.<sup>14</sup> Greenpeace said the €3 billion capital injection for EDF in March 2017, plus €3.8 billion of foregone dividends since 2015 (the state took a share dividend instead of a cash dividend) are incompatible with European Union competition law. The EU has investigated and cleared the French state’s capital increase and financial rescue package for Areva and has to date raised no objections over the recapitalization of EDF.

In April 2017, Greenpeace and other anti-nuclear groups filed a legal challenge against the extension of EDF’s licence for the construction of the Flamanville reactor in northern France.<sup>15</sup> The move was in response to safety concerns over the EPR reactor under construction in Flamanville. The groups said in a statement that the licence, issued in 2007 and renewed this year, should not have been granted because EDF and Areva were aware of technical shortcomings at Areva’s Creusot Forge nuclear foundry since 2005. Nuclear regulator ASN is investigating whether the irregularities threaten the safety of the reactor and whether EDF can proceed with Flamanville’s start-up in 2018 as planned. ASN says a decision will be made by 21 September 2017 at the latest.

“For more than 10 years, EDF and Areva allowed the manufacturing of faulty components for nuclear plants, including for the EPR in Flamanville, and the ASN has allowed this,” the group’s statement said.<sup>15</sup> One member of the group, l’Observatoire du Nucléaire, said in a separate statement that ASN committed a major error in December 2013 by allowing EDF to install the reactor containment vessel in the Flamanville reactor despite being aware of the problems: “This is an unacceptable option for EDF, which is putting maximum pressure on the ASN to force it to validate the use of this faulty vessel.”<sup>15</sup>

In mid-April, ASN defined the preconditions for the resumption of operations at Creusot Forge.<sup>16</sup> The facility has been out of operation since December 2015 following the discovery of quality assurance problems including “irregularities” in paperwork on some 400 plant components.

There are three processes currently under way, ASN said in April:<sup>17</sup>

- the search for technical anomalies on other EDF reactor components similar to those detected on the Flamanville EPR vessel, which has enabled EDF to identify similar anomalies on the channel heads of certain steam generators;
- manufacturing quality reviews on parts at Areva manufacturing plants; and
- initiation of a review of basic nuclear installation licensee monitoring of their contractors and subcontractors, of ASN oversight and of alert mechanisms.

In a January 31 letter to Areva, ASN said its considered a certain number of subjects needed to be adapted and supplemented by Areva, such as management of change, human resources, exhaustiveness of root cause analyses, detection of irregular practices, reviews of manufactured component files, management of current manufacturing processes, internal monitoring by Creusot Forge and the nuclear safety culture.<sup>16</sup>

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# European Commission publishes first report on national nuclear waste programmes

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**NM844.4647** Euratom Directive 2011/70/EURATOM prescribes that Member States of Euratom have to submit comprehensive data about their radioactive waste and waste management plans. Yet the European Commission's first attempt at an overview, published in a report<sup>1</sup> released May 15, is limited because different countries use different definitions, and most countries have not even started to calculate future waste production.

Issues of concern include the lack of sufficient funds for radioactive waste management, the lack of reflection on the fact that no final disposal technologies have been implemented for high-level waste, and the tendency of half of the Member States to want to find final solutions outside of their own borders.

The move from the European Commission to accept the option of shared / regional disposal options as acceptable is a highly worrying development. Especially since many of the Member States are still creating more radioactive waste and have no plans to minimise its production, for instance by a phase-out of the largest source of these wastes – nuclear power generation. The Commission also found that those that seem to want to rely on regional solutions lag behind in the necessary research and planning for waste management. The Commission shows some implicit

concerns (of course, never too explicit), and concludes that any such consideration should be accompanied by maximum transparency and public participation.

The delays in the planning of the start of operation of the potentially first high-level waste disposal repositories – in Finland (from 2020 to 2022), Sweden and France (both from 2025 to 2030) – is a welcome indication that some sense of realism is entering this field. It has to be remarked, however, that all three programmes still need to overcome essential technological and social hurdles. It is especially interesting to see the delay for Sweden, where Finland is relying on the technology that is still under development in Sweden and the primary cause for the delays.

There are a lot of implicit warnings in this generally rather critical overview by the European Commission – especially since the Commission is usually so diplomatic. But the Commission shies away from its official mandate to point out to Member States that they have an obligation under the Aarhus Convention and EU law to take the information in this report and from procedures including public participation into account not only in future reporting (as the Commission does now), but also in concrete decisions. Among others, decisions concerning new nuclear projects and life-time extension of existing reactors.

There are several issues where Member States seem to stick their heads in the sand. For instance, concerning the question as to whether there are sufficient human resources and skills available to deal with the nuclear legacy. The indications on this question in the national reports are only sketchy. Another one is the independence of the national regulator who has to oversee the quality of radioactive waste management. Every Member State declares that this independence is guaranteed, but practice shows that that issue is far more complicated and depends on factors like availability of independent experts, sufficient financial resources, access to sufficient independent research capacity, a well-established culture of transparency and public participation, including safeguards against co-optation.

There is a fundamental disconnect between the information provided by Member States about financial reserves for radioactive waste management and other Commission information. According to this Commission report, Member States – including those with nuclear power programmes – claim to have adequate reserves in place. However, the European Commission's PINC report published on 12 May 2017 on upcoming investments in the nuclear sector until 2050 still flags

a shortfall of €130 billion in reserves for decommissioning and waste management (€133 billion allocated, barely half of the estimated €263 billion required).<sup>2</sup>

Given the realities in countries where the issue of radioactive waste costs has come to real calculations – e.g. Germany and the UK – the need for government guarantees and buy-outs shows that this gap is real. The Commission indicates that it received insufficient information to be able to properly estimate whether sufficient funds have been set aside and will be available when needed. That some Member States now already declare that they might be depending on EU funding is a bad sign.

This European Commission report was long awaited and its outcomes support the worst fears. Even after almost 70 years of nuclear technology in Europe and research investments costing hundreds of millions of euros, the continent is only scratching the surface of what it needs to do to solve the nuclear legacy.

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## Is South Korea's nuclear industry a model for others to follow?

**Author:** *Jim Green – Nuclear Monitor editor*

**NM844.4648** As the nuclear power crisis has unfolded in recent months – engulfing major nuclear companies and utilities in the US, Japan and France – South Korea's nuclear industry has been held up as a model for others to follow. US nuclear lobbyist Michael Shellenberger, for example, explains 'why Korea won': "Korea is winning the global competition to build new nuclear plants against China and Russia despite being a fraction of the size, at just 50 million people, and energy-poor. It has done so through focus: standard design, standard construction of plants, standard operation and standard regulation."<sup>1</sup>

But South Korea's nuclear industry is scandal-plagued, it hasn't won any bids to build reactors overseas since 2009, and it is more than a stretch to describe it as "world class" as nuclear advocate Rod Adams would have you believe.<sup>2</sup> Public and political support has been in freefall over the past five years because of the Fukushima disaster and a domestic nuclear corruption scandal (see the following article in this issue of the *Nuclear Monitor*). In the coming years, nuclear power's contribution to domestic electricity supply is likely to decline and there is little likelihood that an export

industry will flourish. Moreover, with public support for the nuclear industry in freefall, the government has little hope of achieving its aim of securing a site for a high-level nuclear waste repository by 2028.

*Korea Times* noted on April 21 that every major candidate in South Korea's presidential election promised to stop building new nuclear reactors and to close down older ones.<sup>3</sup> The winner of the May 9 presidential election, Moon Jae-in, who stood as the candidate of the Democratic Party of Korea, is a former human rights lawyer. World Nuclear News reported that Moon was one of seven presidential candidates who signed an agreement in March for a "common policy" to phase out nuclear power.<sup>4</sup> During the election campaign, Moon said he would scrap plans for new reactors – including Shin Kori units 5 and 6 – while immediately closing the Wolsong-1 reactor.<sup>4</sup> (In February 2017, the Seoul Administrative Court ordered the Nuclear Safety and Security Commission to cancel its decision to extend the lifespan of Wolsong-1 because legal procedures had not been followed in the decision-making process.) Moon also said he would block lifespan extensions for the older reactors at the

Kori plant<sup>5</sup> – the four Kori reactors were grid-connected between 1977 and 1985.

Moon said during the election campaign that he believes South Korea will have to phase out all of its remaining nuclear power plants over the next 40 years or so.<sup>3</sup> “I will make South Korea build no more nuclear reactors and close down aged nuclear reactors when their lifespan expire,” Moon said. “Through this, South Korea can arrive at nuclear zero in 2060, and until then, we can develop alternative sources.”<sup>2</sup>

Kim Jwa-kwan, head of Moon’s energy policy team, said after the election that the target is to reduce reliance on nuclear power from the current 30% down to 18% by 2030.<sup>6</sup> Kim also reaffirmed Moon’s pre-election pledge to scrap the planned Shin Kori 5 and 6 reactors.

The 18% target is a huge drop from previous targets. It is less than one-third of the 2030 target of 59% announced by Korea Electric Power Company (Kepeco) in 2011 and well short of the 2035 target of 29% announced by the former government in 2013.<sup>7</sup>

South Korea has 25 ‘operational’ reactors, three under construction, and a further eight are planned according to the World Nuclear Association.<sup>8</sup> In the aftermath of the presidential election, the reactors under construction are in doubt and the prospects for the eight planned reactors are dim. Nuclear power generation and capacity has steadily increased since the 1980s but nuclear’s percentage of total electricity generation has fallen sharply, from 45% in 2005 to 30% today.<sup>9</sup>

President Moon Jae-in is also taking steps to reduce the reliance on coal and to boost renewables. For a month in June 2017, eight aging coal-fired power plants will stop operations. From next year, 10 old coal plants will be shut from March to June when electricity demand is relatively low, and the government plans to close them permanently during Moon’s five-year presidency.<sup>10</sup> The government plans to reduce reliance on coal for power generation from 43% to 25% by 2030 – although an increase in gas-fired power production is also planned.<sup>6</sup>

Moon said during the election campaign that he would aim to raise the proportion of electricity generated from renewables to 20% by 2030. Plans will take shape at the Ministry of Trade, Industry and Energy, which releases its eighth annual report later this year.<sup>11</sup>

### Declining public support

A 2005 IAEA-commissioned survey of 18 countries found that only in South Korea was there majority support for new reactors.<sup>12</sup> But in the aftermath of the Fukushima disaster and South Korea’s nuclear corruption scandal, public support has tanked:

- In 2010, the proportion of South Koreans who considered nuclear power safe was 71% but that number halved to 35% in 2012 according to the Ministry of Knowledge Economy. *Reuters* reported: “The ministry has been sharply criticized for its role as regulator and operator of the country’s nuclear power plants, and one of its subsidiaries was accused of suppressing negative public opinion after the Fukushima disaster by not publishing polls.”<sup>13</sup>

- Likewise, 64% of respondents to a May 2014 survey by the Korea Nuclear Energy Promotion Agency said they consider domestic reactors unsafe, up from 56% in March 2013.<sup>14</sup>
- A May 2011 survey found 61% opposition to nuclear power in South Korea and 68% opposition to new reactors.<sup>15</sup>
- A 2013 poll found that 65.6% percent of respondents were willing to pay higher electricity prices if it meant fewer nuclear power plants.<sup>16</sup>
- Korea Nuclear Energy Agency polling in 2015 found that only 30% favored more nuclear power, compared to 51% in 2009.<sup>17</sup>
- A 2015 poll in Yeongdeok, designated as a nuclear power plant site by the government in 2012, found that opposition to the proposed nuclear plant (62%) doubled support (31%).<sup>16,17</sup>
- A local referendum in October 2014 in Samcheok City, Gangwon Province, resulted in 85% of voters opposing the national government’s plan for a new power reactor in the region.<sup>18</sup>
- All political candidates in the June 2014 elections in Busan, the closest major city to the Kori nuclear plant, called for the closure of unit 1, which has been plagued with safety issues.<sup>7</sup>

In February 2015, *Nuclear Intelligence Weekly* reported that South Korea’s anti-nuclear movement has grown and diversified since the Fukushima disaster in 2011 and gained momentum because of the safety / corruption scandals: “Before the Fukushima disaster, the movement was largely limited to environmental groups and people living near nuclear facilities, who focused on opposing newbuild and radioactive waste disposal sites. Since then it has been joined by consumer groups and women’s associations that are concerned about radioactive contamination in food and other products; religious bodies – mainly Catholic groups and Buddhists; and left-wing political organizations and labor unions that criticize the government’s expansionary nuclear policies.”<sup>19</sup>

Concerns about Fukushima were reawakened in September 2016 when two big earthquakes hit the south-eastern part of South Korea, resulting in the temporary shutdown of four power reactors.<sup>20</sup>

### South Korea’s nuclear exports

South Korea’s nuclear export industry ought to be the big winner from the deep troubles facing competitors such as Toshiba, Westinghouse and the French utilities EDF and Areva. Some hope that South Korea’s Kepeco will take a share in bankrupt Westinghouse. That would theoretically open up a range of export options for South Korea: it would give it a toe-hold in the US, Kepeco might pursue the stalled plan for six AP1000 reactors in India, and so on.

Former World Nuclear Association executive Steve Kidd recently argued that the UK nuclear new-build program should have been put out to tender with the winner building 15 or so identical reactors.<sup>21</sup> He misses the irony that if that happened a decade ago, the likely

winner would have been now-bankrupt Westinghouse. If a similar UK tender was established now, Kidd argues, South Korea would be the likely winner.

In any case, while Kepco may be interested in buying into the NuGen project to build three reactors at Moorside in the UK, Kepco president Cho Hwan-eik was unequivocal in his comments in March 2017 about buying a stake in Westinghouse: “We have no plan to acquire Toshiba’s stake [in Westinghouse]... there is no role for us there”.<sup>22</sup> Moreover, discussions about Kepco buying into NuGen date from 2013 if not earlier, yet nothing has been agreed.<sup>23</sup> And South Korean involvement in NuGen might be affected by the recent election of Moon Jae-in as president.

In 2010, South Korea’s Ministry of Knowledge Economy (now the Ministry of Trade, Industry, and Energy) stated that it aimed to achieve exports of 80 nuclear power reactors worth US\$400 billion by 2030.<sup>24</sup> Yet as the *Financial Times* noted in February 2017, that objective is now viewed as “wildly ambitious” and South Korea hasn’t won a single bid to build reactors since 2009, when it secured the contract to build four reactors in the United Arab Emirates.<sup>25</sup> South Korea has signed nuclear cooperation agreements with at least 27 countries<sup>24</sup> but those agreements aren’t leading to reactor supply contracts.

South Korea’s nuclear cooperation agreement with South Africa was ruled to be illegal by a recent South African High Court ruling. South Korea hoped to export reactors to Vietnam, but Vietnam cancelled its nuclear program last year. South Korea’s attempts to get into the Indian nuclear market have come to nothing.<sup>24,26</sup> South Korea’s plan to build ‘SMART’ small reactors in Saudi Arabia has an air of unreality about it since no other country – including South Korea itself – has built such a reactor (and it’s not hard to imagine the new political leadership in South Korea revisiting the wisdom of selling nuclear technology to Saudi Arabia given the Kingdom’s open interest in developing nuclear weapons). The US Nuclear Regulatory Commission has been slowly assessing South Korea’s APR1400 reactor design but even if that review is completed and successful, there is no prospect of new reactors in the US for the foreseeable future. And on it goes ... South Korea has been in discussions with Indonesia and Malaysia but neither country is likely to pursue nuclear power in the foreseeable future.

A detailed 2015 Brookings Institution paper concluded: “Some of the countries that South Korea is targeting for its nuclear exports are in the early stages of planning nuclear power programs, whereas others are more advanced. Given the poor financial condition of some of these countries and their lack of any kind of nuclear infrastructure, it is far from certain that the ambitious nuclear power programs of many of these countries will be realized.”<sup>24</sup>

The recent presidential election won’t help South Korea’s nuclear export industry. Ongoing domestic experience building reactors is the strongest foundation for an export industry yet plans for new reactors in South Korea will likely be shelved. Nuclear lobbyist Rod Adams said Moon Jae-in “might single-handedly reverse the progress that the Korean Electric Power Company (KEPCO) has

achieved in learning how to build large nuclear plants. If the country stops building reactors at home, it will have substantially more difficulty maintaining its ability to successfully export the technology.”<sup>22</sup> Adams further noted that exporting nuclear power plants “requires substantial up-front financial support from the vendor and its home government”<sup>27</sup> but that financial support is now in jeopardy in the wake of the election result.

### South Korea’s APR1400 reactor design

South Korea’s APR1400 reactor design – its version of long-established pressurized water reactor technology – might be a good fit in the context of the deep troubles facing Toshiba, Westinghouse and the French nuclear utilities. Those troubles demonstrate the need to cut nuclear costs and if that means sacrificing safety, so be it. Steve Thomas noted in a 2014 paper that Korean authorities acknowledge that the APR1400 would not meet US or European requirements, particularly on aircraft crash protection and, for Europe, a core-catcher.<sup>28</sup>

Anne Lauvergeon, the CEO of Areva when the French utility lost its bid to build reactors in the UAE, was scathing about Korea’s winning APR1400 design. *Nucleonics Week* reported: “She mentioned in particular that EPR’s containment was designed to withstand the crash of a large jet aircraft and had a provision to prevent molten corium from penetrating the reactor basemat if the core melted through the reactor vessel. She likened the Korean reactor – which she said had neither such feature – to ‘a car without airbags and safety belts.’”<sup>29</sup>

There is hardly any operating experience with APR1400 reactors. Only one is operating – Shin Kori #3 in South Korea – and that reactor only began commercial operation in December 2016. Three other APR1400 reactors are under construction in South Korea, and four in the UAE.<sup>30</sup>

The safety and forgery scandal that first emerged in 2012 has delayed the APR1400 projects in South Korea. Rod Adams wrote in *Forbes*: “That reactor [Shin Kori #3], the world’s first APR1400 was initially scheduled to begin operating in 2013 and to be in commercial service by mid to late 2014. That plan was perturbed when inspectors in Korea found substandard control and safety system cabling installed in a number of Korean nuclear plants. The investigation eventually revealed that Shin Kori unit 3 had out-of-specification cables installed. The complete cycle of discovery, corrective action determination and cable replacement delayed the commercial operation of Shin Kori unit 3 by more than two years.”<sup>31</sup>

And the delays in South Korea have delayed completion of the APR1400 reactors in the UAE.<sup>32</sup>

The completion of four APR1000 reactors on-time and on-budget in the UAE is held up by nuclear lobbyists to be one of the industry’s best good-news stories. But the reactors may not be completed on time and precious little credible information is available on the cost of the reactors and where the funding is coming from. The 2016 World Nuclear Industry Status Report pulled together available information:<sup>7</sup>

*“At the time of the contract signing in December 2009, with Korean Electric Power Corp., the Emirates Nuclear Energy Corp (ENEC), said that “the contract for the construction,*

commissioning and fuel loads for four units equaled approximately US\$20 billion, with a high percentage of the contract being offered under a fixed-price arrangement". The original financing plan for the project was thought to include US\$10 billion from the Export Import Bank of Korea, US\$2 billion from the Ex-Im Bank of the U.S., US\$6 billion from the government of Abu Dhabi, and US\$2 billion from commercial banks. However, it is unclear what other financing sources have been used for the project, and it is reported that the cost of the project has risen significantly, with the total cost of the plant including infrastructure and finance now expected to be about US\$32 billion, with others putting the cost of the contracts at US\$40 billion, including fuel management and operation, although little independent information is available."

## Security and proliferation

Jungmin Kang and Frank von Hippel, writing in the *Bulletin of the Atomic Scientists* on 15 May 2017, argue that the new political leadership in South Korea should cancel an R&D project into pyroprocessing and fast reactors:<sup>33</sup>

*"One of the first orders of business for South Korea's new political leadership should be the review of a plan – developed and promoted relentlessly by the Korea Atomic Energy Research Institute (KAERI) – to reprocess South Korea's spent nuclear fuel to recover its plutonium and other transuranic elements for fueling sodium-cooled fast-neutron reactors. KAERI's scheme would saddle the country with a hugely costly, dangerous, and futile nuclear enterprise. ..."*

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*"KAERI and the ministry that funds it have been promoting pyroprocessing as a technology that could reduce the volume of high-level radioactive waste requiring deep disposal by a factor of up to 20, the area required for geologic disposal by a factor of up to 100, and the toxicity of the radioactive waste by up to a factor of 1,000, relative to spent fuel. All these claims are false. Pyroprocessing is not a dream technology that can solve South Korea's spent-fuel problem. It is a costly detour to nowhere."*

If South Korea abandoned its reprocessing and fast reactors plans, that might make it somewhat easier to convince Japan and China to abandon their reprocessing plans and to stop the vicious cycle of proliferation of dual-use technologies in north-east Asia.<sup>34</sup>

Another task for the new political leadership is to address the vulnerability of nuclear plants to military strikes, all the more important in the context of heightened tensions with North Korea. *Yonhap News* reported on 16 May 2017 that a report by KHNP noted that South Korea's power reactors have not been designed to deal with military attacks – the outer protective walls were not designed to withstand a missile strike or other forms of concerted attacks.<sup>35</sup>

Kim Jong-hoon, a parliamentarian representing the conservative Liberty Korea Party, said that Seoul was several years behind the US in coming up with safety measures to deal with military and terrorist attacks. "The fact that the country has not taken action in the past is a serious lapse, especially with North Korea's evolving missile threats," Kim said.<sup>35</sup>

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## South Korea's 'nuclear mafia'

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**NM844.4649** In May 2012, five engineers were charged with covering up a potentially dangerous power failure at the Kori-1 reactor which led to a rapid rise in the reactor core temperature.<sup>1</sup> 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.

Then in November 2012, a much bigger and broader scandal emerged involving fake safety certifications for reactor parts, sub-standard reactor parts, and bribery.<sup>2,3</sup>

Here's a bland summary of the scandal from the World Nuclear Association:<sup>4</sup>

*"In 2012 KHNP [Korea Hydro & Nuclear Power] discovered that it had been supplied with falsely-certified non-safety-critical parts for at least five power reactors. The utility told the ministry that eight unnamed suppliers – reportedly seven domestic companies and one US company – forged some 60 quality control certificates covering 7682 components delivered between 2003 and 2012. The majority of the parts were installed at Hanbit (Yonggwang) units 5 and 6, while the rest were used at Hanbit units 3 and 4 and Hanul (Ulchin) unit 3. Hanbit units were taken offline while the parts were replaced.*

*"Then in May 2013 safety-related control cabling with falsified documentation was found to have been installed at four reactors. The NSSC [Nuclear Safety and Security Commission] ordered KHNP immediately to stop operation of its Shin Kori 2 and Shin Wolsong 1 units and to keep Shin Kori 1, which has been offline for scheduled maintenance, shut down. In addition, the newly-constructed Shin Wolsong 2, which was awaiting approval to start commercial operation, could not start up. All would remain closed until the cabling has been replaced, which was expected to take about four months. Shin Kori 1&2 and Shin Wolsong 1 were cleared to restart in January 2014. Completion of Shin Kori 3&4 was delayed, to 2015, due to the need to replace control cabling which failed tests. In October 2013 about 100 people were indicted for their part in the falsification of documentation."*

The Korea Institute of Nuclear Safety states:<sup>5</sup>

- 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', with the legitimacy of a further 43 seismic reports '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, and according to a whistleblower, equipment had actually failed under Loss-Of-Coolant-Accident conditions during at least one concealed test.<sup>6</sup>

The situation in Korea was much the same as that in Japan prior to the Fukushima disaster – except that Japan's corrupt nuclear establishment is known as the 'nuclear village'<sup>7</sup> whereas South Korea's corrupt nuclear establishment is known as the 'nuclear mafia'.<sup>8</sup>

A 2014 parliamentary audit revealed that the temporary suspension of the operations of nuclear power plants after the scandal caused the loss of 10 trillion won (US\$8.9 billion).<sup>9</sup> It also led to power shortages that contributed to growing public opposition to the nuclear industry.

Nuclear lobbyist Will Davis wrote this summary of the scandals in 2014:<sup>10</sup>

*"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. A massive program to find all such parts and associated companies and persons was launched and pressed with a vigor and aggression not normally seen in industrially related investigations.”*

The corruption also affected South Korea’s reactor construction project in the United Arab Emirates.<sup>11</sup> Hyundai Heavy Industries employees offered bribes to KHNP officials in charge of the supply of parts for reactors to be exported to the UAE.

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.<sup>12</sup> 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.”<sup>12</sup>

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.<sup>9</sup>

The scandal was still on the boil in 2014. *Korea Times* reported on 25 June 2014:<sup>8</sup>

*“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 on 10 May 2017: “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.”<sup>13</sup>

Japan’s corrupt ‘nuclear village’ survived the political fallout of the Fukushima disaster and is back in charge.<sup>14</sup> 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.

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# Back to the future: old nukes for new

*Nuclear Power: Past, Present and Future*

David Elliott

May 2017, 80 Pages

Morgan & Claypool Publishers

Available for purchase as a paperback or ebook from <http://bit.ly/2pIIX9Q>

**NM844.4650** In his latest book, David Elliott – who worked initially with the UK Atomic Energy Authority and is now an Emeritus Professor at The Open University – offers both a history and analysis of nuclear power. That's quite an accomplishment in a short (80-page) book. 'Nuclear Power: Past, Present and Future' is particularly useful in its discussion of 'Generation IV' nuclear power concepts, many of which were studied and discarded decades ago. To purchase the book (and read a sample chapter) visit: <http://bit.ly/2pIIX9Q>

Here David discusses some key themes in his book:

In 1965, Fred Lee, the UK's then Minister of Power, famously told the House of Commons that 'we have hit the jackpot this time,' with the Advanced Gas-cooled Reactor (AGR). That was maybe a reference back to an earlier episode, when expansive claims were made that the ZETA nuclear fusion test plant heralded a global breakthrough – it didn't. Unfortunately, things also went very wrong as the AGR programme unfolded. The first station, on the south Kent coast, was Dungeness B. It was ordered in 1965, but did not start up until 1982, over 17 years later, by which time its cost had reached more than five times the initial estimate, and its output had been scaled down by over 20%. In 1985, two decades after the original order, the second reactor at the station had only just started up. Atomic Power Constructors, the company that won the Dungeness B contract in 1965, had by 1970 collapsed in total technical, managerial and financial disarray.

Project disasters like that might be seen as part of the learning process, though the UK seems hell bent on a repeat, with EDF's £24bn Hinkley EPR project, to be followed perhaps by more, with a variety of new 'first of kind' reactors projects being proposed. As Peter Atherton put it in evidence to a Lords committee: 'we will be building four different reactor types, with at least five different manufacturers, simultaneously. That is industrial insanity'.

While some nuclear enthusiasts hope that these Generation III reactors, like the EPR or its rivals, will be successful, there is also pressure to move on to new technology and so called Generation IV options, including liquid sodium-cooled fast neutron breeder reactors, helium-cooled high temperature reactors and thorium-fuelled molten salt reactors, at various scales. As I describe in my new book *Nuclear Power: Past, Present and Future*, many of them are in fact old ideas that were looked at in the early days and mostly abandoned. There were certainly problems with some of these early experimental reactors, some of them quite dramatic.



The Superphénix reactor in France was meant to be the world's first commercial fast reactor, but in the 13 years of its miserable existence it rarely operated.

Examples include the fire at the Simi Valley Sodium Reactor in 1959, and the explosion at the 3MW experimental SL-1 reactor at the US National Reactor Testing Site in Idaho in 1961, which killed three operators. Better known perhaps was and the core melt down of the Fermi Breeder reactor near Detroit in 1966. Sodium fires have been a major problem with many of the subsequent fast neutron reactor projects around the world, for example in France, Japan and Russia.

For good or ill, ideas like this are back on the agenda, albeit in revised forms. That includes the currently much promoted idea of scaling down to small modular reactors – SMRs. In theory they can be mass produced, so cutting costs. Not everyone is convinced: scaling down doesn't necessarily reduce complexity and it's that that may be the main cost driver. One cost offsetting option is to locate them in or near cities so that the waste heat they produce can feed into district heating networks. But given the safety and security risks, will anyone accept them in their backyard? And like all nuclear plants, they will produce dangerous long lived wastes that have to be dealt with.

Fast neutron breeder reactors can produce new plutonium fuel from otherwise unused uranium-238 and may also be able to burn up some wastes, as in the Integral Fast Reactor concept and also the Traveling Wave Reactor variant. Molten Salt Reactors using thorium may be able to do this without producing plutonium or using liquid metals for cooling. Both approaches are being promoted, but both have problems, as was found in the early days. Certainly fast breeder reactors were subsequently mostly sidelined as expensive and unreliable. And as heightening nuclear weapons proliferation risks. The US gave up on them

in the 1970s, France and the UK in the 1990s. Japan soldiered on, but has now abandoned its troubled Monju plant. For the moment it's mainly Russia that has continued, including with a molten lead cooled reactor, although India also has a fast reactor programme, linked to its thorium reactors plans.

Thorium was used as a fuel for some reactors in some early experiments and is now being promoted again - there is more of it available globally than uranium. But there are problems. It isn't fissile, but neutrons, fast or slow, provided by uranium 235 or plutonium fission, can convert Thorium 232 into fissile U233. However, on the way to that, a very radioactive isotope, U232, is produced, which makes working with the fuel hard. Another isotope, U234 is also produced by neutron absorption. Ideally, to maximise U233 production, that should be avoided, but experts are apparently divided on whether this can be done effectively.

The use of molten salts may help with some of these problems, perhaps making it easier to play with the nuclear chemistry and tap off unwanted by-products, but it is far from proven technically or economically. The economics is certainly challenging. Nuclear plants of any sort may not be competitive in the emerging

electricity market, as renewables get ever cheaper and their market share expands, but some nuclear options might be able to compete in the heat and synfuel markets. However, even that is unclear - renewables may also be able to compete in meeting these end uses, with fewer side effects.

Back in the 1950s, President Eisenhower launched Atoms for Peace initiative, promising US aid with the world-wide development of bountiful nuclear energy, and that idea has lingered on. In 2006, under the Global Nuclear Energy Partnership (GNEP) backed by President George W Bush, US Energy Secretary Samuel Bodman said that 'GNEP brings the promise of virtually limitless energy to emerging economies around the globe'. After Fukushima and the economic challenges to nuclear presented by gas and renewables, GNEP was in effect abandoned and we don't hear rhetoric like that so much: nuclear is on the defensive, only supplying 11% of global electricity as against 25% from renewables, with the cost of the later falling rapidly, while nuclear costs seem to be rising inexorably. Whether the new Generation of technologies will be able to resuscitate it remains to be seen. It doesn't seem a good bet.

## NUCLEAR NEWS

### **Close Tihange – 60,000 people to take to the streets**

On June 25, around 60,000 people from Germany, the Netherlands and Belgium will literally join hands when they form a human chain of 90 km from the German city of Aachen, via Dutch Maastricht to Belgium Liege and Tihange. It has been decades since the Belgian antinuclear movement has called for such a big action.

The three old nuclear power reactors in Tihange are much debated, not only in Belgium itself but – even more – in neighboring Germany. The reactors are located about 60 km from the border of both Germany and the Netherlands. All three reactors have been plagued in the past years with incidents, accidents and unsolved problems.

On 18 November 2016, the Belgian newspaper *La Libre* reported that the CEO of the Belgian nuclear regulator FANC, Jan Bens, expressed his anger to the owner of the nuclear power stations, Electrabel. In two letters to the government and Electrabel itself, he says "Electrabel didn't show any initiative in order to improve the level of safety." Bens described in the published letters an "alarming probability of a nuclear meltdown", especially in Tihange-2. He warned of the possibility of a new disaster "as in Fukushima and Tsjernoby!".

In the pressure vessels of not only Tihange-2 but also Doel-3 (in the west of Belgium), thousands of cracks have been discovered. During ultrasonic testings in 2012/13, approximately 13,000 cracks were found, a few millimeters long at first. By now, some are documented

with a length up to 17.2 centimeters. The decision of the Belgian government to postpone closure of the reactors has been widely criticized all over Europe, and the federal governments of Germany and Luxembourg have officially called on the Belgian government to permanently close the reactors.

After a year of intense lobbying work by WISE and other Dutch NGOs, the national parliament of the Netherlands on May 25 passed (with the smallest possible majority, 76 to 74) a resolution which calls on the Dutch government to join forces with Germany and Luxembourg in calling on Belgium to permanently close the reactors.

In the meantime, mobilization for the human chain on June 25 intensifies. Numerous local governments in the southern part of the Netherlands (Limburg) support the action and are encouraging their citizens to join. One of the biggest pop festivals of the Netherlands (Pinkpop, in early June) supports the action and will call all their visitors to join the human chain. Local groups are popping up and are organising buses. Well-known artists, politicians and scientists are saying that they will join.

The action is organised by groups in the Netherlands (WISE), Germany (Aktionsbündnis gegen Atomenergie Aachen) and Belgium (11Maar Beweging and Fin du Nucleaire) and is widely supported by dozens of other national and local NGOs. Join us if you can!

More information: [www.chain-reaction-tihange.eu/en/](http://www.chain-reaction-tihange.eu/en/)  
– Peer de Rijk – WISE Director

## Switzerland: referendum supports nuclear power phase-out

Voters in Switzerland supported a May 21 referendum on a package of energy policy measures including a ban on new nuclear power reactors. Thus Switzerland has opted for a “gradual nuclear phase out” in the words of the World Nuclear Association. There are no definitive dates for the closure of the existing five reactors – they can remain in operation as long as the Federal Nuclear Safety Inspectorate deems them safe – but they will probably all be closed by the late 2020s or early 2030s.

Before the Fukushima disaster, plans were in train to build new reactors to replace Switzerland’s aging fleet. However those plans were shelved in the aftermath of Fukushima.

In a November 2016 referendum, Swiss citizens narrowly rejected a Green Party initiative that called for a 45-year limit to be placed on the lifespan of power reactors, which would have resulted in the closure of all plants by 2029.

In the May 21 referendum, 58.2% of Swiss citizens voted in support of the revisions to the Energy Act. Only four of the country’s 26 cantons voted ‘no’.

In addition to the ban on new power reactors, no “basic changes” to existing nuclear power plants will be permitted. In 2003, Switzerland imposed a moratorium on the export of spent nuclear fuel for reprocessing until 2020 and the Energy Strategy 2050, approved by the May 21 referendum, extends this ban indefinitely.

To support the expansion of renewables, 480 million swiss francs (US\$492 million) will be raised annually from electricity consumers to fund investment in wind, solar and hydro power. Power generation from solar, wind, biomass and geothermal sources is to increase at least four-fold by 2035 – from 2,831 gigawatt-hours (GWh) to at least 11,400 GWh by 2035. Hydro currently accounts for 60% of Switzerland’s power generation, with nuclear providing 35%.



Anti-nuclear cartoon in the lead-up to the November 2016 referendum in Switzerland.

An additional 450 million francs (US\$461m) will also be set aside from an existing tax on fossil fuels to help reduce energy consumption in buildings by 43% by 2035 compared with 2000 levels.

“This is a historic day for the country,” Green Party parliamentarian Adele Thorens Goumaz said. “Switzerland will finally enter the 21st century when it comes to energy.”

REACTOR	CAPACITY	COMMISSIONED	AGE (YEARS)
Beznau I	365 MW	1969	48
Beznau II	365 MW	1971	46
Mühleberg	373 MW	1971	46
Gösgen	970 MW	1979	38
Leibstadt	1190 MW	1984	33

[www.world-nuclear-news.org/NP-Swiss-voters-approve-gradual-nuclear-phase-out-2205174.html](http://www.world-nuclear-news.org/NP-Swiss-voters-approve-gradual-nuclear-phase-out-2205174.html)

[www.nuclearpowerdaily.com/reports/Swiss\\_vote\\_for\\_gradual\\_nuclear\\_phaseout\\_energy\\_makeover\\_999.html](http://www.nuclearpowerdaily.com/reports/Swiss_vote_for_gradual_nuclear_phaseout_energy_makeover_999.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](http://www.wiseinternational.org)

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