NUCLEAR MONITOR

December 16, 2016 | No. 836

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

Dear readers of the WISE/NIRS Nuclear Monitor,

In this issue of the Monitor, the last for the year:

- Diet Simon reports on a German court ruling regarding the legality of the government's accelerated nuclear phase-out plan.
- We write about the economic impacts of the Fukushima disaster.
- We write about Japan's nuclear fuel cycle policies, in particular reprocessing.
- We summarize the latest 'Red Book', a 550-page report on the worldwide uranium industry.
- A collection of quotable quotes about the uranium industry.
- Paul Brown writes about the severe financial problems of Électricité de France and the wider implications of those problems.

The next issue of the Monitor will be released in late January. Feel free to contact us if you have feedback on this issue of the Monitor, or if there are topics you would like to see covered in future issues.

Regards from the editorial team.

Email: monitor@wiseinternational.org

Monitored this issue:

German court rules on reactor shut-down compensation

Author: *Diet Simon*

NM836.4608 German taxpayers should pay nuclear power companies "appropriate compensation" for the government order to shut them down by 2022, the country's highest court ruled on December 6.

The Federal Constitutional Court (Bundesverfassungsgericht) didn't put a figure on the compensation entitlement, but the industry talks about €19 billion (US$19.8 bn). Eon said the accelerated nuclear phase-out policy will cost it €8 billion, RWE did not provide any information but analysts estimate its claim at €6 billion euros, while Vattenfall claimed €4.7 billion.

The companies did not argue that they should be allowed to operate reactors for longer, but that they should be compensated. About 70% of Germans regularly reject nuclear power in opinion polls.

After the 2011 Fukushima disaster, the government of Angela Merkel, backed by the then opposition Social Democrats and Greens, rescinded the longer reactor operating lifespans approved in December 2010 and set earlier closure dates for each of the 17 power reactors. Eight closed immediately, nine are due to close by 2022.

The power companies argued that this is an unconstitutional expropriation. The Federal Constitutional Court ruled that the decision to reduce reactor lifespans was constitutional and that it did not constitute expropriation, but that it amounted to a restriction of the companies' property rights and that compensation should therefore be paid.

Eon, RWE und Vattenfall, the companies that brought the case, may prefer to use the entitlement as a bargaining chip in the ongoing acrimonious dispute over who pays for disposing of nuclear waste, the producers of it or the public. That is, credit the entitlement against whatever waste disposal cost is set.

Public money helped set up nuclear power and, one way or another, public money will also pay for the 'clean-up', if that's possible, of the nuclear waste.

On December 15, Germany's coalition government, with the support of the Greens, passed a law regulating the long-term costs of nuclear waste management. As discussed in Nuclear Monitor #833, power companies will pay €23 billion into a government-controlled fund and they will be off the hook for any future cost increases. A leading regional newspaper blasted the deal as "a nasty deal at the taxpayers' expense". 140,000 people have so far signed a petition: 'We're not paying for your waste'.

Activists are especially mad at Jürgen Trittin, a senior Green and former environment minister, who co-headed the group that wrote the law. Trittin knows that the clean-up funds fall far short of what's needed, wrote Jochen Stay, a leading activist.

Parliament will vote on scrapping a tax on nuclear fuel on 1 January 2017. The Social Democrats have said they'll campaign in next year's election to bring the tax back in, but if they have to share government with the conservatives again, that's likely to gurgle down the drain again like it did in the present coalition.

Stay's *.ausgestrahlt* group said in a December 15 statement: "The Bundestag will decide today that in future the general public will have to pay for the nuclear waste, and not those who for years made billions with their nuclear power stations. The power companies can buy themselves out with a once-only payment. At the same time the parliament is highly likely to throw out a motion to extend the tax on nuclear fuel."

Japan's plutonium puzzle

Author: *Jim Green – Nuclear Monitor editor*

NM836.4609 We reported in *Nuclear Monitor* in October that Japan has abandoned plans to restart the ill-fated Monju fast reactor.[1] That decision calls into question the rationale for Japan's ongoing development of reprocessing (in particular the partially-built Rokkasho plant). In the absence of a fast-reactor rationale, the only use for plutonium separated at Rokkasho would be incorporation into mixed uranium–plutonium MOX fuel (or, of course, incorporation into nuclear weapons). MOX fuel makes no sense since uranium is plentiful and cheaper than MOX fuel.

Hideyuki Ban, Co-Director of the Tokyo-based Citizens Nuclear Information Center, takes up this story in the latest edition of *Nuke Info Tokyo*:[2]

"On September 21, 2016, the Ministerial Committee on Nuclear Power, which consists of the Chief Cabinet Secretary, Minister of Economy, Trade and Industry and other relevant cabinet members, adopted a policy entitled "Procedure for Future Fast Reactor Development." This policy included a drastic review of Monju, including its decommissioning, but the continued promotion of the nuclear fuel cycle. Based on the adoption of this policy, the Fast Reactor Development Committee has been established under the initiative of the Minister of Economy, Trade and Industry. The new policy states that the committee is scheduled to reach a conclusion on future development before the end of 2016.

"However, the decision to decommission Monju will not be overturned by the committee. This is because "The committee will not discuss whether Monju should be continued or discontinued" (Toshio Kodama, President of the Japan Atomic Energy Agency). Thus the committee has been set up and will conduct deliberations on the premise that Monju will be decommissioned.

"The specific actions the Ministerial Committee on Nuclear Power plans to promote for the nuclear fuel cycle are to restart the experimental reactor Jōyō and to cooperate with fast reactor development in France. The fast reactor Jōyō was first started in 1977, and was operated as a non-breeding reactor after its breeding function was evaluated. Its operation has been suspended since an accident occurred in 2008. It is currently under investigation for compatibility with the new regulatory standards.

"France plans to build a demonstration fast reactor named ASTRID (Advanced Sodium Technological Reactor for Industrial Demonstration). The cooperation between Japan and France began in 2014. ... The ASTRID project is still at the basic design stage and it has not yet been decided whether construction will go ahead or not. Koji Okamoto (Professor, Nuclear Professional School, University of Tokyo) who has been a strong advocate of nuclear energy in Japan, clearly states in an article contributed to Energy Review, a Japanese industrial monthly, that the ASTRID project is close to coming off the tracks.

"The new Japanese governmental policy states that one purpose of the ASTRID development is to lower the toxicity of radioactive wastes. However, a study (called the OMEGA Project) to reduce the toxicity of radioactive wastes has been ongoing for more than 30 years in Japan, resulting in no practical achievements. Presenting a new aim does not necessarily mean that practical achievements have become more obtainable.

"The construction cost of ASTRID is estimated to be 570 billion yen, of which Japan has been asked to provide 290 billion yen, according to a media report. However, the construction cost is considered likely to increase, and if Japan continues to cooperate, it is certain that the cost shouldered by Japan will increase each time construction budgets are reviewed.

"Even if cooperation with the French project results in some achievements, Japan has no way of taking advantage of them. After the Fukushima Dai-ichi NPS accident, the demonstration reactor project that would follow Monju has been shelved, and has, in fact, been returned to the drawing board, with even the site for construction as yet undetermined. Under

such circumstances, it is unimaginable for an area of this country to accept the construction of a fast reactor, which is far more dangerous than a light-water reactor. If a fast reactor cannot be built, the achievements of the cooperation with France cannot be used. Japan's nuclear fuel cycle policy will, it seems, fade away in the not-too-distant future."

Commitment to reprocessing

Yet while the prospects for the development of fast reactor technology in Japan are bleak, there is no sign of any weakening of the commitment to complete and operate the Rokkasho reprocessing plant. Japan's Ministry of Economy, Trade and Industry (METI) established the Nuclear Reprocessing Organization (NRO) on 3 October 2016 to pursue reprocessing under the Spent Nuclear Fuel Reprocessing Implementation Act, which was approved on 11 May 2016. The NRO's operations are entrusted to Japan Nuclear Fuel Ltd., funded by obligatory contributions from each electric power utility.[3]

Perhaps this financial burden imposed on the power utilities will help to slowly unravel the so-far rock-solid commitment to reprocessing.

Abandoning Rokkasho would mean giving up on the sunk costs – the estimated total cost is ¥2.2 trillion (US$18.6 bn; €17.8 bn) and much of that has already been spent – but continuing with Rokkasho means wasting billions more dollars.

If Rokkasho is abandoned, MOX fuel will sooner or later be abandoned. That said, if for some unfathomable reason Tokyo was determined to pursue the use of MOX fuel, existing plutonium stockpiles could be used to produce MOX fuel far into the future – all the more so since it's unlikely that any more than a handful of reactors will be MOX-fuelled in the foreseeable future (of the 26 reactors either approved and under review for restart by the Nuclear Regulation Authority, only five use MOX fuel).

If fast reactors and reprocessing are abandoned, spent nuclear fuel will be managed as waste – it will be destined for deep underground disposal.

International conference

Given the fluid nature of Japan's policies on fast-reactor R&D – and the potential to unravel the government's illogical commitments to reprocessing and MOX – the Citizens Nuclear Information Center (CNIC) and the US-based Union of Concerned Scientists are jointly organizing an international conference on 23-24 February next year at the United Nations University, Tokyo.[4]

The conference will focus on Japan's plutonium policy and the US-Japan 123 Agreement, which provides the basis for Japan's reprocessing program. The present Agreement came into effect in 1988 and is valid for 30 years. Thus it is due to expire in 2018. The Agreement is subject to automatic renewal unless either party notifies that it would like to negotiate changes. While it is likely that the Agreement will be automatically renewed in 2018, CNIC is planning to use this opportunity to draw attention to the serious problems with Japan's nuclear fuel cycle policy and the growing plutonium stockpile.

Issues to be considered at the conference include the international repercussions – how do countries in the region react to Japan's massive stockpile of plutonium? How do they see the planned Rokkasho Reprocessing Plant, which will produce a further eight tons of plutonium per year? What is the real stance of the US on Japan's plutonium policy?

Organizers plan to include speakers from South Korea, China and Taiwan as well as several US experts. Japanese experts and government officials, both bureaucrats and members of parliament, will be invited to speak, as will speakers from local communities in Aomori Prefecture, host of the Rokkasho Reprocessing Plant.

Vitrified high-level nuclear waste shipments

One of the problematic aspects of Japan's nuclear fuel cycle policies has been the many shipments of spent fuel, MOX, separated plutonium and high-level nuclear waste between Europe (France and the UK) and Japan. These shipments are slowly coming to an end.

The Pacific Grebe, laden with 132 canisters of vitrified high-level waste (HLW) being returned from the UK, arrived on October 20 at Japan Nuclear Fuel, Ltd.'s High-Level Radioactive Waste Storage Center in Rokkasho-mura.[5]

From 1969-90 there were more than 160 shipments of spent fuel from Japan to Europe.[6] The first shipment of vitrified HLW from France to Japan took place in 1995 and the final shipment was in 2007 – in total, 1,310 HLW canisters were transported. Shipment of vitrified HLW from the UK to Japan commenced early in 2010 and will require about 11 shipments over 8–10 years to move about 900 canisters. To date, 520 canisters have been sent to Japan from the UK.

References:

1. 5 Oct 2016, 'The slow death of fast reactors', Nuclear Monitor #831, www.wiseinternational.org/nuclear-monitor/831/nuclear-monitor-831
2. Hideyuki Ban, 5 Dec 2016, 'Planned Monju Decommissioning – The Changed Future of Japan's Nuclear Fuel Cycle', Nuke Info Tokyo No. 175 (Nov/Dec 2016), www.cnic.jp/english/?p=3623
3. CNIC, 5 Dec 2016, 'Nuclear Reprocessing Organization Inaugurated', www.cnic.jp/english/?p=3630
4. CNIC, 5 Dec 2016, 'International Conference on US-Japan Nuclear Cooperation Agreement and Japan's Plutonium Policy 2017', www.cnic.jp/english/?p=3618
5. CNIC, 5 Dec 2016, 'Vitrified HLW Returning from UK Arrives in Japan', www.cnic.jp/english/?p=3627
6. World Nuclear Association, Nov 2016, 'Japanese Waste and MOX Shipments From Europe', www.world-nuclear.org/information-library/nuclear-fuel-cycle/transport-of-nuclear-materials/japanese-waste-and-mox-shipments-from-europe.aspx

The economic impacts of the Fukushima disaster

Author: *Jim Green – Nuclear Monitor editor*

NM836.4610 Japan's Ministry of Economy, Trade and Industry (METI) has revised the estimated cost of decommissioning the Fukushima Daiichi nuclear plant, and compensating victims of the disaster, to around ¥21.5 trillion (US$187 bn; €175 bn).[1]

In 2011/12, the estimate was in the range of ¥5 trillion[2] to ¥5.8 trillion.[3] In November 2012, TEPCO said compensation and clean-up costs could amount to ¥10 trillion.[2] In 2013, METI estimated the cost at ¥11 trillion[4], comprising ¥5.4 trillion for compensation (now estimated at ¥7.9 trillion), ¥2.5 trillion yen for decontamination work in Fukushima Prefecture (now estimated at ¥4 trillion), ¥1.1 trillion for interim storage facilities for contaminated soil (now estimated at ¥1.6 trillion), and ¥2 trillion for decommissioning the Fukushima Daiichi plant (now estimated at ¥8 trillion).[1,5]

The current estimate of ¥21.5 trillion is four times greater than the 2011/12 estimates of ¥5–5.8 trillion, and double the 2012/13 estimates of ¥10–11 trillion. Further increases are likely. "We don't think it will increase further for some time, but it's possible depending on any changes to the situation," METI chief Hiroshige Seko said on December 9.[1] According to *Nikkei Asian Review*, costs could "surge" if the removal of nuclear fuel fragments from stricken reactors proves more difficult than expected.[1]

In October 2016, the Japanese government said that expenditure on decommissioning the Fukushima plant would rise from the current figure of ¥80 billion (US$690m) per year to several hundred billion yen (several billion US dollars) per year.[6]

Indirect costs – fuel imports

In addition to the direct costs discussed above, the Fukushima disaster has resulted in a myriad of indirect costs. While a number of these indirect costs cannot be quantified, it can safely be said that the largest has been the cost of replacing power from Japan's fleet of idled reactors. Replacement power has comprised energy efficiency negawatts, increased use of renewables, and increased use of fossil fuels.

According to METI, fossil fuel import costs to replace power from idled reactors amounted to ¥3.6 trillion (US$31.3 bn) in fiscal year 2013.[7] It's a reasonable assumption that comparable costs have been incurred for each of the 5.5 years since the Fukushima disaster. And since nearly all of Japan's reactors remain idle, a reasonable (if arbitrary) assumption is that comparable costs will be incurred for another three years, bringing the total to 8.5 x US$31.3 billion or US$266 billion.

Adding the estimate of US$187 billion in direct costs to the rough estimate of US$266 billion for fuel imports gives a total of US$453 billion. That figure is consistent with the American Society of Mechanical Engineers' (ASME) "rough estimate" in a mid-2012 report of US$500 billion costs from the Fukushima disaster.[8] ASME estimated costs for clean-up and decommissioning of the Fukushima plant; clean-up of contaminated lands outside the plant boundary; replacement power costs due to the shutdown of all of Japan's reactors; and compensation for citizens evacuated from contaminated areas. ASME noted that the costs would "substantially increase if nuclear electricity generation continues to be replaced for a long time by other means".

The ASME report concluded: "The major consequences of severe accidents at nuclear plants have been socio-political and economic disruptions inflicting enormous cost to society. In other words, even when there are no discernible radiological public health effects from a nuclear power accident, the observed and potential disruption of the socio-economic fabric of society from a large release of radioactivity is not an acceptable outcome."[8]

Macroeconomic impacts

METI noted in its April 2014 *Strategic Energy Plan* that electricity prices have risen as a result of strategies to replace nuclear power in the aftermath of the Fukushima disaster: "Six Japanese electric power companies have already revised their electricity prices by a range of 6.2% to 9.8% for regulated sectors. However, actually, the model electricity price for the average household has risen by around 20% across Japan due to the rise in fuel price, etc."[7]

The 2014 METI report further noted that increased electricity prices have had flow-on effects: "Increases in electricity prices due to various factors have put pressure on the profits of energy intensive industries and small and medium-sized enterprises and are starting to cause adverse effects, including personnel cuts and production transfer to overseas due to deteriorating profitability for domestic business. It is a significant obstacle to expand domestic investment from abroad; it also increases burden against household economy."[7]

Thus, as the METI report notes, the Fukushima disaster and the subsequent shutdown of all of Japan's reactors have had macroeconomic impacts: "Due to increased imports of fossil fuels, Japan's trade balance in 2011 turned to a deficit for the first time in 31 years. In 2012, the trade deficit expanded, and in 2013, it hit a record high of ¥11.5 trillion. Japan's current account has also been significantly affected by the deterioration in the trade balance. The increased imports of fossil fuels have thus caused problems not only in the field of energy but also at the macroeconomic level."[7]

Other indirect costs

The Fukushima disaster has cost the tourism industry billions of dollars – perhaps tens of billions. According to an estimate by the Japan National Tourism

Organization, 6.2 million tourists visited Japan in 2011 – a 28% drop from the previous year.[9]

Billions more have been lost in the agricultural and fishing industries. The local fishing industry collapsed as a result of the Fukushima disaster. According to a June 2013 Reuters report, fishing industry losses by that time amounted to ¥1.26 trillion (US$10.9 billion).[10]

Add these costs to the direct clean-up costs of US$187 billion (almost certain to be upwardly revised ... again), and the rough estimate of US$266 billion for fuel imports, and it's likely that the direct and indirect costs resulting from the Fukushima disaster will exceed US$500 billion.

References:

1. Nikkei Asian Review, 10 Dec 2016, 'Japanese consumers will be paying for Fukushima for decades', http://asia.nikkei.com/Politics-Economy/Policy-Politics/Japanese-consumers-will-be-paying-for-Fukushima-for-decades
2. AFP, 7 Nov 2012, 'TEPCO says Fukushima clean up, compensation may hit $125 bn', www.nuclearpowerdaily.com/reports/TEPCO_says_Fukushima_clean_up_compensation_may_hit_125_bn_999.html
3. Kyodo, 27 Aug 2014, 'Fukushima nuclear crisis estimated to cost ¥11 trillion: study', www.japantimes.co.jp/news/2014/08/27/national/fukushima-nuclear-crisis-estimated-to-cost-%C2%A511-trillion-study/
4. Reuters, 28 Nov 2016, 'Fukushima nuclear decommission, compensation costs to almost double: media', www.reuters.com/article/us-tepco-outlook-idUSKBN13N03G
5. Nikkei Asian Review, 9 Dec 2016, 'Fukushima cost estimate set to swell to $188bn', http://asia.nikkei.com/Politics-Economy/Policy-Politics/Fukushima-cost-estimate-set-to-swell-to-188bn
6. South China Morning Post, 25 Oct 2016, 'Cost to scrap Fukushima nuclear plant massively underestimated, Japanese officials admit', www.scmp.com/news/asia/east-asia/article/2039929/cost-scrap-fukushima-nuclear-plant-massively-underestimated
7. Ministry of Economy, Trade and Industry, April 2014, Strategic Energy Plan', www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/4th_strategic_energy_plan.pdf
8. American Society of Mechanical Engineers, June 2012, 'Forging a New Nuclear Safety Construct: The ASME Presidential Task Force on Response to Japan Nuclear Power Plant Events', www.asme.org/getmedia/73081de8-e963-4557-9498-f856b56dabd1/Forging_a_new_nuclear_safety_construct.aspx
9. Japan Times, 9 March 2012, 'Selling Japan's Food and Tourism after Fukushima', www.realclearworld.com/2012/03/09/selling_japans_food_and_tourism_after_fukushima_133680.html
10. Antoni Slodkowski / Reuters, 3 June 2013, 'Rising radioactive spills leave Fukushima fishermen floundering', http://planetark.org/enviro-news/item/68817

Costing Fukushima morbidity and mortality

The impacts of the Fukushima disaster include ill-health and deaths resulting from radiation exposure and from the evacuation of 160,000 people and the prolonged exclusion from contaminated areas.

Putting a dollar value on ill-health and death is both fraught and arbitrary. With those qualifications, figures used by the US Nuclear Regulatory Commission (NRC) can be used to cost the ill-health and death resulting from the Fukushima disaster.

The NRC, in its own words, "uses the dollar per person-rem conversion in cost-benefit analyses to determine the monetary valuation of the consequences associated with radiological exposure and establishes this factor by multiplying a value of a statistical life coefficient by a nominal risk coefficient."[1]

The NRC suggests a value of $5,100 per person-rem of radiation exposure (US$510,000 per person-Sievert).[1] The UN Scientific Committee on the Effects of Atomic Radiation estimates radiation exposure from the Fukushima disaster at 48,000 person-Sieverts.[2,3] Multiplying the exposure (48,000 person-Sieverts) by the (fraught, arbitrary) NRC figure of US$510,000 per person-Sievert gives a total of US$24.5 billion.

The NRC suggests a figure of US$9 million for each death caused by radiation exposure (in the jargon, US$9 million is the 'value of a statistical life' or VSL).[11] A reasonable ball-park estimate is that 5,000 deaths will result from exposure to radiation from the Fukushima disaster (using a Linear No Threshold-derived risk estimate, almost twice the risk estimate used by the NRC).[3] Multiplying the US$9 million VSL figure with the estimate of 5,000 deaths gives a figure of US$45 billion.

In addition, there have been ill-health and deaths attributable to the Fukushima disaster but not directly radiation-related, in particular the impacts of the evacuation and prolonged exclusion from contaminated regions. According to reports in early 2014, information compiled by police and local governments found that 1,656 people had died in Fukushima Prefecture as a result of stress and other illnesses caused by the 2011 disaster.[4]

If we assume that the number of non-radiation-related deaths has risen from 1,656 by early 2014 to, say, 2,000 deaths up to late 2016, and we use the NRC's US$9 million VSL figure, that gives a cost of US$18 billion.

Regardless of those fraught, arbitrary costings of morbidity and mortality, there's no disputing the American Society of Mechanical Engineers' conclusion that the Fukushima disaster has resulted in an "enormous cost to society" and that the "disruption of the socio-economic fabric of society from a large release of radioactivity is not an acceptable outcome".[5]

1. US Nuclear Regulatory Commission, Aug 2015, "Reassessment of NRC's Dollar Per Person-Rem Conversion Factor Policy: Draft Report for Comment", www.regulations.gov/contentStreamer?documentId=NRC-2015-0063-0005&disposition=attachment&contentType=pdf
2. www.unscear.org/docs/reports/2013/13-85418_Report_2013_Annex_A.pdf
3. Ian Fairlie, Feb 2014, 'New UNSCEAR Report on Fukushima: Collective Doses', www.wiseinternational.org/nuclear-monitor/785/new-unscear-report-fukushima-collective-doses
4. The Times (UK), 21 Feb 2014, 'More Fukushima victims die of stress than were killed in the disaster', www.thetimes.co.uk/tto/news/world/asia/article4012190.ece
5. American Society of Mechanical Engineers, June 2012, 'Forging a New Nuclear Safety Construct: The ASME Presidential Task Force on Response to Japan Nuclear Power Plant Events', www.asme.org/getmedia/73081de8-e963-4557-9498-f856b56dabd1/Forging_a_new_nuclear_safety_construct.aspx

Uranium 'Red Book' released

NM836.4611 The OECD's Nuclear Energy Agency and the International Atomic Energy Agency have released the 2016 version of their biennial 'Red Book'.[1] The 550-page document contains vast amounts of information on uranium exploration, production and demand, including sections on 49 countries.

The Red Book is a highly sanitized report that contains scarcely any of the critical information compiled by, for example, the WISE Uranium project[2] or the EJOLT environmental justice project.[3] Nonetheless it is a useful source of facts and figures on uranium mining.

Uranium resources

Uranium resources are classified by a scheme based on geological certainty and costs of production:

- *Identified resources* include reasonably assured resources (RAR) and inferred resources (not defined with such a high degree of confidence).
- *Undiscovered resources* (prognosticated and speculative) refer to resources that are expected to exist based on geological knowledge of previously discovered deposits and regional geological mapping.

The 2016 Red Book, which takes a snapshot of the uranium sector as of 1 January 2015, finds that total identified uranium resources have increased by only 0.1% since 1 January 2013. The resource base has changed very little "due to lower levels of investment and associated exploration efforts reflecting current, depressed uranium market conditions", the 2016 Red Book states.

Total identified resources (RAR and inferred) as of 1 January 2015 amounted to:

- 7,641,600 tonnes of uranium metal (tU) in the highest cost category (<US$260/kgU or <US$100/lb U3O8), a 0.1% increase compared to the total reported for 2013.
- 5,718,400 tU in the <US$130/kgU (<US$50/lb U3O8) category, a decrease of 3.1%.
- 2,124,700 tU in the <US$80/kgU category, an 8.6% increase.
- 646,900 tU in the lowest cost category (<US$40/kgU), a 5.3% decrease.

Total undiscovered uranium resources (prognosticated and speculative) as of 1 January 2015 amounted to an estimated 7,422,700 tU, a slight decrease from the estimate two years earlier.

At the 2016 level of uranium requirements (63,404 tU)[4], identified resources in the highest cost category are sufficient for 121 years of supply for the global nuclear power fleet.

In addition to as-yet unmined deposits, there are large and growing uranium stockpiles, secondary sources, and the potential to develop unconventional uranium resources (e.g. phosphate, seawater).

Global stockpiles have grown sharply since the Fukushima disaster[5] and now amount to more than 1.4 billion pounds U3O8 according to Ux Consulting[6] or 1.2 billion pounds according to the 2016 Red Book. Thus stockpiles alone would suffice to keep the entire global reactor fleet operating for around eight years. And stockpiles continue to grow – supply from mines and secondary sources currently exceeds demand by about 30 million pounds U3O8 per year or 18%.[6]

As of 1 January 2015, uranium production provided about 99% of reactor requirements with the remainder supplied by previously-mined uranium (secondary sources) including government and commercial inventories, reprocessed uranium, underfeeding at enrichment plants (extracting more U-235 per given volume of feedstock), uranium produced by the re-enrichment of depleted uranium tails, and low-enriched uranium produced by blending down highly enriched uranium (typically from military sources).

The Red Book states: "Although information on secondary sources is incomplete, the availability of these sources is generally expected to decline somewhat after 2015. However, available information indicates that there remains a significant amount of previously mined uranium (including material held by the military), some of which could feasibly be brought to the market in the coming years. With the successful transition from gas diffusion to centrifuge enrichment now complete and capacity at least temporarily in excess of requirements following the Fukushima Daiichi accident, enrichment providers are well-positioned to reduce tails assays below contractual requirements and in this way create additional uranium supply."

Exploration

Uranium exploration expenditures continued to decrease in 2013–14 and no significant resources were added to the resource base during this reporting period.

The 2016 Red Book states: "From 2012 to 2014, domestic exploration and mine development expenditures decreased in many countries, mainly as a result of the declining uranium price which slowed down many exploration and mine development projects, particularly in the junior uranium mining sector. Significant decreases are reported for Argentina, Australia, Canada, Finland, Kazakhstan, Russia, South Africa, Spain and the United States. In contrast, Brazil, China, the Czech Republic, Jordan, Mexico and Turkey reported increases in expenditures during this period. "

For the 2013–14 reporting period, China accounted for the highest non-domestic and domestic exploration and development expenditures.

Production

Global uranium mine production decreased by 4% from 58,411 tU in 2012 to 55,975 tU in 2014. The small drop in production was largely the result of decreased production in Australia, Brazil, the Czech Republic, Malawi, Namibia and Niger.

From 2012 to 2014, uranium was produced in 21 different countries; the same number as in the last reporting period.

Kazakhstan's growth in production continued, but at a much slower pace, and it remains the world's largest producer, reporting production of 22,781 tU in 2014 and 23,800 tU in 2015. Production in Kazakhstan in 2014 totalled more than the combined production in Canada and Australia, the second and third largest producers of uranium, respectively.

In-situ leaching (ISL) uranium mining accounted for 51% of world production as of 1 January 2015, largely as a result of continued ISL production increases from Kazakhstan and other ISL projects in Australia, China, Russia, the US and Uzbekistan.

The breakdown for all uranium mining methods in 2014 was:

- ISL 51%
- underground mining 27%
- open-pit mining 14%
- co-product and by-product recovery from copper and gold mining 7%
- heap leaching <1%
- other methods <1%

The future of nuclear power

The Red Book presents low and high scenarios for nuclear power growth or decline to 2035. As discussed previously in *Nuclear Monitor*[7], the IAEA's high scenarios are always proven to be too high (often absurdly so), and even the low projections are usually too high. Nonetheless, the low projections are a reasonable guide.

According to the 2016 Red Book, nuclear power capacity is estimated to expand from 377 gigawatts (GW) in January 2015 to 418–683 GW by 2035, representing growth of 11–81%.

In the low scenario (418 GW by 2035), global nuclear capacity increases by 41 GW, with China accounting for 74 GW of growth and a 33 GW (9%) decline in the rest of the world.

The estimates presented in the 2016 Red Book for nuclear capacity in 2035 (418–683 GW) are substantially lower than those presented in the 2011 Red Book for 2035 (540–746 GW). The low estimate is down 23%, and the high estimate is down 8%.

Regional and national projections

The Red Book anticipates "significant" growth of nuclear power (and thus uranium demand) in East Asia (48–166 GW new nuclear capacity by 2035) and non-EU European countries (21–45 GW). There will also be "significant" nuclear capacity growth include the Middle East, Central and Southern Asia and South-East Asia according to the Red Book. However there is no likelihood of significant growth in any of those regions except South Asia (and then only if India manages to overcomes the obstacles holding back its ambitious nuclear expansion plans).

For North America, the low-case projection sees nuclear generating capacity remaining about the same by 2035 and increasing by 11% in the high case.

In the European Union, nuclear capacity in 2035 is projected to decrease by 48% in the low case scenario or increase by 2% in the high case.

The Red Book states: "These projections are subject to even greater uncertainty than usual following the Fukushima Daiichi accident, since the role that nuclear power will play in the future generation mix in some countries has not yet been determined and China did not report official targets for nuclear power capacity beyond 2020 for this edition."

Some country projections of interest:

- China: current capacity of 16 GW is estimated to increase to 91.3–158.4 GW in 2035.
- France: current capacity is 63.2 GW and capacity in 2035 is estimated to be 37–63.2 GW.
- India: current capacity of 4.8 GW is estimated to increase 4–8-fold to 18.2–36.7 GW.
- Japan: The estimates for nuclear capacity in 2035 range from 6.7 GW to 41.3 GW.
- Russia: current capacity of 25.2 GW is estimated to increase to 32–42.7 GW.
- South Korea: current capacity of 20.7 GW is estimated to increase to 37.6–43.2 GW.
- Ukraine: current capacity of 13.8 GW is estimated to increase to 26–30.5 GW.
- UK: current capacity is 9.4 GW and capacity in 2035 is estimated to be 0–12.2 GW.
- USA: current capacity of 99.2 GW is estimated to increase to 101.4–110.4 GW.

All of the projections are uncertain, as the Red Book freely acknowledges. Some of the projections are implausible; for example there is no likelihood of a doubling of nuclear capacity in Ukraine. The projection for growth in the US is heroic; decline is much more likely. For China, the low estimate of 91.3 GW in 2035 stretches credulity and the high estimate of 158.4 GW is ridiculous.

The Red Book notes that the uranium market "is currently well-supplied and projected primary uranium production capabilities including existing, committed, planned and prospective production centres would satisfy projected low and high case requirements through 2035 if developments proceed as planned."

The expansion of already-large stockpiles is one of the reasons that getting new mines into production is proving to be increasingly difficult. The Red Book states: "Challenges remain in the global uranium market with high levels of oversupply and inventories, resulting in continuing pricing pressures. ... Producers will have to overcome a number of significant and, at times, unpredictable issues in bringing new production facilities on stream, including geopolitical factors, technical challenges and risks at some facilities, the potential development of ever more stringent regulatory requirements, and the heightened expectations of governments hosting uranium mining."

The report further notes that "the Fukushima Daiichi accident has eroded public confidence in nuclear power in some countries, and prospects for growth in nuclear generating capacity are thus being reduced and are subject to even greater uncertainty than usual."

References:

1. OECD's Nuclear Energy Agency and International Atomic Energy Agency, 2016, 'Uranium 2016: Resources, Production and Demand', www.oecd-nea.org/ndd/pubs/2016/7301-uranium-2016.pdf
2. www.wise-uranium.org/
3. www.ejolt.org/tag/uranium-mining/
4. www.world-nuclear.org/information-library/facts-and-figures/world-nuclear-power-reactors-and-uranium-requireme.aspx
5. 26 Feb 2016, 'Yellowcake blues', Nuclear Monitor #819, www.wiseinternational.org/nuclear-monitor/819/nuclear-monitor-819-26-february-2016
6. 9 Aug 2016, 'Uranium: the world's worst commodity', Nuclear Monitor #828, www.wiseinternational.org/nuclear-monitor/828/uranium-worlds-worst-mined-commodity
7. 23 Sept 2015, 'Fanciful growth projections from the World Nuclear Association and the IAEA', Nuclear Monitor #811, www.wiseinternational.org/nuclear-monitor/811/fanciful-growth-projections-world-nuclear-association-and-iaea

Quotable quotes about uranium

NM836.4612

"About two-thirds of the uranium in the United States is on indigenous lands. On a worldwide scale, about 70 percent of the uranium is either in Aboriginal lands in Australia or up in the Subarctic of Canada, where native people are still fighting uranium mining."

– Winona LaDuke.[1]

"The Government would not listen and forced the Ranger uranium mine on us, but the old people were right and today we are dealing with everything they were worried about."

– Yvonne Margarula, Mirarr Senior Traditional Owner, Northern Territory, Australia.

"I believe this uranium business will give the Anglo-Saxons such tremendous power that Europe will become a bloc under Anglo-Saxon domination. If that is the case, it will be a very good thing. I wonder whether Stalin will be able to stand up to the others as he has done in the past."

– German nuclear physicist Werner Heisenberg, August 1945.[2]

"The brutal truth is that no one has yet managed to work out a way of getting nuclear reactors to burn uranium as effectively as they burn money."

– Tom Burke, 2005.[3]

"Uranium is the raw material of a power-elite who has taken Mother Earth's every living creature hostage."

– The late Petra Kelly, German Green Party.

"We extract ... uranium from the formation and send it to atomic reactors, so we are actually purifying the subsoil from heavy metals."

– Kazatomprom manager Kalilallo Baytasov, 2013.[4]

"This is like a water clean up project, and we are going to sell the by-product on."

– Powertech manager Mark Hollenbeck on the Dewey-Burdock ISL uranium project in South Dakota.[5]

"We're taking the uranium out of the ground, we're exporting it to be used for productive purposes, so we should be getting a medal for cleaning up the environment."

– Neville Huxham, Paladin Energy Africa, operator of the Kayelekera uranium mine, 2009.[6]

"Mining is a 24 hour operation and cannot be stopped as a result of a shortage of available dust masks."

– Johan De Bruin, geology superintendent at Paladin's Kayelekera uranium mine in Malawi, 2010.[7]

"The beauty of the uranium product and nuclear waste is that you can put your hands around it, you can control it and you can manage it."

– Brian Reilly, Minerals Council of Australia, November 2016.[8]

Weapons and War

"Again and again it has been demonstrated here and overseas that when problems over safeguards prove difficult, commercial considerations will come first."

– Former South Australian Premier Mike Rann, 1982.[9]

"You can guarantee that mining uranium will lead to nuclear waste. You can't guarantee that uranium mining will not lead to nuclear weapons."

– Anthony Albanese, Australian Labor Party MP, 2006.[10]

"For eight years in the White House, every weapons-proliferation problem we dealt with was connected to a civilian reactor program. And if we ever got to the point where we wanted to use nuclear reactors to back out a lot of coal ... then we'd have to put them in so many places we'd run that proliferation risk right off the reasonability scale. And we'd run short of uranium, unless they went to a breeder cycle or something like it, which would increase the risk of weapons-grade material being available."

– Former US Vice President Al Gore, 2006.[11]

"The splitting of the atom has changed everything save our mode of thinking, and therefore we drift toward unparalleled catastrophe. The solution to this problem lies in the heart of mankind. If only I had known, I should have become a watchmaker."

– Albert Einstein, 1946.[12]

Diversification!

"A minerals exploration company is trying to position itself to become Australia's first legal medicinal marijuana grower."

– ABC, April 2015. The share price of uranium explorer Capital Mining doubled following the announcement.[13]

"In Western Australia, United Uranium, which holds several uranium exploration licences, has decided to get out of uranium exploration and instead focus on property development. The company said its strategic review "underlined a consistent theme, that junior resource companies and in particular uranium focussed companies, are currently 'unloved' by the investment community"."

– Mining Australia, 2014.[14]

"As investors try to predict what will happen next, analysts at RBC Capital Markets are advising clients to go overweight on fertilizer equities and underweight on uranium and precious metals equities in the fourth quarter."

– Financial Post, 2014.[15]

"Until now inveterate fraudsters, even convicted heroin traffickers, have happily promoted their floats on the [Australian Stock Exchange]. ... Until now, the same promoters have beaten a path back to the market − decade in, decade out − pouncing on every fad, boom and bubble. That they haven't been required to disclose their myriad failures − before "backdoor listing" the likes of a "uranium" asset into a nickel explorer's shell, itself born from a dotcom play, having emerged from the ruins of a biotechnology float − has played nicely into the hands of the promoters, brokers, lawyers, accountants and other capital markets fee-takers."

– Journalist Michael West, 2011.[16]

Uranium industry downturn

"[L]ess clued-up people continue to buy uranium penny dreadfuls rather than do something sensible, like bet the house (the wife and the kids) on the horse carrying the jockey wearing pink polka dots in the fourth at Ascot next Saturday."

– The West Australian, October 2005.[17]

"[T]he uranium industry is definitely in crisis, I believe, and is showing all the symptoms of a mid-term paralysis if this situation does not demonstrably change."

– [Then] Paladin Energy chief executive John Borshoff, November 2013.[18]

"[Uranium] is the worst-performing mined commodity this year."

– Wall Street Journal, July 2016.[19]

"Uranium executives radiate sunny optimism at the start of each year when pitching their new project. This then disappears by the summer ... This time even that optimism has gone. All the executives I spoke to looked about as miserable as England football fans in the second week of a major tournament. What's to be done? Can this ever change? There is so much potential, but we never perform, why can't we be put out of our misery? Is it Wayne Rooney's fault?"

– RFC Ambrian, September 2016.[20]

"[U]ranium bulls know how Moses felt when he was destined to wander forty years in the desert and never get to see the Promised Land."

– Christopher Ecclestone, March 2016.[21]

"There is too much of nearly every commodity in the world today. Then there is uranium. The outlook for the element that powers nuclear reactors may be worse than for any other, and there is almost no prospect for improvement soon. Unlike other commodities, low prices won't stimulate demand. No commodity faces the unique pressure that uranium and nuclear fuel do and there is little prospect of a near-term recovery."

– Wall Street Journal, September 2016.[22]

"It has never been a worse time for uranium miners."

– Alexander Molyneux, CEO of Paladin Energy.[23]

"The days of nuclear power based upon uranium-based fission are coming to a close because the fear of nuclear proliferation, the reality of nuclear waste and the difficulty of managing it have proven too difficult over time."

– Former Shell executive John Hofmeister.[24]

"There has indeed been a nuclear winter verging on an Ice Age over the last few years with bad news heaped upon bad news within the context of a pretty dismal financing situation for mining all around. ... The yellow mineral had made fools and liars of many in recent years, including ourselves."

– Christopher Ecclestone / Hallgarten & Company, 2014.[25]

"What gets us excited and what gets us out of bed in the morning are the long-term fundamentals of the uranium market."

– Brian Reilly, Minerals Council of Australia, November 2016.[8]

(Compiled by Nuclear Monitor.)

References:

1. www.thequietamerican.org/quotes
2. http://germanhistorydocs.ghi-dc.org/docpage.cfm?docpage_id=3064 www.brainyquote.com/quotes/keywords/uranium.html
3. www.guardian.co.uk/society/2005/mar/02/environment.environment
4. Christian Science Monitor, 28 Aug 2013, www.wise-uranium.org/new.html
5. 5. Mark Hollenbeck / Powertech, South Dakota Public Broadcasting, 5 Apr. 2010. www.wise-uranium.org/new.html
6. IPS, 24 Aug 2009. www.wise-uranium.org/new.html
7. Nyasa Times, 25 Sept. 2010. www.wise-uranium.org/new.html
8. http://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;query=Id%3A%22committees/commjnt/bb2ebe97-486c-4b49-8be6-3da3faa922dc/0000%22
9. Mike Rann, 1982, 'Uranium: Play It Safe'.
10. Quoted in the New York Times, 2 Aug 2006, page A9.
11. David Roberts, 10 May 2006, 'An interview with accidental movie star Al Gore', www.grist.org/article/roberts2
12. https://en.wikiquote.org/wiki/Albert_Einstein_and_politics
13. www.abc.net.au/news/2015-04-17/capital-mining-in-bid-to-be-first-to-grow-medicinal-cannabis/6400544 www.wise-uranium.org/upaussa.html
14. Vicky Validakis, 6 June, 2014, 'Price collapse sees junior miner ditch uranium to focus on property development', www.miningaustralia.com.au/news/price-collapse-sees-junior-miner-ditch-uranium-to
15. Peter Koven, 1 Oct 2014, 'Buy fertilizer stocks, don't buy uranium and precious metals: RBC', http://business.financialpost.com/2014/10/01/buy-fertilizers-dont-buy-uranium-and-precious-metals-rbc/?__lsa=f40a-e287
16. Michael West, 16 April 2011, 'Not just another crackdown', www.theage.com.au/business/not-just-another-crackdown-20110415-1dhpk.html

17. Tim Treadgold, 20 Oct 2005, 'Briefcase - Smart money takes leave of uranium', The West Australian, www.reocities.com/jimgreen3/nnn2.html
18. 2 Nov 2013, http://au.news.yahoo.com/thewest/a/-/breaking/18043640/uranium-industry-in-crisis-borshoff
19. Rhiannon Hoyle and Mayumi Negishi, 31 July 2016, 'Japan Nuclear-Power Jitters Weigh on Global Uranium Market', www.wsj.com/articles/japan-nuclear-power-jitters-weigh-on-global-uranium-market-1469990663
20. RFC Ambrian, 16 Sep 2016, 'In the news: The Nuclear Industry', www.proactiveinvestors.co.uk/columns/the-rfc-ambrian-metals-mining-and-oil-gas-overview/26047/in-the-news-the-nuclear-industry-26047.html
21. Christopher Ecclestone, 22 March 2016, 'Uranium – Waiting for Godot or Forging Ahead?', http://investorintel.com/uranium-energy-intel/uranium-waiting-godot-forging-ahead/
22. Spencer Jakab, 18 Sept. 2016, 'Uranium Investments Grow Radioactive', Wall Street Journal, www.wsj.com/articles/why-uranium-investments-will-remain-radioactive-1474225882
23. Geert De Clercq, 3 Oct 2016, 'Desperate uranium miners switch to survival mode despite nuclear rebound', www.reuters.com/article/us-uranium-nuclearpower-idUSKCN1230EF
24. Pia Akerman, 7 Oct 2013, 'Ex-Shell boss issues nuclear call', The Australian, www.theaustralian.com.au/national-affairs/policy/ex-shell-boss-issues-nuclear-call/story-e6frg6xf-1226733858032
25. Christopher Ecclestone, 10 Nov 2014, 'Ecclestone on NexGen Energy – A Survivor of the Nuclear Winter', http://investorintel.com/nuclear-energy-intel/nexgen-energy-nxe-v-survivor-nuclear-winter/

Taxpayers face bill for nuclear crisis

Author: *Paul Brown*

NM836.4613 The liabilities of Électricité de France (EDF) − the biggest electricity supplier in Europe, with 39 million customers − are increasing so fast that they will soon exceed its assets, according a report by an independent equity research company,

Bankruptcy for EDF seems inevitable − and if such a vast empire in any other line of business seemed to be in such serious financial trouble, there would be near-panic in the workforce and in governments at the subsequent political fall-out.

But it seems that the nuclear-dominated EDF group[1] is considered too big to be allowed to fail. So, to keep the lights on in western Europe, the company will have to be bailed out by the taxpayers of France and the UK.

The French government, facing elections next spring, and the British, struggling with the implications of the Brexit vote to leave the European Union, are currently turning a blind eye to the report by AlphaValue that EDF has badly under-reported its potential liabilities.[2]

Aging nuclear reactors

While EDF is threatening to sue people who say it is technically bankrupt, the evidence is that the cost of producing electricity from its aging nuclear reactors is greater than the market price.

Coupled with the impossibility of EDF paying the full decommissioning costs of its reactors, it is inevitable that it is the taxpayers in France and the UK who will eventually pick up the bill.

There is also the ongoing thorny problem of disposing of the nuclear waste and spent fuel rods, which are building up in cooling ponds and stores on both sides of the Channel, with no disposal route yet in sight.

A looming problem for EDF, which already admits is has €37 billion of debt, is that 17 of its aging fleet of nuclear reactors, which provide 70% of France's electricity, are being retired.

According to AlphaValue, EDF has underestimated the liabilities for decommissioning these reactors by €20 billion. Another €33.5 billion should be added to cost of handling nuclear waste, the report says.

Juan Camilo Rodriguez, an equity analyst who is the author of the report, says that a correct adjustment of nuclear provisions would lead to the technical bankruptcy of the company.

In a statement, EDF said it "strongly contests the alleged accounting and financial analyses by the firm AlphaValue carried out at the request of Greenpeace and relating to the situation of EDF".

It says that its accounts are audited and certified by its statutory auditors, and that the dismantling costs of EDF's existing nuclear power fleet have also been subject to an audit mandated by the French Ministry of the Environment, Energy and the Sea.

Even with its huge debts, EDF's problems could be surmounted if the company was making big profits on its electricity sales, but the cost of producing power from its nuclear fleet is frequently greater than the wholesale price.

That creates a second problem − that unless the wholesale price of electricity rises and stays high, the company will make a loss on every kilowatt of electricity it sells.

The new right-wing French presidential candidate, François Fillon, promises not to retire French reactors and to keep them going for 60 years. But this cannot be done without more cost.

This is the third problem: vast sums of capital are needed to refurbish EDF's old nuclear fleet for safety reasons following the 2011 Fukushima nuclear disaster in Japan.

New nuclear stations

Even more money is required to finish new nuclear stations EDF is already committed to building. The first, Flamanville in northern France, is five years late and billions over budget. Questions over the quality of the steel in its reactor are still not resolved, and it may never be fully operational.

Add to that the need for €12 billion capital to complete the two nuclear stations EDF is committed to building at Hinkley Point in southwest England, and it is hard to see where all the money will come from.

To help the cash-strapped company, its ultimate owner, the French state, has already provided €3 billion in extra

capital this year, and decided to forego its shareholder dividend. But that is a drop in the ocean.

Mycle Schneider, a Paris-based independent international consultant on energy and nuclear policy, says: “The French company overvalues its nuclear assets, and underestimates how much it will cost to decommission them.

“However, EDF’s biggest problem is the cost of producing power from these aging power stations. The cost is greater than the wholesale price, so everything they sell is at a loss. It is impossible to see how they can ever make a profit.”

He says that is not the company’s only problem: France has not dealt with the problem of nuclear waste, and has badly underestimated the cost of doing so.

Schneider says: “With German electricity prices going down and production increasing in order to export cheap electricity to France, it is impossible to see how EDF can ever compete. It is really staggering that no one is paying any attention to this.”

Even former EDF director Gérard Magnin agrees. He resigned from the board in July as he thought the Hinkley Point project too risky for the company because of its already stretched finances. Now he says that, with the reactors closed for safety checks, the French nuclear industry faces “its worst situation ever”.[3]

The company’s troubles do not stop in France, as EDF also owns the UK nuclear industry. Ironically, it took over 15 reactors in the UK after British Energy went bankrupt in 2002 because the cost of producing the electricity was greater than the wholesale price[4] − exactly the situation being repeated now in France.

Repeated life extensions

Since the sale of UK nuclear plants to EDF in 2008 at a cost £12.5 billion[5], the company has continued to operate them, and has repeatedly got life extensions to keep them running.

But this cannot go on forever, and they are expected to start closing in the next 10 years. Once this happens, the asset value of each station would become a liability, and EDF’s mountain of debt would get bigger.

So far, the French and UK governments, and the company itself, seem to be in denial about this situation. Although 17 French reactors are currently shut down for safety checks, the company has issued reassuring statements that they will be back to full power after Christmas.

Meanwhile, to make up the shortfall from the closed reactors, electricity is being bought from neighbouring countries to keep the lights on in France, temporarily causing an increase in wholesale prices. The future remains unpredictable − but as long as there are no actual power cuts, no action is expected from governments.

Despite official denials, the calculations of many outside the industry suggest that it is only a matter of time before disaster strikes.

The cost of producing electricity from renewables is still falling, while nuclear gets ever more expensive, and massive liabilities loom. Ultimately, the bill will have to be passed on to the taxpayers.

Reprinted from Climate News Network, http://climatenewsnetwork.net/taxpayers-bill-nuclear-crisis/

References:

1. www.edf.fr/en/the-edf-group
2. www.alphavalue.fr/secure/portal/files/AV_EDF_Greenpeace.pdf
3. www.theguardian.com/environment/2016/nov/29/french-nuclear-power-worst-situation-ever-former-edf-director
4. http://bellona.org/news/nuclear-issues/nuclear-uk/2002-10-british-government-saves-british-energy-from-bankruptcy-for-now
5. www.independent.co.uk/news/business/news/edf-agrees-takeover-of-british-energy-940558.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

Subscriptions:

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

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

Contact us via:

WISE International
PO Box 59636, 1040 LC Amsterdam, The Netherlands
Web: www.wiseinternational.org
Email: info@wiseinternational.org
Phone: +31 20 6126368
ISSN: 1570-4629

TPG Post

Port betaald

WISE/NIRS NUCLEAR MONITOR
c/o WISE Amsterdam
PO Box 59636
1040 LC Amsterdam
Netherlands

PRINTED MATTER
MATTIERE IMPRIME

PRIORITY
PRIORITAIRE