

## Russian Nuclear Energy in the Wake of Fukushima<sup>1</sup>

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### Abstract

Russia has staked its future as an energy producer and high tech exporter on nuclear energy technology. The accident last year in Fukushima did not change these plans, though rising supplies of cheap natural gas present a viable competitor.

### State, Society Clash over Nuclear Policy

The energy sector is central to Russia's economic and political recovery under president Vladimir Putin. Russia is the world's leading producer of oil and gas, and has major assets in coal, hydro and nuclear power. The current energy dynamic in Russia has some serious flaws, since its Soviet-era infrastructure is in need of massive new investment, and the system must transition to a model that is based on prices that take into account market conditions and long-run externalities. The problem is that Russia's political and economic elites have found a way to make the status quo work well—very well—to their own personal benefit.

Russian civil society is not completely inert: it has proved capable of mobilizing over ecological issues, such as Lake Baikal. But the political system provides few opportunities for society to hold officials accountable, and a widespread respect for nature is not matched by a sophisticated culture of risk evaluation and safety consciousness.

The disaster that struck the Fukushima reactors in March 2011 was the most serious nuclear accident since the Chernobyl disaster of March 1996. The significance of Chernobyl as one of the factors leading to the break-up of the Soviet Union is often overlooked. Apart from the economic burden of dealing with the disaster, Chernobyl triggered a wave of protests across the country by citizens concerned about local nuclear sites. This breathed grass-roots life into the top-down glasnost campaign. After Chernobyl, Russia overhauled the safety of its reactors and no new plants were started. In the wake of Chernobyl, two plants then under construction were finished, the 4-unit Balakovo in 1988–90, and a third unit at Smolensk in 1990. After a hiatus in the 1990s, four additional reactors were completed in the 2000s, at Kalinin and Volgodonsk. The anti-nuclear movement is now struggling to gain momentum in the face of a Russian state determined to expand the nuclear industry to meet the energy challenges of the 21<sup>st</sup> century.<sup>2</sup>

### In the Wake of Fukushima

After Fukushima revealed the vulnerability of reactors to the loss of power for their cooling systems, in June 2011 Rosenergoatom announced a \$530 million program providing supplementary power and water back-up systems for its reactors.<sup>3</sup> Otherwise, the main impact of Fukushima was to make Russian natural gas more attractive for power generation in Japan and other countries such as Germany, which are newly wary of nuclear power.

However, this favorable development for Russian natural gas has been countered by the explosive arrival of shale gas on the US markets since 2008. This unexpected gas output has led to a radical drop in the price of natural gas in the US and by extension elsewhere, as the US has cut imports of liquefied gas (LNG) and may even build capacity to export LNG to Europe in the future. US customers are now paying \$2 per million BTUs, while European customers are paying \$11 and Japan is signing LNG contracts at \$17.<sup>4</sup> This radical and unforeseen development is likely to undermine Gazprom's pricing policy of long-term, take-or-pay contracts tied to the price of oil. The dawn of a new era of cheap gas poses a particular challenge to the viability of some of Gazprom's new projects, which require drilling in expensive off-shore Arctic or remote Siberian fields.

Even before Fukushima, escalating safety concerns and unresolved environmental issues, including the disposal of spent fuel and radioactive waste, were pushing up construction costs to prohibitive levels. The share of nuclear power in the generation of electricity around the world fell from 18% in 1996 to 13% by 2010. Nuclear reactors can cost \$4,000–\$5,000 or even \$9,000 per kW of installed capacity, versus \$1,000 for power stations fueled by natural gas (although the Chinese claim to be able to build reactors for \$2,000 per kW).<sup>5</sup> Russia's newest reactor, Kalinin-4, came in below \$3,000

1 An earlier version of this paper was presented at Indiana University on 6 April 2012.

2 Alisa Nikulina, "The Russian anti-nuclear movement," *Russian Analytical Digest*, no. 101, 1 August 2011. [http://kms2.isn.ethz.ch/serviceengine/Files/RESSpecNet/132291/ipublicationdocument\\_](http://kms2.isn.ethz.ch/serviceengine/Files/RESSpecNet/132291/ipublicationdocument_)

[singleddocument/799c98c8-8b61-43a6-a27e-89e6947f88e8/en/Russian\\_Analytical\\_Digest\\_101.pdf](http://singleddocument/799c98c8-8b61-43a6-a27e-89e6947f88e8/en/Russian_Analytical_Digest_101.pdf)

3 <http://world-nuclear.org/info/default.aspx?id=366&terms=russia>

4 Guy Chazan, "Shale gas: terminal decline no longer," *Financial Times*, 23 April 2012.

5 "Bandwagons and busts," *The Economist*, 10 March 2012.

per kW, while the two new blocs at Nizhnii Novgorod are projected at close to \$4,000.<sup>6</sup>

In June 2011 the German government announced it would close the country's 17 nuclear reactors by 2022. Japan is likely to follow suit. Vladimir Putin reacted to Germany's decision with the acid comment "They don't want nuclear energy; they don't want natural gas. Do they want to go back to heating with wood?"<sup>7</sup>

Nuclear power also faces an uncertain future in the US. Only four new plants are currently under construction, in Georgia and South Carolina, where regulators are able to pass the costs straight on to the customer. Nevertheless, it remains an attractive option for rising economies, such as China and India, which are dependent on fossil fuel imports, and which face more immediate environmental problems from their continued dependence on coal as a source of power generation.

### Ambitious Development Plans

Currently 16% of Russia's electricity is generated from nuclear power—less than the US, at 20%. Natural gas accounts for 48% of electricity generated followed by hydro (18%) and coal (17%).<sup>8</sup> Russia thus has room to expand its nuclear capacity—and the more electricity is generated from atomic power, the more gas can be exported to European customers.

Russia has 32 nuclear reactors, with 11 more under construction, all under the jurisdiction of the Russian Nuclear Energy Corporation, Rosatom.<sup>9</sup> Much of this capacity was laid down in the 1960s, such that over one quarter of Russia's plants are now beyond their initial 30 year operational lifetime, having been granted 10–15 year extensions. (A similar situation pertains in the US.)

In 2006 the Russian government launched an ambitious plan to spend \$55 billion, doubling the country's nuclear power capacity and raising nuclear to 25% of power generation by 2030. This means building two new plants a year from now through 2020. They are also moving ahead with the construction of floating reactors that will power remote mining communities on the Arctic shore and Kamchatka peninsula. The *Energy Strategy 2030* released in November 2009 projects nearly

doubling electricity generation capacity from 225 gigawatts (GW) in 2008 to 355–445 GW in 2030.<sup>10</sup> Nuclear capacity would grow from 24 GW in 2010 to 51 GW by 2020. During a visit to mark the opening of the Kalinin-4 plant Putin said the industry was going through a "renaissance,"—but he also had to field complaints that Rosatom no longer has any social funds to provide schools or housing for its workers.<sup>11</sup>

Since 2000 the electricity monopoly RAO EES was prepared for privatization by its head Anatolii Chubais. Regional energy companies were sold off to Russian and foreign buyers, the process being completed in July 2008—just as the global economic crisis shattered the demand projections for investors in these dilapidated generating companies. The main challenge facing investors in the electricity sector is the continuing cross-subsidization of households by industrial customers (and the subsidization of domestic natural gas customers with receipts from foreign sales.) Russian households only pay about 9 cents per kilowatt/hour compared with an EU median of 18.5 cents.<sup>12</sup> Promised annual tariff increases have lagged behind inflation and were repeatedly postponed in the face of successive waves of elections (including the December 2011 Duma election). Nevertheless, regional energy companies in Siberia are investing heavily in power stations linked to giant aluminum smelters.

In March 2008 Rosatom was given a 60% stake in Inter-RAO, the branch of the electricity monopoly RAO EES that handled foreign sales of electricity. Russia is stepping up exports of electricity to China and East Europe. In February 2010 Inter-RAO broke ground on the construction of two reactors in the enclave of Kaliningrad, with a view to exporting the surplus electricity to Poland and Germany. The move was in part a response to the closure of the Ignalina nuclear plant in Lithuania in 2009, which led to concerns of an electricity deficit in the Baltic region.<sup>13</sup> Inter-RAO has tried without success to find an international partner to co-finance the project. Lithuania has its own rival reactor project at Visaginas.<sup>14</sup>

Moscow also sees a lucrative international market for Russian nuclear engineering, which is handled by the Rosatom subsidiary Atomstroyexport.<sup>15</sup> This is one of

6 Based on the reported cost of \$3 billion and \$8 billion respectively. Vadim Ponomarev, "Atomnyi kart-blansh," *Ekspert*, 16 December 2011; Anna Pavlova, "Dorozhayushchii atom," *Kommersant*, 5 April 2012.

7 Quoted in "Undeterred by Fukushima," *Der Spiegel*, 8 March 2012. <http://www.spiegel.de/international/world/0,1518,819452,00.html>

8 <http://world-nuclear.org/info/default.aspx?id=366&terms=russia>

9 The state corporation Rosatom was formed in 2007 on the basis of the previous Federal Nuclear Agency, which had been converted from the Ministry of Nuclear Energy in 2004. The liberal economist Sergei Kirienko has headed Rosatom since 2005.

10 [http://www.energystategy.ru/projects/docs/ES-2030\\_%28Eng%29.pdf](http://www.energystategy.ru/projects/docs/ES-2030_%28Eng%29.pdf)

11 "Prime Minister Vladimir Putin meets with workers of the Kalininskaya nuclear power plant," 12 December 2011. <http://premier.gov.ru/eng/events/news/17370/>

12 <http://www.world-nuclear.org/info/inf45.html>

13 The European Union made closure of Ignalina, an RBMK reactor with no containment vessel, a condition of Lithuania's entry to the EU in 2004.

14 Marijus Antonovic, "The Baltic Nuclear Power Plant in Kaliningrad," *Geopolitika*, 3 August 2011. <http://www.geopolitika.lt/?artc=4813>

15 Ponomarev, 2011.

the few manufacturing sectors in which Russia is still competitive on international markets—the other being arms. Russia is building one in three of all new reactors under construction around the world. Atomstroyexport claims a portfolio of \$17 billion worth of orders to build 21 reactor units in China, India, Bangladesh, Belarus, Vietnam, and of course Iran, where the Bush-ehr reactor is ready for start-up.<sup>16</sup> Ten of these contracts were added in the past year.

Back in 2009 Germany's Siemens had cut its ties with France's Areva and instead announced its intention to partner with Rosatom to build reactors in developing countries. But in September 2011, in the wake of Germany's decision to give up nuclear power, Siemens withdrew from the Rosatom partnership.

For uranium to fuel the dozens of new domestic and international reactors, Rosatom had to look beyond domestic sources, which account for just 10% of the global supply. In the past two years Rosatom has spent \$2 billion purchasing uranium deposits in Kazakhstan, Tanzania, and elsewhere, mainly through its acquisition of a controlling stake in the Canadian company Uranium One by its subsidiary ARMZ. The International Uranium Enrichment Center at Angarsk takes in radioactive waste from other countries that lack their own facilities and processes it for re-use in reactors. Russia now accounts for 40% of the global enrichment market.

Rosatom's export strategy suffered a blow in March 2012 when the Bulgarian government announced it was terminating the nuclear plant at Belene. Construction of a VVER reactor at the site had been halted in 1990, and only in 2008 did Rosatom win a contract to complete the project. Bulgaria had invested close to \$1 billion in Belene, and will have to compensate Rosatom for its outlays, another \$150 million. The Bulgarians concluded it was more cost-effective to build a new gas-fired power plant—using gas that will be imported from Russia. (Bulgaria is backing the planned South Stream pipeline across the Black Sea.) Apart from cost considerations, safety concerns are causing problems at some Rosatom projects. In October 2011 protestors managed to halt work at Rosatom's Koodankulam site in Tamil Nadu, at the southern tip of India. The first of the two reactors there may become operational at any time.

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Most of Russia's 32 reactors utilize the VVER pressurized water design technology. Experts believe that the RBMK type reactor, the sort that exploded at Chernobyl, is seriously flawed in that it relies on a graphite moderator and water coolant, increasing the chances of meltdown if the coolant leaks, particularly since it lacks a containment vessel. All 11 RBMK reactors in Russia (clustered at three locations) are still in operation, though they are due to be closed down by 2024. (They are all past their initial 30 year projected lifespan.) The European Union has insisted that RBMK reactors be shut down in Ukraine and Lithuania.

In Russia there was a protracted debate over whether to spend an additional \$1–2 billion to complete the Kursk-5 RBMK reactor, which is 70% finished. On the eve of the Fukushima anniversary, on March 1, 2012, Rosatom announced that the plant will be abandoned—a signal victory for the environmentalist movement.<sup>17</sup>

Russia is a leading source of greenhouse gases and was a passive spectator to the Kyoto Protocol. It finally joined in 2004, but the fact that its emissions were locked in at 1990 levels, before the 1990s deindustrialization radically cut Russian emissions, meant that this was an empty gesture. It would not obligate Russia to curb emissions, and would allow Moscow to profit from the sale of unused carbon credits. Russia is one of the few countries that sees itself as standing to gain from climate change, from a longer growing season to an Arctic maritime trade route to Asia. With Russia on the brink of joining the WTO, it will be crucially important to get Moscow involved as a leader and not just an opportunistic bystander in tackling climate change.

#### **Conclusion**

Russia sees the expansion of nuclear power as part and parcel of its aspiration to the status of an energy superpower. Constructing new reactors at home and abroad frees up natural gas for lucrative export and may reverse the shrinkage of Russia's high-tech manufacturing base. The accident at Fukushima has not made a dent in this national industrial strategy. However, the current slump in global natural gas prices poses a serious challenge.

16 Sergei Kirienko press conference, 23 March 2012. <http://www.rosatom.ru/>

17 Vadim Ponomarev, "Fukusimy' v Kurske ne budet," *Ekspert*, 7 March 2012.