



ROSATOM RISKS

**EXPOSING THE TROUBLED HISTORY OF
RUSSIA'S STATE NUCLEAR CORPORATION**

October 2014

GREENPEACE

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Russia’s state nuclear corporation

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Greenpeace has campaigned for decades both against nuclear companies and against the governments that support them. Our position is that all nuclear reactors are dirty, dangerous, and unnecessary.

Countries with nuclear reactors subject their citizens to unnecessary risks and costs. A serious nuclear accident threatens people in a wide area. The enormous costs of bringing an accident under control, cleaning up and decommissioning highly dangerous nuclear facilities end up being paid by taxpayers. That’s because an unfair global system protects the nuclear industry from the costs of its disasters, and increases risks to people. Also, taxpayers, not companies, compensate victims, who are not treated fairly under this system.

Greenpeace campaigns widely against nuclear companies. We have highlighted the design, safety and cost concerns, and other issues, of French company Areva’s European Pressurised Reactor (EPR). Areva’s EPRs in Finland and France have serious flaws and are significantly over budget and delayed.

We have addressed the inadequacy of safeguards at the Rokkashomura plant in Japan for reprocessing waste nuclear fuel; the concerns about France exporting its nuclear waste to Russia; and the fears about nuclear waste shipments between Germany and France.

More recently, Greenpeace has campaigned to make GE, Toshiba and Hitachi pay some of the costs of the Fukushima disaster of March 2011 in Japan. All three companies built flawed reactors at Fukushima. Yet, they are not held responsible for helping with costs.

In Europe, excluding Russia, we have highlighted the dangers of the 151 nuclear reactors that operate in the midst of millions of vulnerable people. More than half these reactors are over 30 years old. Yet, many European governments want to extend the life of some of these old, decrepit nuclear reactors and subject their citizens to even higher risks.

As the safe alternative to nuclear power, Greenpeace promotes the development of renewable energy.



EXECUTIVE SUMMARY

Rosatom, the state nuclear corporation of Russia, is actively pursuing expansion domestically and abroad, despite the decline of the nuclear industry globally.¹ Rosatom is a questionable business partner, plagued by concerns over corruption, the safety and quality control standards of its nuclear reactors, its competence at building and operating nuclear plants, its model for financing projects, and concerns over its ability to complete construction on time and on budget.

While Rosatom is the focus of this report, Greenpeace has campaigned extensively against other nuclear companies. For years Greenpeace has identified the risks of reactors from Areva in France, General Electric (GE) in the US, Atomic Energy of Canada Limited (AECL) in Canada, Toshiba and Hitachi in Japan, various reactors in South Korea, India, Turkey, Europe and elsewhere. In addition, Greenpeace takes on the nuclear policies of countries that put their citizens at risk by developing and promoting dangerous nuclear power.

Rosatom optimistically projects significant increases in foreign orders at a time when nuclear power is outpaced and overpriced, and is in competition with modern, safe, clean and affordable renewable energy alternatives, such as solar PV and wind power.

Although Rosatom has recently broadened its foreign portfolio by bidding on projects in well-established nuclear states, at the heart of its expansion dream is its new business model of “Build-Own-Operate” (BOO). Under this model, Rosatom offers to attend to all aspects of construction and operation of a nuclear project. Theoretically, this model would allow a nation to become a nuclear state even though it has little to no knowledge and infrastructure in place to support operation and oversight of a nuclear reactor.

Close examination of Rosatom's track record shows the Build-Own-Operate model is not an ideal arrangement for foreign clients. The concerns over Rosatom as a business partner, as well as the risks embodied in its offer, under the model, to take back spent nuclear fuel generated at its reactors in other countries raise serious red flags for any country considering doing nuclear business with Rosatom.

In addition, not only does the model increase dependency on Rosatom to operate nuclear reactors, it also increases dependency on imported uranium.² Rather than achieving energy independence and security, countries would be going in the opposite direction.

In 1991, when it was created, the Russian Federation inherited the nuclear programme of the former Soviet Union, which had placed the responsibility for both civil and military programmes within the purview of the same agencies. This inheritance brought with it a culture of secrecy and significant safety concerns. Post-Soviet disorder resulted in corruption. Although Rosatom is a fairly new entity, it is the successor agency to both Soviet and post-Soviet state nuclear agencies.

Some things undoubtedly remain unchanged. One of Rosatom's predecessor agencies oversaw the worst nuclear disaster in world history. While Rosatom claims to have learned from the Chernobyl catastrophe and improved the safety of its reactors, it continues to operate Soviet-era reactors, and has completed construction of three reactors that were started under the Soviet government. The safety of these old reactors and reactor designs, as well as the safety of new designs, could be compromised by the apparent and significant concerns with Rosatom about corruption and quality control. Rosatom has also repeatedly failed to deliver its reactor construction projects abroad on time and on budget, and has failed to meet its own projections for expansion.

Although Rosatom receives significant financial backing from the Russian government, financial analysts are already voicing scepticism³ as to whether Rosatom could financially support its foreign expansion goals under the BOO model. However, should other countries agree to binding nuclear contracts, similar to the contract Hungary signed in April 2014 with this Russian state corporation, the burden, financial risks and cost overruns for which Rosatom is known would be borne by the foreign governments and taxpayers.

Further, although Rosatom's offer to take back and reprocess highly radioactive spent fuel from its foreign reactors appears to offer a solution to the unsolvable burden of nuclear waste, this is hardly a solution to the waste problem. There will still be onsite risks since the radioactive waste must be cooled for years before it can be transported. In addition, the transport of nuclear waste itself would put communities along the route at risk, while the final reprocessing in Russia would generate an even greater volume of radioactive wastes.

Reprocessing has been rejected in some nations, such as the US, due to the increased risks of the proliferation of nuclear bombs from reactor-grade, but weapons-usable plutonium. The Russian Federation claims the reprocessed waste would be used for its fast- breeder reactor programme, not only has the programme been a failure – as such programmes have been in every nation – but the Russian government already has one of the largest stockpiles of reactor-grade, weapons-usable plutonium in the world.⁴

Rosatom's offer to reprocess spent foreign fuel would only increase Russia's stockpile of dangerous plutonium for no apparent or immediate use. Finally, Rosatom has secured a legislative loophole⁵ that would allow it to ship the radioactive wastes generated by reprocessing back to the country of origin – thus creating a problem that the countries that sign into a reprocessing deal with Rosatom would likely be seeking to avoid.

In sum, Rosatom presents considerable and troubling problems as a potential business partner, from finance to performance to significant safety concerns.



Houses in Muslyumovo village, one of the country's most lethal nuclear dumping grounds. © Denis Sinyakov /Greenpeace

INTRODUCTION

Since the mid-2000s, the Russian State Atomic Energy Corporation (Rosatom) has controlled Russia's domestic nuclear programmes, both military and civil, based on what was launched in the 1940s by the Soviet Union and inherited by the Russian Federation when it was formed in 1991.

Today, Russia and Rosatom have a secretive nuclear empire with little separation between the military nuclear programme and nuclear power used for generating electricity.⁶ This empire of nuclear facilities, infrastructure, closed cities, and hundreds of thousands of employees stretches across the vast expanse of the country, and has been built with decades of investment.

Rosatom operates nuclear reactors that have proven to be some of the most dangerous in the world.⁷ Of the nine reactors currently under construction, three were begun during the pre-1991 Soviet period, and the remaining six were begun in and after 2007.⁸ One central strategy of Russia through Rosatom has been to establish itself as a major supplier internationally, participating in bids all over the world, and sometimes taking over existing programmes that have lost the interest of their original investors.⁹

Those countries entertaining or signing contracts with Rosatom are aligning themselves with a nuclear programme that has a history of serious accidents. The most dramatic example was the 1986 Chernobyl nuclear accident in Ukraine.

So enormous were the political, societal, environmental and economic impacts of the accident that the last leader of the Soviet Union, Mikhail Gorbachev, described the Chernobyl disaster as the real cause of the collapse of the Soviet Union.¹⁰ In addition to the human and environmental consequences, the accident cost hundreds of billions of dollars.¹¹

The cost of Chernobyl may have been a surprise to countries with nuclear energy programmes, but it should not have been. The potentially enormous costs of a nuclear accident were known from the earliest days of nuclear power.¹² Western governments that were committed to supporting nuclear power devised elaborate incentives and subsidies to encourage nuclear expansion¹³ – which externalised much of the financial risk associated with nuclear accidents.

Rosatom operates nuclear reactors that have proven to be some of the most dangerous in the world. Of the nine reactors currently under construction, three were begun during the pre-1991 Soviet period, and the remaining six were begun in and after 2007.

The 1986 Chernobyl disaster exposed the massive environmental and economic consequences of a major nuclear accident. The disaster was a significant blow to the future development of the nuclear industry. Since Chernobyl, the nuclear industry has focused more and more on keeping the existing fleet of nuclear reactors running while also building some new reactor projects, largely in the quickly growing economies of Asia.¹⁴

In contrast, successive Russian governments have promoted expansion of nuclear energy both at home and abroad. Russia, through Rosatom's enormous nuclear infrastructure, continues to operate Soviet-era nuclear reactors, while also building new ones. In the last 10 years, the government has frequently announced its ambitions to dramatically increase its domestic nuclear power programme, and also to extend its influence over the global nuclear industry by securing foreign contracts in Europe, Asia, and the Middle East.

This Russian effort at expansion has been mirrored in Western nuclear countries, which in the last decade and a half have promoted the idea of a "nuclear renaissance" with large-scale nuclear expansion. That supposed renaissance has, in fact, become a nuclear reversal.¹⁵

While the ongoing Fukushima Daiichi catastrophe has once again shown the enormous human, environmental, and economic costs of nuclear power, the decline of the nuclear industry was evident before 2011.¹⁶ In addition to the Fukushima disaster, other factors have contributed to the crisis in the nuclear power industry, including cost, safety, and issues related to the ageing of reactors. In addition, the increasing cost-competitiveness and development of renewable energy – which can be installed more quickly and at lower cost¹⁷ – are undermining nuclear energy. The 2013 edition of the World Nuclear Industry Status Report shows how deep the decline has become; nuclear power's share of the global energy supply continues to dwindle.¹⁸ In 2012, for example, electricity generation worldwide from nuclear plants dropped by a historic 7%, adding to the previous record drop of 4% in 2011.¹⁹

The decline in nuclear energy and stalled expansion in the West has apparently eroded the ability of Western suppliers to construct and operate nuclear power plants. This loss of technical expertise was summarised by Mr Václav Bartuška, a Czech Republic government envoy charged with evaluating candidates – which included Westinghouse, Areva and Rosatom – in a tender for nuclear expansion at the Temelín site:

I visited all construction sites of all our candidates. It is remarkable, with what effort the nuclear industry in the world seeks to counter its many years of decline. Nevertheless, the weaknesses of the entire sector are evident. There is a lack of basic blue-collar workers, above all specialised welders and installation workers for valves and fittings, but also higher experts: project managers on all levels.

But the largest shortage is in experts that prepare the start-up of the reactor and its connection to the grid. Those who commissioned the reactors of the second generation are in the best case retired. (The newest reactors in the EU are Temelin 1+2 that were started up in 2000-2001; the majority of the 437 reactors in the world is older than thirty years, the average age of the 143 reactors in the EU is even higher.) Furthermore, the power stations of the third generation are different from those older ones. The reactor itself has changed relatively little – but all control and safety systems, sensors and computers have undergone decades of large transformation.²⁰

*That supposed renaissance
has, in fact, become a
nuclear reversal.*

In contrast to nuclear power, renewable-energy development has continued its rapid expansion in both capacity and generation. China, Germany and Japan – three of the world's four largest economies – as well as India, are now generating more power from renewables than from nuclear power, and this in spite of China also being one of the few countries expanding nuclear energy.²¹ In 2012, wind produced almost 500 Terawatt hours (TWh), and solar power about 100 TWh more than in 2000.²² While renewables continued to increase their share of supply, nuclear power lost major ground – generating 100 TWh less.²³ In 2012, for the first time, China and India generated more power from wind than from nuclear plants, and in China solar electricity generation also grew by 400% in one year.²⁴

While nuclear energy is largely in decline globally, some nations, in particular China, Japan, South Korea, India, and Russia, are pushing forward with domestic projects to build new reactors.

An important issue arises with Rosatom's push to significantly expand its international nuclear trade, namely is a Russian state-backed corporation a wise choice as a business partner?

In order to answer this question, this Greenpeace report explores three critical areas of Rosatom's operations. This examination is similar to Greenpeace analyses of other nuclear suppliers and operators, such as Westinghouse and Areva, in multiple countries.

First, we examine the peculiar legal framework of Rosatom. The nuclear programmes currently run by this state corporation were initiated by the First Main Directorate of the Council of People's Commissars of Stalin's Soviet Union. It later became a ministry and then finally attained its current legal status as a state corporation. This report also provides an overview of the difficulties and conflicts of interest, and corporate cultural issues, like secrecy, that can arise from consolidating both the industries for nuclear weapons and nuclear power into one entity. In addition, we look at the impacts of Rosatom's financial model that requires federal money to fund itself, but also generates profits from the corporation's business activities.

Second, the report exposes the weaknesses of Rosatom's operational model, including problems with nuclear safety, corruption, the poor handling of nuclear waste, and the risks of the proliferation of nuclear bombs from the company's nuclear waste import deals. We provide a number of examples where these weaknesses in the Rosatom framework have led to problems or even acute danger.

Finally, the report analyses the performance of Rosatom's international activities, in particular how challenges at its foreign reactors parallel its domestic quality-control and safety problems.

This report also discusses Rosatom's expenses and prices at different points in time – focusing on the potential costs to both Russian citizens and foreign-export clients. Since the Russian rouble has been a highly volatile currency, all sums are also given in the approximate amount of the euro as of the conversion date indicated in the footnotes to provide clarity in the cost development.²⁵



A signpost near the Chernobyl nuclear facility in Ukraine.
©Greenpeace / Steve Morgan

ROSATOM'S ROLE IN RUSSIAN STATE ADMINISTRATION

The Russian nuclear energy programme was born during World War II, and its immediate aftermath, when the Soviet Union and the US competed to produce nuclear weapons, resulting in the nuclear arms race.²⁶ After the collapse of the Soviet Union in 1991, the newly born Russian Federation consolidated all civil and military nuclear activities under the Ministry of Atomic Energy of the Russian Federation or Minatom. In 2004, the Federal Agency on Atomic Energy replaced Minatom but the functions remained essentially the same. In 2007, the agency was turned into a state corporation, governed by its own special legislation, and renamed the Russian State Atomic Energy Corporation, or Rosatom.²⁷

Rosatom today is a Russian state corporation that owns and operates most of the Russian civil and military nuclear functions. Rosatom operates Russia's nuclear power plants, and is responsible for nuclear reactor exports, the development of nuclear technology, nuclear waste storage and disposal, plutonium reprocessing plants, uranium mining and enrichment, nuclear fuel production, nuclear icebreakers, nuclear medicine, as well as nuclear weapons production companies, and related research institutes.²⁸

Rosatom is directed mostly by the President of the Russian Federation, but also, to some extent, by the Russian government. Rosatom's Director General and all members of its Supervisory Board are appointed directly by the President.²⁹

It is important to understand that it is the Russian government that sets Rosatom's long-term objectives, and also grants it funding from the Russian federal budget for both military and civilian operations. An internal auditing committee appointed by the Supervisory Board is the only agency that monitors Rosatom's activities on a regular basis.³⁰

There are also significant overlaps in personnel between Russian government officials and members of the Supervisory Board.³¹ For example, the Rosatom Director General is the former Prime Minister of Russia, Sergei Kiriyenko.³² The Supervisory Board consists of the Russian Minister of Energy and a number of security officials and personal advisors to President Vladimir Putin.³³

Rosatom has a unique legal status within the Russian government, which provides it certain special protections.³⁴ Outside of the strategic direction of the Russian government and President, Rosatom has an unusually high degree of autonomy.³⁵ Russian federal authorities, authorities of the constituent entities of the Russian Federation or local authorities have no right to interfere with Rosatom's activities, except in special cases, are defined in law.³⁶ The creditors of the corporation do not have to give their consent to their claims being transferred to a new organisation in case of corporate restructuring. Rosatom is also excluded from obligations to make public its activities, expenditures or use of property.³⁷ The Director General also has the right to classify information as state secrets, as provided by Russian Federal Law.³⁸

The definition of state secrets is quite broad, including *"design, construction, operation and safety practices of nuclear facilities, physical protection of nuclear materials, their derivative products, nuclear plants, nuclear storage facilities and the protection of dangerous nuclear and radiation facilities"*.³⁹

Therefore, Rosatom has been exempt from some of the standard requirements that both commercial, and non-commercial companies are obligated to provide. Thus, the public oversight and scrutiny that come with public transparency – and can help to prevent corruption, quality-control issues, and safety problems – are eliminated.

FACTS⁴⁰

- Rosatom employed an average of 256,400 people in 2012.
- Rosatom's EBITDA was almost 140.8bn roubles (€3.49bn⁴¹), with direct funding from the state budget of 119.9bn roubles (almost €2.97bn⁴²) in 2012.
- According to Rosatom, 44% of Russia's population support the development of nuclear power generation.

ROLE OF STATE SUBSIDIES IN ROSATOM'S NUCLEAR POWER OPERATIONS

Russia's civil nuclear fleet consists of 33 operating reactors, with a total capacity of almost 25 GWe. This makes it the world's fourth largest nuclear nation after the US, France and Japan.⁴³ In terms of nuclear utilities, Rosatom has more reactors than any other utility worldwide, with the exception of Électricité de France (EDF).⁴⁴ While Rosatom plans to expand rapidly in Russia, history shows that its ambitious plans have consistently failed to materialise. For example, in the last 10 years, three reactors have begun operation: one in 2004 after nearly 20 years of construction, one in 2010 at Rostov after 27 years of construction, and one in 2011 after 25 years of construction.⁴⁵ It currently has nine nuclear reactors under construction – two of which are seaborne-floating reactors – with 31 reactors planned and 18 proposed.⁴⁶

Rosatom has pursued international expansion both through procurement contracts and through the ownership of foreign nuclear generating assets,⁴⁷ sometimes combining these two into a model called "Build-Own-Operate" (BOO).⁴⁸ Rosatom's ambition is to have orders for 80 international reactors by 2030,⁴⁹ and it is currently in negotiations or at some stage of planning or building for 19 reactors outside Russia.⁵⁰ However, the Russian nuclear industry has historically over-promised and failed to meet its domestic targets and deliver on declared international sales.⁵¹

In addition to nuclear power generation, Rosatom also provides almost a fifth of the nuclear fuel globally,⁵² including 27% of the uranium used by the nuclear utilities in the EU.⁵³

In the complicated framework of overlapping functions, it is hard to determine how funds are allocated within the various functions of this Russian-state corporation, i.e. which are paid for with public money and which are funded through commercial profits. Rosatom's financing is no exception to this opaqueness.

The capital expenses of Rosatom's fleet of Soviet-era nuclear reactors were amortised a long time ago, which is reflected in low production prices for nuclear generation. According to Rosenergoatom, Rosatom's subsidiary that handles nuclear electricity generation and sales in Russia, the average weighted selling price of Russian nuclear power in 2012 was 914.63 roubles (around €22.7)⁵⁴ /MWh with a total production of 177.3 TWh/a.⁵⁵

According to an analysis by the Russian power market news agency, Big Power News,⁵⁶ Rosatom's revenues have been falling while its costs have been increasing, partly due to the amortisation costs of new capacities.⁵⁷

It also appears that the costs for nuclear power generation in Russia are kept artificially low by using state money to cover a significant portion of the company's expenses – though again, the exact allocation of funds, whether to civil or military nuclear programmes, remains unclear.

In 2012⁵⁸, according to Rosatom, it paid 82.4bn roubles (€2.04bn⁵⁹) in taxes and received 119.9bn roubles (€2.97bn) from the Russian federal budget. Therefore, Rosatom's activities produced more than 30% less tax income than Russia spent on the corporation. A major part of the income from the federal budget, 58.2bn roubles (€1.44bn), was spent on building new reactors in Russia while another 876m roubles (€21.73m) was spent on improved radiation-protection measures. Other Russian federal budget spending went mostly into research and development programmes, including more than 10bn roubles (€248m) for the development of new reactor technologies.

Besides direct federal subsidies to Rosatom, the corporation also benefits from some indirect subsidies. For example, it is provided land-use tax relief for its nuclear power stations.⁶⁰ It also receives the enormous economic benefit of being permitted to dispose of liquid radioactive waste by underground injection,⁶¹ which is far less expensive – though environmentally damaging – than glassification or other technologies and provides such savings that it is effectively an indirect subsidy.

While the reported costs for nuclear generation appear low, in reality Russia has no special solution that provides cheap nuclear power, since the costs are simply not fully covered by the nuclear industry itself but rather are externalised to the public – both domestically and in its reactor exports. This financial model, combined with the legal framework that grants unique protections and exemptions and minimal external scrutiny allows Rosatom to function almost like a state within a state – which has led to a number of safety, quality control, and corruption problems.

The entrance to 30km zone around the Chernobyl power station in 1995.
© Clive Shirley / Signum Greenpeace

COST OVERRUNS, DELAYS, SAFETY ISSUES AND CORRUPTION IN RUSSIA

Although Russia's allocation of federal money to Rosatom has provided the support for its domestic and foreign activities that many nuclear vendors and operators in other countries lack, the company has still suffered from many of the same problems plaguing the rest of the industry, including: delays, cost overruns, safety problems and quality-control failures. In addition to the usual problems, Rosatom's special structure, halfway between a military complex and an enormous international corporation, has apparently fostered an environment where some major corruption issues have taken root.

COST INCREASES AND DELAYS IN CONSTRUCTION

As illustrated in the first part of this report, the Russian government has provided significant federal financial support and legal exemptions for the Russian nuclear programme. However, this Russian government support does not seem to have insulated Rosatom from many of the problems plaguing the global nuclear industry.

The high costs associated with the construction of new reactors for Rosatom's flagship series of reactor designs – the Water-Water Energy Reactor (VVER) – are but one example of the problems Rosatom faces. Rosatom promotes its VVER reactor when bidding on new-build projects in foreign countries.⁶²

In 2005, the Russian Society for Nature Conservation and Greenpeace Russia set up an independent scientific committee to conduct an environmental impact analysis on the new-build project at the Russian Balakovo nuclear power plant.⁶³ For comparison, the committee examined the most recent completed nuclear reactor at the time, the VVER-1000 type Unit 3 of the Kalinin nuclear power plant.

The expert committee found that while the completion of the reactor project was estimated to cost 8.2bn roubles in 2001 (around €303m⁶⁴), the final cost of the project in 2005 was 27.3bn roubles (around €801.86m⁶⁵), over **triple** the original estimate in roubles.⁶⁶

The story of the price increases is not limited to Kalinin.

In 2000, the predecessor to Rosatom estimated the cost to build two new VVER-1200 reactors at the Leningrad nuclear power plant 2 in Sosnovyi Bor at 46.9bn roubles (€1.74bn⁶⁷).⁶⁸ However, by 2011, Rosatom set a target price of 156bn roubles (€3.73bn⁶⁹) for this type of project, more than tripling the original price in roubles.⁷⁰

Part of the reason for the higher-than-expected prices may be the pattern of significant delays in Rosatom's nuclear reactor construction.

According to the World Nuclear Association (WNA), a global nuclear industry lobby organisation, the completion dates of many Russian reactors have been pushed back – sometimes significantly. For example, at the end of 2012, the Leningrad 2 nuclear power plant was slated to achieve grid connection in October 2013. However, just before the estimated completion date, the grid connection was unexpectedly pushed back to 2016.⁷¹

Similarly, the VVER 1200 Baltic-1 project near Kaliningrad has been subject to international opposition as the Environmental Impact Assessment does not comply with Russian norms and has not been adequately discussed with neighboring countries.⁷² In May 2013, construction of the Baltic-1 was “reported halted”⁷³, “as the possibility to export its power appears less certain”, due to lower-than-expected demand and a lack of investments in transmission infrastructure.⁷⁴

Rosatom’s experimental projects suffer from significant delays, like many “new” nuclear-reactor-construction projects around the world, despite generous state funding for research and development. For example, Rosatom began a project to build a floating nuclear reactor on the Academic Lomonosov barge in 2007 with completion estimated for 2010. By June 2013, completion was pushed to 2019.⁷⁵ The history of the development of the prototype fast breeder reactor BN-800 is an even more aggravated case of significant delay. Construction began in 1985. Rosatom recently announced the first criticality, after nearly three decades of construction.⁷⁶ The corporation says it plans to connect the reactor to the grid before the end of 2014.⁷⁷

As mentioned earlier, Rosatom competed in a tender for the expansion of the Czech Temelín nuclear power plant with Areva and Westinghouse. Between 2010 and 2014, Mr. Václav Bartuška served as the Czech government envoy for this expansion. In his final report to the government of the Czech Republic, dated 6 August 2014, Mr. Bartuška characterised his evaluation of Rosatom:

Asking about some things – for instance the price of delay – sometimes just made no sense.

Otherwise, the fate of both Russian projects of the third generation are quite similar with the story of the others [Areva and Westinghouse]: the construction was agreed well before the final project was in the world; the supply chain fell apart, so that for special parts unique, time- and finance-consuming solutions have to be found; a lack of mid-level project managers. In Russia on top of that still always the splitting rivalry between Moscow and St. Petersburg.

When I was last year for the third time at Leningradskaya II, the shift against the original timetable was four years.⁷⁸

These significant delays are hardly unique to Rosatom, as most other nuclear suppliers and operators worldwide experience similar problems – which is again one of the reasons nuclear has been losing record percentages of its global supply share,⁷⁹ and will likely continue to do so in light of rapid and cheaper renewable energy development. In addition to the financial risks and costs associated with extended nuclear construction delays, there are also major unresolved safety issues.

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SAFETY ISSUES AT RUSSIAN NUCLEAR POWER PLANTS

With regard to the safety of Russian reactors, it is important to keep in mind that Rosatom is the Russian-government entity whose predecessors were responsible for some of the worst accidents in the history of nuclear power generation.

The most well known is the Chernobyl nuclear disaster of 1986, the world’s worst nuclear catastrophe. The meltdown and explosion in the RBMK nuclear reactor located in Ukraine released 100 times more radiation than the nuclear bombs dropped on Hiroshima and Nagasaki.⁸⁰ The power of the explosion, fire and reactor meltdown carried the radioactive plume to high enough altitudes that it deposited radionuclides thousands of kilometres away, sweeping across the whole of Europe and contaminating vast tracts of land. Between 125,000 and 150,000km² of land in Belarus, Russia and Ukraine were contaminated to levels requiring the evacuation of people or the imposition of serious restrictions, including restrictions on land use and food production. The land area affected is roughly equivalent to the area of Bangladesh, or nearly five times the size of the Netherlands.⁸¹ From a long-term perspective, the most significant form of contamination is with caesium-137. Given its half-life of 30 years, it will take several centuries for the radioactive pollution to decay.⁸²

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A lesser known, but major nuclear accident, occurred decades earlier. On 29 September 1957, a large storage tank filled with radioactive waste exploded in the waste-processing facility of Mayak in South Urals, contaminating a large area of between 15,000 to 20,000km²,⁸⁴ leading to the evacuation of 10,000 people from 23 settlements. As of today some 180km² near the site of the explosion is still officially off limits.⁸⁵

While there have not been events of the extreme severity of either of these incidents in recent years, Rosatom continues to have problems with safety issues in its new power plants – a red flag for potential clients. Although Rosatom claims to have learned from these accidents, a close examination of its safety and quality-control record raises significant doubts. Those issues could result in reactor safety issues with potentially serious consequences.

CASE STUDY 1

INCIDENTS AND SAFETY ISSUES IN THE KALININ NUCLEAR POWER PLANT

Rosatom's most recent reactor start-up of reactor 4 at the Kalinin nuclear power plant highlights the latest safety issues with domestic new-build reactors.

Reactor 4 at the Kalinin plant achieved criticality for the first time on 20 October 2011.⁸⁶ Between 15 November 2011 and 15 January 2012, the new unit experienced 11 incidents⁸⁷ – including potentially serious issues such as the emergency shutdown of the reactor due to decreasing pressuriser levels and several instances where the primary circulation pump responsible for transferring water through the reactor failed for different reasons.⁸⁸ These not only raise safety concerns, but also expose the myth that nuclear reactors– even new-build reactors – are a stable source of energy, since such repeated shutdowns significantly compromise reliability.

But the worst of these early incidents occurred at another Kalinin NPP unit on 26 November 2011 when a hydrogen explosion inside the nuclear power plant led to a leak of possibly radioactive gases to the reactor containment building.⁸⁹ The extent of the damage has not been publicly disclosed.

These early safety-related incidents foreshadowed the on-going problems with the new Kalinin Unit 4 reactor opened by then Prime Minister Vladimir Putin on 12 December 2011, in the middle of the series of incidents.⁹⁰ It was granted a commercial operating licence in September 2012.⁹¹ According to a Rosatom internal inspection report, the reactor experienced five technical failures in 2013, one of them leading to an automatic shutdown of the reactor, and in March 2013, Kalinin 4 was again closed for an overhaul of nearly two months.⁹² The internal report cited the lack of qualified staff leading to an overall low quality of maintenance as the primary reason for problems.⁹³

CASE STUDY 2

THE CONSTRUCTION OF THE LENINGRAD 2 NUCLEAR POWER PLANT

Other new reactors in Russia also have potentially serious issues. In July 2010, the prosecutor's office of Sosnovyi Bor and the Russian nuclear regulator, Rostekhnadzor, found that the Leningrad 2 construction site had serious problems with its working conditions. Among the concerns were incidents of noncompliance with fire safety standards, as well as a lack of proper sewers and running water. Since Rosatom failed to react to these concerns, a court suspended work on site on 29 December 2010 by request from the prosecutor's office.⁹⁴

However, soon after the court order was overturned on 11 January 2011, a strong wind caused a 14-metre-high reinforcement structure to collapse at the Unit 1 construction site that same month. Fortunately, a foreman managed to evacuate the workers before the structure fell on them.⁹⁵

In June 2011, during a visit of a delegation from Baltic Sea countries, the Director General of the Finnish nuclear regulator STUK, Jukka Laaksonen, affirmed that the construction and design of the reactors were of the highest quality.⁹⁶

This assessment soon proved to be false. On 17 July 2011, a 600-800-tonne reinforcement cage of the containment building fell on its concrete frame⁹⁷. By a stroke of luck, the workers were having lunch at the time and the incident did not result in any casualties. The weight of the cage caused the concrete frame to crack and the entire structure had to be replaced – causing major additional costs and a delay of approximately one year for the project.⁹⁸

Following his grossly flawed review of the safety and quality of the Leningrad 2 construction, Laaksonen left his position at the Finnish regulator STUK, and soon after became the Vice President of the Rosatom international sales unit Rusatom Overseas.⁹⁹

ADEQUACY OF QUALIFIED STAFF

In 2006, Rosatom had only approximately 5,000 professional construction workers, well below the number needed to scale up its ambitious programme to build new reactors.¹⁰⁰ By 2012, Rosatom managed to considerably expand its construction staff. However, many of these workers were poorly paid migrants from the former Soviet republics. According to a local NGO working at the site of the Leningrad nuclear power plants, the workers were subjected to living conditions akin to slave labour. They lived in unhygienic, cold barracks, were paid very low salaries, and often Rosatom officers confiscated their passports to prevent them from leaving the site.¹⁰¹

CORRUPTION IN ROSATOM'S ACTIVITIES

Rosatom, and its predecessors, have had serious and widespread corruption problems, likely due, at least in part, to the structural lack of transparency and external accountability. Between 2009-2012, Rosatom fired 68 executives and 208 mid-level managers due to corruption charges.¹⁰²

One recent allegation of corruption relating to the top management at Rosatom was the case of Rosatom's Deputy Director General, Evgeny Yevstratov. He was responsible for nuclear safety. Yevstratov quit his job at Rosatom in April 2011, and was arrested in July on suspicion of embezzling 50 million roubles (around €1.2mn¹⁰³).¹⁰⁴

In November 2012, Yevstratov was released on bail but the case continued.¹⁰⁵ Originally Yevstratov was only accused of collaborating with his staff in claiming that research material was his own rather than copies taken from the internet, and pocketing the money intended for research.

Later investigators found that Yevstratov and another high-level Rosatom executive, Mustafa Kashka, the Deputy Director General of the corporation's subsidiary Atomflot, may have embezzled an additional 60m roubles (around €1.5m¹⁰⁶) intended for reprocessing of nuclear waste.¹⁰⁷ The court case against Yevstratov is still pending as of June 2014.

Besides its own corruption problems, Rosatom has also had serious issues with some of its subsidiaries.

For example, in 2010, Transparency International Russia and a Kaliningrad-based NGO, Ecodefense, together conducted a detailed review of 200 orders that had been publicly placed on the Rosatom website. The NGOs found that 83 out of 200, or more than 40%, of the orders violated the Russian procurement standards regarding compliance with order placement processes, transparency, and/or use of public money.¹⁰⁸

Some of these cases connected with the violation of procurement standards have gained publicity inside Russia.

In December 2010, investigative journalists at the Kommersant newspaper reported that Alexei Votyakov, the Director General of the Rosatom waste subsidiary, RosRAO, and his Managing Director, Maxim Belyaev, had purchased nuclear waste containers at a cost of 450m roubles (around €11m¹⁰⁹).¹¹⁰ This was estimated to be several times above the normal market price. Rosatom's own investigation found that the containers were bought without a legally required tender, and in violation of Rosatom's internal procedures.¹¹¹ RosRAO's archives also had letters of acceptance for some undelivered containers. Both men were subsequently fired and prosecuted.¹¹² As of June 2014, there has been no final ruling in this case.

Rosatom's corruption problems have resulted in potentially serious compromises of nuclear safety both domestically and abroad.

One of the cases that gained broader international attention involved Sergei Shutov, the Procurement Director of ZIO-Podolsk, a nuclear construction subsidiary of Rosatom. He was charged in December 2011¹¹³ with collaborating to steal more than 145m roubles (€3.47m¹¹⁴) with his cohorts by forging supply certificates for reactors at home and abroad for what was low quality, cheaper steel in order to fake compliance with industry standards while keeping the difference in price for himself.¹¹⁵ Like the Votyakov-Belyaev case, this case is also still pending as of June 2014.

Shutov's case was not the only one of its kind. In 2007, workers at the Kalinin nuclear power plant noticed that some of the recently manufactured power switches had the on and off sides marked the wrong way around. A closer examination showed a number of defects in equipment arriving from the Kharkov Electromechanical Plant. When confronted with the problems, it turned out that the Kharkov plant had not manufactured some of the parts. Instead, an intermediary had been forging the certificates and buying cheaper parts from somewhere else to increase profit margins.¹¹⁶

According to an inspection report on the Kalinin nuclear power plant from February 2014, the current procurement procedures failed to prevent the use of low-quality equipment and components and subpar subcontractors.¹¹⁷

The scale of the alleged and proven corruption cases, and the resulting potential financial and safety risks and costs, raise serious questions about whether Rosatom's institutional framework can support the large nuclear expansion that its executives proclaim. Given these serious problems at this stage of nuclear operation, Rosatom's ambition to own and operate multiple reactors across vast distances in other countries certainly raises the potential spectre of exacerbated problems. The corporation could be stretched even thinner and may try to fill in the gaps with cheap, unqualified labour as it has done domestically.

It is worth restating, this endemic corruption involving falsified documentation and poor quality control relates to parts necessary for the operation of nuclear power plants. The Shutov case is one clear example of that. And, these are just the reports that have been uncovered; others may have gone undetected.

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FAILURE IN SPENT NUCLEAR FUEL MANAGEMENT

To conduct its nuclear weapons programme, the former Soviet Union built a number of closed nuclear cities across its vast territory from the late 1940s. These were constructed in absolute secrecy by hundreds of thousands of prison labourers.¹¹⁸

One of these facilities, the Mayak Production Association, located in Ozersk, is one of Russia's oldest nuclear material production facilities. It has, at different times "operated five plutonium production reactors, five tritium production reactors, several reprocessing facilities, a plutonium metallurgy plant, and various supporting facilities. It is also a major storage site for weapons-grade materials as well as for separated reactor-grade plutonium."¹¹⁹

The facility of particular relevance to the operation of the planned Rosatom-supplied nuclear reactors in Turkey and Hungary would be Mayak's RT-1 spent nuclear fuel reprocessing plant. Spent fuel generated in the future from reactors in these countries could be sent to Mayak, which would require retrofitting to be capable of reprocessing these types of fuel assemblies.¹²⁰ Another option that Rosatom is considering is to build a new RT-2 reprocessing plant specifically for reprocessing fuel assemblies from VVER reactors and from the western-design Pressurised Water Reactor (PWR). Mayak has operated since 1976 with the task of storing and reprocessing spent nuclear fuel from domestic and foreign nuclear power reactors. After nearly four decades, reprocessing continues at Mayak with around one ton of commercial reactor-grade plutonium separated each year.¹²¹ Reactor-grade plutonium can be used to manufacture nuclear weapons at all levels of sophistication, and each year Mayak produces enough plutonium for between 250 and 400 nuclear weapons.¹²²

Rosatom has justified continued reprocessing at Mayak on the basis that the plutonium will be used as fuel in its fast-breeder reactor programme. But, as with other nations that have invested the equivalent of billions of euros in breeder programmes over the decades, it has been – for all intents and purposes – a failure.¹²³

The Russian fast-breeder programme was started six-and-a half-decades ago, in 1949.¹²⁴ The programme has been estimated to cost \$12bn in 2010.¹²⁵ During this time, the USSR/Russia programme has only been successful up until this late date in starting less than a handful of experimental and demonstration fast reactors.¹²⁶ Russia says that its demonstration BN-600 reactor¹²⁷ has achieved a greater capacity factor than any other fast reactor globally. However, nuclear experts and physicists have pointed out, this is "only because of the willingness of its operators to keep it operating despite multiple sodium fires".¹²⁸

Although the industry has touted the first criticality of the BN-800 as a major success and breakthrough, it can hardly be called such. By most measurements of adequate performance in any field, a 65-year delivery time, with an over \$12bn investment for one commercial reactor¹²⁹ of 30-year-old technology, due to a 30-year construction time, would hardly be called "success".

Even if Rosatom's fast-breeder programme continues, it will be decades before its stockpile of reactor-grade plutonium will be used, as Russia is committed to first using at least 34 tons of excess weapon-grade plutonium under an agreement with the US.¹³⁰

While Rosatom has been advocating reprocessing as an environmentally friendly alternative to disposal, reprocessing has yielded Russia one of the largest stockpiles of reactor-grade plutonium in the world, and it has come at terrible environmental and social costs.¹³¹ The reprocessing of one ton of spent fuel results in 45m³ of high-level liquid radioactive waste, 150m³ of medium-level liquid waste, and 2,000m³ of low-level liquid waste. In addition to routine operational releases of radioactive gases and liquids,¹³² there have been three major accidents at Mayak: major releases of radionuclides from the reprocessing facilities to the Tcha River between 1949 and 1956 due to time pressures imposed by the nuclear weapons programme; an explosion in a high-level radioactive waste tank in 1957 (the so called Kyshtym disaster); and dispersal of radionuclides from the dried out bed of Lake Karachay in 1967. As a result of the 1957 explosion, 10,000 people from 23 settlements were evacuated and the accident left a radioactive trace 30-50km wide, stretching for 300km. An area of 1,000km² also had to be taken out of economic production.¹³³

While Mayak still continues to reprocess spent nuclear fuel, the current state of the environment surrounding the facility is unclear. In 2011, the Swiss nuclear operator Axpo suspended its contract with Rosatom's subsidiary TVEL to import fuel, citing a lack of transparency in Mayak. This opacity on the part of Rosatom included forbidding the Swiss authorities and the Axpo officials from inspecting the site. After years of back and forth, Axpo decided in 2014 to entirely forgo the use of Rosatom's reprocessed uranium from Mayak.¹³⁴

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ROSATOM'S DOMESTIC AND INTERNATIONAL NUCLEAR PROJECTS

Within Russia, the government has set a goal of expanding the nuclear-power share of the domestic energy supply to 25% by 2030¹³⁵, from the current 17%.¹³⁶ One objective of such a target was to reduce domestic consumption of oil and gas, which would then be exported to generate a higher rate of return for the Russian state.¹³⁷

But in recent years, the magnitude of domestic ambitions has decreased. In 2008, the Russian government approved a maximum of 42 new nuclear reactors in Russia by 2020, of which 38 would have been conventional nuclear reactors and four sea-borne floating reactors.¹³⁸ By 2009, Rosatom's plans were revised to just 23 conventional reactors to be built by 2020.¹³⁹ In 2013, ambitions for the programme were again scaled back to only 16 reactors.¹⁴⁰ The further reversal of strategy resulted in the cancellation of two units in 2014 that were to be built at a new Baltic nuclear power plant, thus decreasing the 2020 target number yet again, to 14 reactors.¹⁴¹

Instead, Rosatom has been making a concerted effort to expand its nuclear exports.¹⁴² Buoyed by an allocation of 1.247 trillion roubles (around €29.2bn¹⁴³) of Russian federal funding for the next eight years, the Rosatom Director General, Sergei Kiriyenko stated in July 2013: "We want to make profits out of nuclear energy. We want to power the world."¹⁴⁴

Rosatom appears to be deliberately overstating its nuclear reactor construction programme. In the case of domestic nuclear plants, Rosatom claims that 13 are under construction¹⁴⁵ (the IAEA reports 10 under construction¹⁴⁶), whereas in reality it is nine.¹⁴⁷ The Baltic 1 reactor at Kaliningrad construction was halted in May 2013,¹⁴⁸ while unit 2 construction never began. Two reactors at Nizhny Novgorod are also listed as under construction, whereas in reality no construction has begun, in large part due to a lack of finance.¹⁴⁹

In the case of overseas construction, again Rosatom is overstating the number of its reactors it is building. In 2012, Rosatom touted 30 reactor projects that were either under construction or active projects.¹⁵⁰ By 2014, it listed only 13 reactors on its public website as under construction.¹⁵¹

In reality, only three of those listed in 2014 by Rosatom are under construction – two in China, one in India.¹⁵²

Two reactors are listed as under construction in Belarus, whereas only one began construction in November 2013 at the Astravyets site, despite major opposition from Lithuania.¹⁵³ Rosatom also claims that construction of two reactors is under way at Ninh Thuận in Vietnam, whereas no construction is under way, and in January 2014, officials in Vietnam announced that construction would be delayed to 2017 or 2018.¹⁵⁴ Rosatom lists four reactors as under construction at Akkuyu in Turkey, whereas site preparation for one has begun. Also in 2012, Rosatom listed a reactor at Metsamor, Armenia but it is not under construction; the country is currently unable to secure financing¹⁵⁵, and construction is not stated to begin until at least 2018.¹⁵⁶

Finally, Rosatom in 2014, also lists two reactors as under construction in Bangladesh, though it does qualify this as “site preparation”. Construction was supposed to begin in 2015, but has already been pushed back to 2017 according to officials in the country.¹⁵⁷ Financing of the project has yet to be agreed with reports suggesting that the original estimate of \$1.5bn US dollars for one reactor has been revised to \$10bn for two under a loan agreement from Russia.¹⁵⁸ This is the equivalent of more than 8% of Bangladesh’s GDP as of 2012.¹⁵⁹

Though Rosatom’s approach may not reflect reality, it looks good for Rosatom and has led to favourable, if inaccurate, international media coverage.¹⁶⁰

Rosatom’s exaggerated claims for its global market share should also be seen in the context of its historical failure to meet its domestic targets, and to deliver on declared international sales targets. Yet, since Rosatom is a significant nuclear supplier to the global markets, it is worthwhile to examine the corporation’s export model.¹⁶¹

PROBLEMS WITH DELIVERING ON PROCUREMENT CONTRACTS

After the change of the political system in Russia, the first contract that Rosatom’s predecessors started was the building of two VVER-1000 type reactors for the Tianwan nuclear power plant in China in 1999.¹⁶²

As in the cases of reactors built in Russia, the Tianwan reactors were also delayed. The reactors were scheduled to achieve grid connection in 2004 and 2005, but both were delayed by two years. Rosatom alleged that the delay was a result of the desire of the Chinese to copy Russian technology, which was not a part of the contractual agreement.¹⁶³

Like the new Kalinin-4 reactor, the Tianwan reactors had to be stopped for over two months for a “scheduled maintenance” outage, less than a year after they were started.¹⁶⁴

These problems were paralleled in the Kudankulam VVER-1000 type reactor project in India.

Construction at Kudankulam started in March 2002. The reactor finally achieved grid connection in 2013, six years after the original target date.¹⁶⁵

The exact reasons for the delay have never been completely clarified. Kudankulam faced heavy resistance, including mass demonstrations, from the local community. However, there may have been unreported problems with the construction process itself. Following the uncovering of the ZIO-Podolsk low quality steel scandal, discussed earlier in this report, the former head of the Indian nuclear regulatory board, AERB, voiced serious concerns about the project.¹⁶⁶

In addition to the contracts with rapidly growing economies, Rosatom has been also willing to seek increased market share by signing contracts with extremely controversial countries.

In 1995, Rosatom’s predecessor, Minatom, started building a VVER-1000 type reactor in Bushehr, Iran. The project was heavily criticised by several countries that believed the Bushehr nuclear power plant might assist Iran in obtaining a nuclear weapon.¹⁶⁷ As with other projects, construction on this project has experienced major delays and cost increases. It was on the verge of being cancelled when Iran finally promised to pay all overruns.¹⁶⁸ The plant was finally commissioned in 2011.¹⁶⁹

Another similar example is Rosatom’s floating-reactor design. Although the design was purportedly to be marketed to countries not yet developed enough to operate a large nuclear power plant, the primary underlying motivation for this type of reactor was to power Russian oil exploration and extraction in the fragile Arctic region.¹⁷⁰ The design consists of two small 35 MWe nuclear reactors on a barge that would be moved to an area where electricity was required.¹⁷¹ Rosatom was looking for opportunities to market these floating nuclear plants to such countries as Cape Verde, Namibia, Tunisia, Morocco, Brazil and Uruguay.¹⁷² At this stage, this ambition appears to be wholly unrealistic. In spite of Rosatom’s aspirations, critics raise serious questions about the marketability of the floating reactor design – particularly in light of the turbulent history of the project and potential major vulnerabilities to severe weather events and terrorist attacks.¹⁷³

Rosatom began building a floating nuclear reactor, the Academic Lomonosov, in 2007 with start up estimated to take place in 2010. By June 2013, the project had already been delayed until 2019 with increasing doubts about the feasibility of the whole project.¹⁷⁴

BUILD-OWN-OPERATE (BOO) BUSINESS MODEL FOR NUCLEAR EXPORTS

Rosatom’s focus on procurement deals with countries that aspire to move from small nuclear generating capacity to large-scale nuclear power generation – such as India and China – has recently expanded to include both completely new nuclear nations such as Vietnam, Belarus, Bangladesh and Turkey, as well as countries with a long history with nuclear power such as Finland, Hungary¹⁷⁵, and the UK¹⁷⁶.

To be able to enter these new markets, Rosatom has started to promote itself as being able to provide the whole nuclear cycle from financing, to holding the assets and operating the reactors, and if needed, to disposing of the spent nuclear fuel – a scheme called “Build-Own-Operate” or BOO.¹⁷⁷ Rosatom markets this as ideal for countries that do not have the infrastructure in place to support or adequately regulate nuclear reactors.¹⁷⁸

Under the BOO scheme, Rosatom projects that it will have orders for 80 reactors abroad by 2030.¹⁷⁹ However, financial analysts have raised doubts about the economic feasibility of such ambitions, suggesting that it would be difficult for Rosatom to financially support so many expensive nuclear projects – even with state funding.¹⁸⁰ Besides that, the impact of Western sanctions due to the Ukraine crisis, the potential vulnerability of the rouble if capital flight continues at current rates, and the downgrading of the country’s credit score to BBB – or “just one notch above junk”¹⁸¹ – cast further doubt on whether this Russian state-backed corporation will have the financial means to meet its advertised ambitions.

The sheer scale of Rosatom’s export expansion goals, coupled with its poor track record in its domestic Russian operations, raise serious doubts about the safety of such a large-scale international new-build programme.

In spite of Rosatom’s ambitions, the secrecy of the company itself is an additional obstacle, hindering its ability to license its designs abroad and thus to effectively compete on an equal footing with other vendors in foreign markets.¹⁸² Though the transparency of Western and Asian nuclear reactor companies is not exactly high either.

Indeed, a closer examination of Rosatom’s foreign portfolio reveals very similar problems to those haunting its activities in Russia.

CASE STUDY 3

ROSATOM'S INVOLVEMENT AT THE BELENE NUCLEAR POWER PLANT, BULGARIA

Rosatom's failure to complete its own BOO contract in Bulgaria highlights the general problems its model faces.

After negotiating, but never signing, a construction contract with the ex-communist Bulgarian Socialist Party (BSP) government, Rosatom proposed a BOO arrangement for the Belene nuclear power plant. This contract included the construction of two VVER-1000/AES-92 reactors on the site of an abandoned project in the Bulgarian town of Belene.¹⁸³

It is worthwhile mentioning that the negotiations between Rosatom's export arm Atomstroyexport, the Bulgarian government and state utility NEK addressed a broad range of non-nuclear incentives in addition to the reactor deal. These included linking the Belene deal with gas deliveries, the long-planned South Stream gas pipeline project,^{184,185} active lobbying by the Russian state oil firm, Lukoil,¹⁸⁶ and alleged close links between technical engineering consultant Worley Parsons and Atomstroyexport – all of which took place during the tendering process.¹⁸⁷ The tendering process was widely seen as favouring Atomstroyexport from the start, leading to early departures by all other contesters. The Canadian company, Atomic Energy of Canada Limited (AECL), explicitly stated that it would withdraw unless, "the process of selecting consultants and technology were made transparent, fair and competitive". Ultimately, the Canadian company terminated its bid.¹⁸⁸

When the Socialist Party lost power to the right wing, Citizens for European Development of Bulgaria (GERB), the new government set out policy measures to restrict Rosatom's influence over the project, by among others, seeking support for the project from France¹⁸⁹. Rosatom attempted to influence the situation through various channels¹⁹⁰, and even convinced then Prime Minister Vladimir Putin to make a personal visit to Bulgaria.¹⁹¹ Unconvinced, the GERB government demanded a full cost estimate. It finally hired HSBC Holdings, one of the largest banking and financial services institutions in the world, to provide such a cost analysis due to its lack of trust in Rosatom to provide accurate information.¹⁹²

When the contract was signed in January 2008, the published contract price was around €4bn. In 2010, HSBC revealed that Rosatom had inflated the total cost of the project to €10.15bn.¹⁹³ Having discovered that they had been deceived regarding the true costs, the Bulgarian government cancelled the contract. After the GERB lost the election in early 2013, the new BSP-led government has tried to re-establish the old project in full BOO form, so far without success.¹⁹⁴

CASE STUDY 4

ROSATOM AND THE AKKUYU NUCLEAR POWER PLANT IN TURKEY

The Akkuyu project in Turkey is the first instance of one of Rosatom's BOO contracts beginning site preparation as it moves towards the construction phase – though problems remain. Construction is not due to begin until 2016.¹⁹⁵

In March 2008, Turkey put out a tender for the construction of the first Turkish nuclear power plant at the Akkuyu site. The country was seeking a comprehensive contract, although a BOO basis was not explicitly required.¹⁹⁶ Fourteen companies from different countries¹⁹⁷ requested the tender documentation. All the tender participants requested an extension; but this request was denied.¹⁹⁸ However, a Russian-Turkish syndicate consisting of the Rosatom subsidiaries Atomstroyexport and InterRAO, and the Turkish Park Teknik Group was permitted to resubmit its bid, after its initial bid.¹⁹⁹

Rosatom offered to build a nuclear power plant with four VVER-1200 reactors. The initial price of the power produced by the four Rosatom-designed reactors was 21.13 US cents per kWh (17.21 eurocents²⁰⁰).²⁰¹ In the negotiations conducted during 2010, this was reduced to 12.35 US cents per kWh (9.3 eurocents²⁰²) for 70% of the produced electricity at units 1 and 2, and for 30% of the electricity produced by units 3 and 4 over 15 years after **the** start of commercial operation.^{203,204}

In 2012, the former Russian Deputy Minister of Atomic Energy, Bulat Nigmatulin, posted an analysis of the project that used exceptionally harsh language about the feasibility of the project for Rosatom. According to his analysis, the Turkish side has no financial obligations while Rosatom has been bound to obtain financing, which can only happen via Russian federal funds.²⁰⁵ Rosatom had also agreed to train Turkish workers for free, as well as to sell power at a fixed price regardless of inflation, variability of fuel costs, cost overruns during construction or variation in currency exchange rates.²⁰⁶ Rosatom is obliged to provide power whether the plant is running or not, and there are no force majeure clauses. The site is fairly close to the popular beach resort of Antalya and, therefore, a target for protests by community members and could be impacted by delays due to mass public opposition.²⁰⁷

The project has already experienced a series of delays – most recently after twice failing to submit an environmental impact report that met Turkish regulatory standards,²⁰⁸ though recently it has been resubmitted.²⁰⁹ The Akkuyu project has also failed to find a company qualified to conduct a safety review of the VVER-1200 design with three tenders cancelled so far²¹⁰, the latest in September 2013.²¹¹

As anticipated by Nigmatulin, local citizens' groups oppose the project for a number of reasons. In February 2014, they filed a legal challenge with the Mersin administrative court seeking the withdrawal of the site licence.²¹² They argue that the original licence, granted in 1975, has been updated by the Turkish Atomic Energy Agency (TAEK) without adequately taking into account data, acquired during recent decades, showing the region is at risk of major seismic events.²¹³

With the problems in both Turkey and Russia mounting, it still remains unclear if all four reactors will indeed be built, although construction preparation for the first reactors has been started.

CASE STUDY 5

ROSATOM'S DEAL WITH THE HUNGARIAN GOVERNMENT

Rosatom has signed a much better deal for itself with the Hungarian government than its Turkish deal, which appears to have possibly committed it to something it will find hard to deliver.

Whether Rosatom agreed to the unfavourable terms in the Turkey contract out of a desire to have a flagship BOO project finally under way, or whether the state corporation was more politically motivated, as is posited by a former Soviet official²¹⁴ is impossible to determine with certainty. In contrast, the Hungarian deal to build two VVER-1200 reactors in Paks certainly was much better for Rosatom than the Turkey contract – at the expense of the Hungarian government and taxpayers.

On 31 March 2014, the ruling Hungarian right-wing populist government secretly signed a nuclear reactor new-build treaty with Rosatom, just five days before a general election. Hungarians learned of the deal only the next day when the Russian media started reporting on this contract.²¹⁵

Where the Akkuyu deal had been close to disastrous in its economic terms for Rosatom, the Paks 2 deal was a complete reverse. According to the agreement, Hungary will receive a €10bn credit from Russia, which it has to start paying back in 2026 – regardless of whether the Paks plant is completed by then or not.²¹⁶ The Hungarians also have to find an additional €2bn in financing from another source to move forward with the project. The loan has a variable interest rate, which will rise over time, and the Hungarian government will have to repay in euros instead of forints or roubles, absorbing the full risk of changes in exchange rates.²¹⁷ Unfortunately, the Hungarian parliament approved the contract on 23 June 2014.²¹⁸

The conditions of the Paks 2 deal make the Hungarian government either effectively dependent on Rosatom for the next 30 years or liable to an expensive litigation case that would be challenging to win. However, there is an option for Hungary to avoid such a devastating financial burden: if there are no construction contracts with Rosatom, then money will not be lent. Hungary would then not owe billions for nuclear construction that may or may not be completed, and may experience significant delays and cost overruns, as Rosatom's other construction projects have done.

EXPORTS OF NUCLEAR WASTE

One of the critical unresolved problems for nuclear suppliers and operators across the planet is the industry's utter failure to produce a viable long-term solution for the hundreds of thousands of metric tonnes²¹⁹ of highly radioactive spent fuel wastes generated by the nuclear industry in past decades. The industry continues to worsen this already unsolvable, critical environmental problem by generating on average an additional 20 metric tonnes of spent nuclear fuel at each reactor site every year.²²⁰

Since the collapse of the Soviet Union, successive Russian governments have attempted to secure contracts with European and Asian nuclear power plant operators to import spent nuclear reactor fuel for eventual reprocessing. This is far from being a solution to the nuclear waste problem, as it instead increases the volume of radioactive wastes. In addition, reprocessing is a direct pathway to the production of separated plutonium – a nuclear weapons material. During the 1990s initiatives were launched in an attempt to pass legislation that would provide a legal basis for these contracts. Greenpeace Russia, together with environmental organisations from the Chelyabinsk region and across Russia, collected 2.5 million signatures to initiate a federal referendum banning the importation of radioactive wastes into Russia. In an unsurprising, but appallingly undemocratic move condemned by Greenpeace, the Russian Regional and Central Elections Committees threw out over 600,000 signatures, which brought the total below the 2 million needed for a national referendum.²²¹

Challenges by Greenpeace and other environmental groups delayed the import plans until 2001 when finally a law²²² was passed that would permit the importation of spent nuclear fuel from abroad from any operator for reprocessing.²²³

Under the terms of the 2010 Russian agreement with Turkey²²⁴, the spent fuel produced at the Akkuyu nuclear plant will be the responsibility of Rosatom²²⁵, which may have been an incentive for both Rosatom and Turkey to agree to the terms of the Turkish contract. The Turkish government, in the pre-bidding process for Akkuyu, indicated that it wanted spent fuel to be the responsibility of the reactor operator. Turkey has no infrastructure to manage spent nuclear fuel, either technically or in regulatory terms.²²⁶ In addition, there have been international concerns about the proliferation threat as Turkey embarks on its nuclear programme, which would provide it with enough plutonium to produce hundreds of nuclear weapons.²²⁷

However, there remains, as of July 2013, no final agreement between Turkey and Rosatom that the spent fuel from Akkuyu will be reprocessed. As the Turkish Atomic Authority stated in 2013: "Subject to separate agreement that may be agreed by the Parties, spent nuclear fuel of Russian origin may be reprocessed in the Russian Federation".²²⁸

As indicated, while the Akkuyu reactors will be generating electricity in Turkey, as far as the authorities are concerned the nuclear waste would be Russian. In this sense, Turkey will be in the same client relationship with Rosatom as the states of Eastern Europe were during the cold war with the Soviet Union,²²⁹ and as Iran is under its more recent agreement for spent fuel produced at the Bushehr reactor.²³⁰

The potential environmental, human health, and security risks of any future Rosatom-Turkey agreement regarding the transport and reprocessing of spent fuel would certainly not be limited to the impact in and around the Mayak facility or any other new reprocessing facility for spent nuclear fuel in Russia. Additional risks would come from onsite storage for cooling spent fuel prior to transport, and from the transport of the spent fuel itself to Mayak. Major populations along the potential transport routes – a possible combination of routes via the Sea of Marmara, the Bosphorus Straits and the Black Sea and rail transport – would be at significant risk of accident or sabotage.²³¹

Compounding all of these areas of potential concern for current and future clients, Rosatom has also secured a legislative backdoor that allows it to return reprocessed spent nuclear fuel to countries of origin.²³² Should the Russian government chose to return radioactive waste produced from reprocessing Akkuyu's spent nuclear fuel to Turkey – which is permissible under current legislation – the Turkish government would then be required to attempt find a long-term solution for managing high-level radioactive waste in Turkey.²³³ This is the very issue that has plagued the nuclear industry since its inception – a problem that all other nuclear nations have failed to solve – and one that Turkey appears to have been seeking to avoid through its spent-fuel agreement with Rosatom.

These concerns are paralleled by a similar deal with the Hungarian government for the export of radioactive wastes generated at its VVER 440 reactors to Mayak for reprocessing. This deal was reached on 29 April 2004, a few days before EU entry – although Hungary was well aware of the fact that such delivery could be problematic within the European Union (EU).²³⁴ The 2011 Euratom Radioactive Waste Directive includes the possibility of sending spent fuel to Russia for reprocessing.²³⁵

When Greenpeace Hungary requested more information²³⁶ about Hungary's plans to send to Russia spent-fuel waste that resulted from an International Nuclear Event Scale (INES) level 3 incident in 2003 at the Paks 2 reactor, it was confirmed that the damaged spent-fuel assemblies from the incident were to be shipped to Mayak. It was also made clear that ownership of this exported radioactive waste was to be transferred to Rosatom's subsidiary, TVEL – with no possibility for the return of resulting waste, as would potentially be possible under the EU Directive. Transfer of ownership is only allowed under the EU Directive in cases where there is a proven functional final repository, which Russia does not have.²³⁷ The status of the plans for radioactive waste export from Hungary is currently unknown.²³⁸



The village of Muslimova is the nearest village to Chelyabinsk 65, the Mayak nuclear reprocessing plant, in 1993

© Eugene Poggeo / Greenpeace



The Chernobyl facility in 1996.
©Greenpeace / Steve Morgan

CONCLUSIONS

As a Russian state-backed entity that oversees almost every aspect of Russia's civil and military nuclear programmes, Rosatom is one of the largest nuclear vendors in the global market. Yet problems are rampant, due to its very size and the scale of its operations, its entrenchment within the Russian government and the revolving door between government officials and Rosatom top management, and the lack of truly independent oversight over the company.

One of Rosatom's predecessor entities oversaw the world's worst nuclear disaster at Chernobyl. Although the corporation now says that it has learned from the catastrophe, its more recent safety record exposes that little has changed in terms of its safety culture – both within Russia and in other countries to which it exports nuclear technology. Plagued with safety violations and accidents, lacking an adequate skilled workforce, using the equivalent of low-skilled, forced labour on reactor sites, and having an absence of adequate quality controls, Rosatom's reactors pose an unacceptable risk to the public both within Russia and abroad.

The pervasive corruption within the company that has come to light in recent years not only reveals the inordinate potential for the siphoning of public funds – some of which were intended to promote nuclear safety – into wealthy private accounts, but also casts serious doubts on the ability of the Russian government to ensure such gross violations do not occur again.

Rosatom has enormous ambitions to expand its nuclear programme globally. Fuelled by Russian federal money and income from oil and gas exports, the state corporation aims to vastly expand its global nuclear fleet via its "Build-Own-Operate" model. This ambition seems less focused on investing in smart economic ventures than on other potentially motivating factors. Yet, even with the funding of the Russian government behind Rosatom, analysts have still raised significant doubts as to whether it is possible for any one operator to adequately finance so many nuclear projects – as the financial burden would be enormous if not impossible to bear. Rosatom's claims are inflated but their ambition remains unchecked.

Further, both within Russia and in other countries, Rosatom's nuclear construction projects have not only been characterised by a lack of proper quality control and safety concerns, but also by delays and cost overruns – like the nuclear industry everywhere else. In cases where investors have put in their own funds, rather than leaving financing up to Rosatom, potential customers are either waiting for energy they thought they would have years earlier, or are left with an enormously growing expense. Alternatively, as in the case of Bulgaria, they end up terminating the project after realising that the bill had more than doubled.²³⁹

Finally, Rosatom's spent-fuel reprocessing leads to large-scale releases of radioactivity into the environment and increased health risks to the general population, as well as to a major risk of accidents and to an even greater spread of contamination. The proposal to take back spent-fuel waste from reactors supplied by Rosatom but operated overseas not only fails to remove the risk at a reactor site – since spent fuel must be cooled onsite prior to transport – but significantly increases the risks to the public, including during transportation.

At the same time, Russia's fast-breeder programme – used to justify continued reprocessing and plutonium stockpiling – experiences significant delays and other problems, as has happened with other countries that have attempted to develop such reactors. The one result has been a greater risk of nuclear weapons proliferation, as stockpiles of weapons-usable plutonium have continued to increase in Russia. The on-going geopolitical crisis in Ukraine has highlighted the vulnerability of the nuclear industry to political developments. One major current problem arising from recent developments is that Rosatom could be prevented from transporting nuclear fuel through Ukraine.

Rosatom presents major concerns as a business partner in every respect. From a financial, safety, political and security perspective, the company's nuclear expansion ambitions both within Russia and abroad pose unnecessary and unacceptable risks to communities and potential customers alike.

Harvest within
the 30km zone
in Chernobyl,
Ukraine, 1996.
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/ Signum /
Greenpeace



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- 230** See the report: Kuznetsov V, Slivyak V (2001).Transportation of radioactive substances and nuclear fissile materials in Russia: The practice of imminent risk. Ecodefense, 2001
- 231** In accordance with Article 48 of the Law on Environmental Protection procedure of import to the Russian Federation of irradiated fuel assemblies to be established by the Government of the Russian Federation, taking into consideration the priority right of Russian Federation to return radioactive waste made after reprocessing irradiated fuel to the State of origin nuclear materials.
- 232** Ibid.
- 233** Republic of Hungary, National Report – Fourth Report prepared within the framework of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Budapest (2011), pp. 11-12; [www.haea.gov.hu/web/v2/portal.nsf/download_en/BB7BC932616F8A8DC12579270032DCDB/\\$file/4th_nat_rep_JC.pdf](http://www.haea.gov.hu/web/v2/portal.nsf/download_en/BB7BC932616F8A8DC12579270032DCDB/$file/4th_nat_rep_JC.pdf) ; European Parliament questions. Transfer agreement of radioactive waste between Hungary and Russia. 24 June 2005. : <http://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vj6ipf8rehzq>
- 234** Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste. OJ L 199, 2.8.2011, pp.48-56 <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0070>
- 235** Personal contact of a delegation of Greenpeace with the management of Paks on 30 August 2013 at the Paks nuclear power station.
- 236** Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, art. 4(4); <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:199:0048:0056:EN:PDF>
- 237** More information: <http://www.nuclear-transparency-watch.eu/activities/complaint-european-commission-radioactive-waste-export-hungary-russia.html>
- 238** Greenpeace International. 2007. Mayak: A 50-Year Tragedy. Summary of the Report released by Greenpeace Russia. September 2007 <http://www.greenpeace.org/international/Global/international/planet-2/report/2007/9/mayak-a-50-year-tragedy.pdf>
- 239** Ria Novosti. Ukraine Resumes Nuclear Fuel Transit. 7 March 2014 <http://en.ria.ru/world/20140307/188157514/Ukraine-Resumes-Nuclear-Fuel-Transit.html>



The deserted city of Prip'yat, in 1995, a few kilometres from the Chernobyl nuclear power station. The city was a "Soviet dream" with a sport stadium and swimming pools.

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