The Competition for the Ukrainian Nuclear Fuel Cycle: Rosatom, Westinghouse, and Implications for Nuclear Energy In the Near Abroad

Sarah Lynn McPhee

A thesis submitted in partial fulfilment of the

requirements for the degree of

Master of Arts in International Studies

University of Washington

2015

Committee:

Christopher Jones, Chair

Scott Radnitz

Program Authorized to Offer Degree:

Russian, East European, and Central Asian Studies

University of Washington

Abstract

The Competition for the Ukrainian Nuclear Fuel Cycle:
Rosatom, Westinghouse, and Implications for Nuclear Energy
In the Near Abroad

Sarah Lynn McPhee

Chair of Supervisory Committee:
Associate Professor Christopher D. Jones
Henry M. Jackson School of International Studies

Contemporary Ukraine suffers from multiple energy security challenges. Ukrainian dependence upon Russian gas has sent shivers through Western Europe, leading to a 2014 EU policy commitment to energy diversity. The "Gas Wars" have captured international headlines, but a lesser known struggle which has quietly unfolded in the region since the fall of the Soviet Union — the competition for the Ukrainian nuclear fuel cycle — which may actually result in real changes to Near Abroad energy dependence as well as the global nuclear energy landscape. Ukraine relies upon nuclear energy for nearly 50% of its energy needs, ranking fourth in the world in nuclear-reliance[1] and eighth in nuclear power generation.[2] Due to the highly proprietary nature of nuclear reactors and fuel assemblies, TVEL, the fuel fabrication arm of the Russian national nuclear corporation Rosatom, has

[1] "Top 10 most nuclear dependent nations: Ukraine." *CS Monitor.* Accessed January 29, 2015, http://www.csmonitor.com/Business/2011/0311/Top-10-most-nuclear-dependent-nations/Ukraine-48-percent.

[2] http://www.businessinsider.com/countries-generating-the-most-nuclear-energy-2014-3#8-ukraine-10.

supplied almost 100% of the fuel for Ukraine's reactors. Russia has also provided 85% of all related equipment and has been the sole recipient of Ukrainian spent fuel, effectively monopolizing the Ukrainian fuel cycle for decades.

Influenced by the tragic and tumultuous events of 2014 in the Donbas, a deal was finally realized between Ukraine's Energoatom and Westinghouse to provide fuel assemblies for six of fifteen VVER reactors until 2020.[3] This victory in the VVER market is a result of a State Department-funded initiative to help Ukrainians with their energy dependency woes. Spanning seventeen years, the Ukraine Nuclear Fuel Qualification Project (UNFQP) was initiated by geopolitical nuclear nonproliferation calculations, constantly obstructed by hegemonic ambitions, and often impeded by influential domestic actors. Despite all complications, the success of the project is undeniable, with far-reaching consequences.

This paper will address several important questions arising from the success of the UNFQP. How has Russia utilized Rosatom as a foreign policy tool, and what are the politics of nuclear energy dominance and dependence in the Near Abroad? After almost twenty-five years, why have states like Ukraine remained dependent upon Russia for their nuclear fuel cycles, despite the known national security risk? Finally, how and why have Western governments such as the United States and the European Union intervened in the politics of nuclear energy dominance and dependence in the Near Abroad?

These are vital questions to address as nations in Eastern and Central Europe begin to reassess their relationship and dependence upon Moscow as a matter of national security.

---

[3] Ukraine hopes to develop its own fuel fabrication capabilities by 2020, http://www.world-nuclear-news.org/C-Energoatomseeks-to-extend-links-with-Westinghouse-11031501.html.

Countries which have been careful to maintain close economic ties with Russia, such as Bulgaria and the Czech Republic, have already begun considering Western bids for plant extensions, new reactors, and fuel contracts. Westinghouse's competition with TVEL seems to be in the best interest of the West since its success lessens the Moscow's influence in those regions, but it is important to consider that nuclear energy is more than just business when the Kremlin's 'power vertical' controls all aspects of the Russian nuclear industry.

Table of Contents

Glossary of Terms and Abbreviations i

I. INTRODUCTION 1

II. LITERATURE REVIEW AND METHOD 3

The Nuclear Legacy of the Soviet Union in Ukraine and Eastern Europe 3

Ukrainian Nuclear Energy: A Complicated Past 5

The Beginning of a Very Different Era 8

Method 18

III. CHAPTER I: The Energy Troika 19

Rosatom, The Dark Horse of the Energy Troika 20

BOO: Build, Own, Operate 24

The Near Abroad — Nearer 25

The Special Case of Ukraine 26

IV. CHAPTER II: The Ukraine Nuclear Fuel Qualification Project 28

Risky Business 29

Western Influence and the Results of Competition 31

The Crimea Backlash 39

The Russian Perspective 41

EU Policies 42

V. CONCLUSIONS 43

Implications for the Near Abroad 43

Broader Conclusions 46

VI: WORKS CITED 46

Appendices 52

Glossary of Terms and Abbreviations

For in-depth descriptions and diagrams, see Appendices.

Nuclear Corporations and Companies

- Atomenergoprom: Atomic Energy Power Corporation, 100% state-owned holding company that unites the Russian nuclear power industry. Subsidiary of Rosatom.
- Energoatom (Enerhoatom): Ukrainian National Nuclear Energy Generating Company, state enterprise which operates all four nuclear power plants in Ukraine, with a total of 15 reactors.
- Rosatom: National Russian nuclear corporation, encompassing all aspects of nuclear energy, weapons complex, ice breakers, medical research, development, and training.
- Rusatom Overseas: Rosatom's global development arm, offers the BOO (Build-Own-Operate) model for international customers.
- TVEL: A Russian acronym for 'fuel rod', the heat-releasing element of a reactor. TVEL is a part of Atomenergoprom, primarily a mining and fuel fabrication company.
- Westinghouse Electric: American-based nuclear energy company, 51% owned by Toshiba Corp.

Reactors

- Pressurized Water Reactor (PWR): A common reactor design through which water (the primary coolant) is pumped under high pressure to the reactor core where it is heated by the energy of the fission process. The heated water flows to a steam generator which heats a different water loop to create steam. This steam moves turbines, which spin an electric generator.
- RBMK Reactor: Реактор Большой Мощности Канальный, transliterates to Reaktor Bolshoy Moshchnosti Kanalnyy, and translates to "High Power Channel-type Reactor." A class of graphite-moderated reactors, the oldest model still in wide operation. Certain design flaws in this model contributed to the disaster at Chernobyl, but 11 RBMK reactors still operate within Russia following safety upgrades.
- VVER Reactor: Водо-водяной энергетический реактор, transliterates as Vodo-Vodyanoi Energetichesky Reaktor, translates to Water-Water Power Reactor. A series of pressurized water reactors designed by the Soviet Union and then the Russian Federation.

Nuclear Fuel Cycle Terms

- Fuel rods, fuel assemblies: Every fuel assembly is composed of multiple fuel rods, which are hermetically sealed tubes filled with nuclear fuel pellets composed of enriched uranium.
- Low enriched uranium (LEU): Uranium that has been enriched to 3-4% U_{235}. Natural uranium ore is 99.2% U_{238}, 0.72% U_{235}. In contrast, Highly Enriched Uranium (weapons grade) is 90% U_{235}.
- Qualification: Testing for quality control, ensures that the fuel will work as planned with the reactor technology and instrumentation.
- Uranium hexaflouride (UF6): Created from yellowcake uranium, part of the uranium enrichment process.
- Yellowcake: Uranium ore that is crushed into a fine powder and chemically processed prior to enrichment.

I. INTRODUCTION

Contemporary Ukraine suffers from multiple energy security challenges. For a decade, Ukrainian dependence upon Russian gas has sent shivers through Western Europe, leading to a 2014 EU policy commitment to energy diversity. The "Gas Wars" have captured international headlines, but a lesser known struggle which has quietly unfolded in the region since the fall of the Soviet Union — the competition for the Ukrainian nuclear fuel cycle — which may actually result in real changes to Near Abroad energy dependence as well as the global nuclear energy landscape. Ukraine relies upon nuclear energy for nearly 50% of its energy needs, ranking fourth in the world in nuclear-reliance[4] and eighth in nuclear power generation.[5] Due to the highly proprietary nature of nuclear reactors and fuel assemblies, TVEL, the fuel fabrication arm of the Russian national nuclear corporation Rosatom, has supplied almost 100% of the fuel for Ukraine's reactors. Russia has also provided 85% of all related equipment and has been the sole recipient of Ukrainian spent fuel, effectively monopolizing the Ukrainian fuel cycle for decades.

Influenced by the tragic and tumultuous events of 2014 in the Donbas, a deal was finally realized between Ukraine's Energoatom and Westinghouse to provide fuel assemblies for six of fifteen VVER reactors until 2020.[6] This victory in the VVER market is a result of a State Department-funded initiative to help Ukrainians with their energy dependency woes. Spanning

---

[4] "Top 10 most nuclear dependent nations: Ukraine." *CS Monitor.* Accessed January 29, 2015, http://www.csmonitor.com/Business/2011/0311/Top-10-most-nuclear-dependent-nations/Ukraine-48-percent.

[5] http://www.businessinsider.com/countries-generating-the-most-nuclear-energy-2014-3#8-ukraine-10.

[6] Ukraine hopes to develop its own fuel fabrication capabilities by 2020, http://www.world-nuclear-news.org/C-Energoatomseeks-to-extend-links-with-Westinghouse-11031501.html.

seventeen years, the Ukraine Nuclear Fuel Qualification Project (UNFQP) was initiated by geopolitical nuclear nonproliferation calculations, constantly obstructed by hegemonic ambitions, and often impeded by influential domestic actors. Despite all complications, the success of the project is undeniable, with far-reaching consequences.

This paper will address several important questions arising from the success of the UNFQP. How has Russia utilized Rosatom as a foreign policy tool, and what are the politics of nuclear energy dominance and dependence in the Near Abroad? After almost twenty-five years, why have states like Ukraine remained dependent upon Russia for their nuclear fuel cycles, despite the known national security risk? Finally, how and why have Western governments such as the United States and the European Union intervened in the politics of nuclear energy dominance and dependence in the Near Abroad?

These are vital questions to address as nations in Eastern and Central Europe begin to reassess their relationship and dependence upon Moscow as a matter of national security. Countries which have been careful to maintain close economic ties with Russia, such as Bulgaria and the Czech Republic, have already begun considering Western bids for plant extensions, new reactors, and fuel contracts. Westinghouse's competition with TVEL seems to be in the best interest of the West since its success lessens the Moscow's influence in those regions, but it is important to consider that nuclear energy is more than just business when the Kremlin's 'power vertical' controls all aspects of the Russian nuclear industry.

It is no secret that Rosatom has been keen to modernize its nuclear industry across the board to utilize nuclear energy expertise as a projection of hard and soft power abroad.

Competition from Western companies is met with hostility and warnings of safety issues. As journalists and politicians talk about a "Second Cold War," it is beneficial to understand how the competition for the Ukrainian nuclear fuel cycle has contributed to the current political climate, and what the implications may be for the future of global nuclear energy.

II. LITERATURE REVIEW AND METHOD

The Nuclear Legacy of the Soviet Union in Ukraine and Eastern Europe

The Soviet Union built the first peaceful, grid-connected nuclear power reactor at Obninsk in 1954, and from the 1970s Soviet nuclear reactors were established in Ukraine, Bulgaria, Hungary, the former Czechoslovakia, Romania, Lithuania, East Germany, and Armenia. While the Soviet-built reactors in eastern Germany and Lithuania have been decommissioned due to safety concerns, many Russian-built reactors are still operational in Eastern and Central Europe. The fuel needs of these reactors has led to a relationship of energy dominance and dependence between these former satellite states and the Russian Federation. The Russian-Ukrainian relationship has been particularly challenging because Ukraine is Russia's biggest nuclear fuel market[7] and its closest neighbor, in both geography and culture.

To comprehend the complexity of the issues behind the competition for the Ukrainian nuclear fuel cycle and why Westinghouse's victory is so compelling, it is valuable to examine the intersection of two narratives: the nuclear legacy of the Soviet Union and the development of energy trade in Eurasia since the end of the Cold War. Taken separately, these are somewhat esoteric subjects. Combined, they provide interesting points of intersection and a context for

[7] See Appendix for statistics on nuclear reactors in the former Soviet region.

understanding the future of nuclear energy in the Near Abroad. This literature review will offer a survey of research conducted by leading scholars following the collapse of the Soviet Union to the present.

From the inception of the Soviet Union, science and literacy were employed in place of Romanov "Russification" efforts as the main civilizing force throughout the provinces and satellite Soviet nations. The spread of ideology required literacy, and the subjugation of religion required new symbols and mysteries readily available in the pursuit of scientific discovery. Bolshevik rule was consolidated at a time when the mysteries of the atom were rapidly coming unravelled in the hands of the international scientific community. Paul Josephson, author of the definitive history of the Soviet nuclear program *Red Atom: Russia's Nuclear Power Program from Stalin to Today*, insisted that atomic energy was "international, even within the borders of the

USSR," and particularly in the Baltic states and Black Sea region, where there was a stronger Western scientific tradition, "the peaceful atom molded elites whose pursuit of science submerged feelings of local nationalism in a sea of communist ideology and isotopes."[8]

Red Atom is a comprehensive overview of Russia's nuclear power program from its inception until the year 1999, the year of publication. While focusing on the history of nuclear energy in the Soviet Union, the monograph is the product of nearly a decade of research into the arc of the physical scientific tradition and interplay with government policy in the Russian

[8] Paul R. Josephson, *Red Atom: Russia's Nuclear Power Program from Stalin to Today*, Pittsburgh, University of Pittsburgh Press, 204.

Empire, the satellite states of the USSR, and the early Russian Federation.[9] The narrative begins at the dawn of the 20th century to provide the context for the Soviet mindset, gathering steam as the

Bolsheviks successfully industrialize the backwardness of the Russian Empire.

Ukrainian Nuclear Energy: A Complicated Past

Josephson describes Lenin as a "technological utopian," and maintains that energy production was intrinsic to the Soviet mindset. The Bolsheviks staked a large part of their legitimacy on a massive industrialization and electrification project of the entire Soviet Union, with the popular slogan, "Communism equals Soviet power plus electrification of the entire country."[10] The primary challenge faced by the Soviet leaders in maintaining political legitimacy and bringing the promise of modern life to their people was the location of energy resources. The Soviet Union had large, untapped fossil fuel resources in the East, but logistics and infrastructure could not be updated quickly enough. They needed to "harness the machine to Soviet power" with the help of scientists, whose loyalty the Party constantly questioned:

> [T]he Party both deeply feared the potential technocratic impulses of scientists yet recognized the need for independent expertise to build a new industrial

[9] Fluent in Russian, Josephson began his research as a graduate student in Moscow, but he refers to St. Petersburg as his
"second home." Drawing from newspapers, scientific as well as popular scientific journals, topical Russian language books, and archives in eleven different institutions, Josephson's exhaustive examination also includes 26 pages of endnotes which provide even more background information and Russian language sources.

[10] Ibid.

> power. A tense relationship between knowledge and power characterized scientific life from the late 1920s until the fall of the Soviet Union.[11]

While the cities of Eastern Europe were generally fertile ground for scientific imperialism, Josephson contended that of all the republics, "radioisotopes, accelerators, and reactors found the most comfortable home in Ukraine" given the "physical proximity to Russia, a strong tradition of nuclear physics, and significant personal, scientific, and political ties."[12] In fact, during the most exciting years in nuclear physics, the 1930s, Ukraine was instrumental to the success of Soviet nuclear physics.[13]

The Soviets built fifteen reactors in Ukraine, and Chernobyl was one of the first reactors to be built in the satellite republics. Conceived as an idealistic center to the urban landscape, the engineers and leaders imagined a "reactor park" in which nature, man, and machine coexisted in a socialist utopia.[14] In light of the significant Ukrainian contribution to nuclear research and development, it is unfortunate that the country is best known for the tragedy at Chernobyl. Even

---

[11] Ibid.
[12] Ibid. 204

[13] Ukraine was a hub for nuclear physics under the leadership of Aleksander Leipunskii, the father of breeder reactors, and Kirill Sinelnikov, who would eventually become head of the Ukrainian Physical Technical Institute (UFTI) in Kharkiv. Igor Kurchatov, the father of the Russian nuclear bomb, earned his doctorate in physics from the highly respected Crimea State University in Simferopol. Sinelnikov's and Kurchatov had close personal and family ties, which "helped ensure a Ukrainian nuclear future," Ibid., 204-205.

[14] The RBMK reactors were designed to produce heat as well as energy, which would flow through large underground conduits, eliminating the need for the "bourgeoisie furnace."

amongst Ukrainians, Chernobyl is a symbol of "bankrupt Soviet rule and exploitation, perhaps even a deliberate attempt to risk the lives of non-Russians."[15]

The 1986 explosion, which was the result of a flawed reactor design and poor training and safety standards, took place north of Kyiv in Pripyat. The Kremlin waited almost a month to publicly address the disaster. Mikhail Gorbachev addressed the world in a speech meant to highlight the humanitarianism of the socialist world while denouncing the "veritable mountain of lies" circulated by the United States. As a reminder of the Cold War rhetoric of the time, he also used the disaster to raise the specter of nuclear war, offering to meet Reagan as soon as possible in "any European country, or, say, in Hiroshima, and agree to a ban on nuclear testing."[16]

The World Nuclear Association labels Chernobyl "a direct consequence of Cold War isolation and the resulting lack of any safety culture."[17] Many Western scholars believe that the beginning of the end of the Cold War happened in Berlin; in Gorbachev's view, the Soviet meltdown began in Chernobyl. "There was the era before the disaster, and there is the very different era that has followed."[18]

---

[15] Ibid., 204.

[16] "Excerpts from Gorbachev's Speech on Chernobyl Accident," *The New York Times,* May 15, 1986, Accessed February 9, 2015, http://www.nytimes.com/1986/05/15/world/excerpts-from-gorbachev-s-speech-on-chernobyl-accident.html?pagewanted=1.

[17] "Chernobyl Accident 1986." World Nuclear Association. Updated December 14. Accessed February 9, 2015, http://www.worldnuclear.org/info/safety-and-security/safety-of-plants/chernobyl-accident/.

[18] Mikhail Gorbachev, "Turning Point at Chernobyl," *Project Syndicate*, April 14, 2006, https://www.project-syndicate.org/commentary/turning-point-at-chernobyl.

The Beginning of a Very Different Era

Regardless of the accuracy of Gorbachev's assessment, six tumultuous years following the tragedy, Soviet republics such as Ukraine found themselves independent. In 1991, these countries metamorphosed in a single night from republics of an energy-rich mega-state to separate energy-poor nations. Ukraine was energy poor, but she suddenly possessed the third largest stockpile of nuclear weapons in the world, as well as significant technology and capabilities for producing nuclear equipment. Throughout the 1990s, the Clinton Administration worked to strengthen the safety culture in the former Soviet Union and to tackle the nuclear proliferation risk posed by the potential illicit sale of nuclear materials and equipment from both countries.[19] In 1998, the Russian ruble collapsed, which undermined the closely integrated Ukrainian economy. Russia had already been pursuing nuclear energy cooperation with Tehran on the

Bushehr NPP since 1995. When pressed to cease cooperation with the Iranians, Ambassador Yuli Vorontsov told an American diplomat, "If you find $500 million [in aid] for the [$1billion] reactors, we'll forget we ever heard of Iran."[20] While there was no stomach to offer Russia such an aid package at that time, the Clinton Administration had learned its lesson for the future. By 1998, the Ukrainians had been engaged to sell the turbines for the Bushehr NPP. Understanding that the Ukrainian government would lose a significant contract at a dire moment, the

[19] Justin Bresolin and Brenna Gautam, "Fact Sheet: Nunn-Lugar Cooperative Threat Reduction Program," *The Center for Arms Control and Non-Proliferation,* Accessed May 14, 2014, http://armscontrolcenter.org/publications/factsheets/fact_sheet_the_cooperative_threat_reduction_program/.
[20] Herrold L. Schecter, *Russian Negotiating Behavior: Continuity and Transition*, 45.

Administration agreed to help Ukraine with its nuclear fuel dependence in return for shunning the Iranians and irking the Russians.[21]

When signing the cooperation agreement with the United States in Kyiv, Ukrainian Foreign Minister Hennediy Udovenko reminded Secretary Albright that his country was choosing "deepened integration of Ukraine into your Atlantic structures, including development of cooperation with NATO based on the charter of special partnership… and creation of a favorable environment for business activities which finally should promote our economy and economic growth."[22] By June 5, 2000, the two governments had signed an agreement for a Ukrainian Nuclear Fuel Qualification Project. The project, based upon a proposal by Richard Latorre at Pacific Northwest National Laboratory, would involve a technology transfer, fuel assemblies (Ukraine agreed to provide the fuel), on-the-job training, and the establishment of the Center for Reactor

Core Design at the historically respected Kharkiv Institute of Physics and Technology.[23]

---

[21] Ukraine owns a 10% share in the International Uranium Enrichment Centre at Angarsk, a multilateral nuclear approach (MNA) initially conceived as a diplomatic solution to the Iranian nuclear enrichment controversy. In November 2005, Foreign Minister Sergey Lavrov submitted a proposal to the Iranians where their domestically produced uranium tetraflouride (UF4) would be converted to uranium hexaflouride (UF6) and then enriched to low-enriched uranium (LEU). The IUEC is a multilateral fuel enrichment enterprise and a fuel bank with low-enriched uranium fuel that is intended to provide fuel for countries without their own fuel cycles, regardless of political situation.

[22] "Remarks at Signing Ceremony on Several Agreements, Mariinsky Palace, Kiev, Ukraine, March 6, 1998" U.S. Department of State Archive, http://www.state.gov/1997-2001-NOPDFS/statements/1998/980306a.html.

[23] "Nuclear Matters: Nuclear Fuel Qualification Project," *Agreement Between the United States of America and Ukraine,* Signed at Kiev June 5, 2000, http://www.state.gov/documents/organization/195304.pdf.

In 2000, Margarita Balmaceda, a leading expert on the comparative energy politics of post-Soviet states,[24] co-authored a book of essays, *On the Edge: Ukrainian-Central EuropeanRussian Security Triangle.* She explained that upon independence, Ukraine and Central Europe were not part of the old system, but not yet part of a new order.[25] Balmaceda predicted that the "the experience and patterns established during this very important formative period" will continue to define the relationships between Russia and these former satellites for many years. [26] she also insisted that the psychological aspect of Ukraine's threat perception from Russia could not be overstated. Unlike Central European nations, Ukraine has been widely seen as outside the realm of NATO expansion and within Russia's natural sphere of influence:

> From the Foreign Ministry to academic institutions, few people in Moscow seem able or willing to fully accept Ukraine's independence. To make matters worse and even more complicated, Russia feels, probably sincerely, that it is [acting] for the benefit of its Ukrainian brothers. This psychological element in Russian perceptions affects relations with Central Europe as well, because of Russia's unwillingness to deal with these countries as equals and to discuss bilateral and

[24] Margarita Balmaceda, also the editor of this book, has undergone multiple field research visits in Eastern Europe and the former USSR, including Russia, Ukraine, Belarus, Lithuania, Hungary and Moldova. Balmaceda is pentalingual and has been awarded three Fulbright Awards to "follow the pipeline," or the complex, interconnected web of energy producers, suppliers, and consumers in the post-Soviet space. Her research is witness to the political drama of energy dominance and dependence in twenty-first century Eurasia.

[25] In this early work, Balmaceda relies upon realist IR theory and the concept of security dilemmas, whereby insecure states threaten the security of other states, resulting in dangerous arms races. She contends that the early Western focus on Ukraine's nuclear weapon status and "over-concentration on Russia…did much to exacerbate the country's feelings of isolation and perceptions of a hostile international environment during its first years of independence…contributing to the growth of a pro-nuclear and anti-American lobby."

[26] Margarita M. Balmaceda, *On the Edge: Ukrainian-Central European-Russian Security Triangle, 15.*

> regional issues at the highest levels, preferring to 'deal directly with the boss', that is, the West.[27]

Vladimir Putin was barely in power when Balmaceda concluded that for the foreseeable future of the Russian Federation, "political objectives may be more important than making money in the world market. This may be symptomatic of some of the new ways in which Russia is trying to 'flex its muscles' and exert influence" in the Near Abroad.[28]

Keith Smith, former Ambassador to Lithuania and global energy consultant, released a report in 2004 for the Center for Strategic Studies, *Russian Energy Politics in the Baltics, Poland, and Ukraine: A New Stealth Imperialism?* Smith confirmed that "Putin's reassertion of control over the energy industry has made it easier for him to use energy as an instrument by which to project state influence and control over the countries of East Central Europe."[29] He points to Russian energy strong-arming tactics in the Baltics during the1990s as an early example of energy dominance.[30] In Lithuania alone, from 1998-1999, Smith described nine separate instances of energy cutoff involving LUKOIL.[31] Smith believes that Russia will do whatever it

---

[27] Balmaceda, *On the Edge*, 14.

[28] Ibid., 208.

[29] Keith Smith, *Russian Energy Politics in the Baltics, Poland, and Ukraine: A New Stealth Imperialism? The Center for Strategic International Studies,* Washington DC: CSIS Press, 2004, iv.

[30] Smith cites the extremely cold winter of 1992-1993, when Latvia and Estonia demanded the withdrawal of all Russian troops from their land. Yeltsin utilized an energy cutoff tactic "as a warning to non-Baltic former republics of the USSR to think hard before defying Russia on economic or security policy," Smith, *Russian Energy Politics in the Baltics, Poland, and Ukraine,* v.

[31] LUKOIL is "ostensibly a private firm but one that was and remains an instrument of Kremlin policy," and it was attempting to seize control of Lithuania's oil pipelines, refinery, and port terminal. Russia blamed the disruptions, which lasted hours to weeks, on technical or supply issues. Smith insists that this signals the

may to gain an advantage, as any country would, but its tactics are not compatible with the contemporary political environment in the West.

> Western leaders no longer systemically use their companies to influence or undermine democratically elected governments. Western firms are also required to open their books to international scrutiny. Most Russian energy companies avoid adopting current international business standards that would require them to engage in greater transparency, domestically and overseas. Russia imposes no penalties on companies that interfere in foreign elections and corrupt foreign officials…Nor does Moscow yet accept that it should develop a more level playing field for both domestic and foreign firms in order to attract greater foreign investment and promote an open society.[32]

Smith contends that Russian national security has always been at the expense of its neighbor's security and in the twenty-first century, when even a "fifth-rate power such as North Korea" can rattle the nuclear saber, the Russian power elite realized that the "energy card" is the strongest tool for international leverage.[33] Just prior to its collapse, the Soviet Union was the largest energy producer in the world, and according to Smith, "Moscow has announced plans to return to the impressive production levels of the 1980s within the boundaries of present-day Russia and to use the resulting export revenue to raise living standards at home to levels closer to

---

Russian government's "willingness to strong-arm its neighbors almost a decade after the breakup of the Soviet Union…" Ibid.

[32] Ibid., vii.

[33] Smith accurately predicts that "[n]ostalgia for past imperial glory is likely to be reflected in its international energy trade policy. Even during the Soviet period, international trade was closely tied to foreign policy…[and] implementation of this strategy was often in the hands of the intelligence agencies, which generally handled cash transactions outside of Russia. The Ministry of Foreign Affairs and the Ministry of Economic Development often took a back seat to the KGB and GRU on foreign commercial interests," Ibid., 16.

those in Western Europe."[34] He insists that the Kremlin and the "power ministries" (Foreign Affairs, Defense, Interior, and the intelligence organizations) intend to use energy revenues to "increase Russia's leverage in international security affairs and influence the political and economic policies of Russia's trading partners."[35]

By 2004, Balmaceda updated her research by publishing a Kennan Institute Occasional Paper, *Ukraine's Energy Policy and U.S. Strategic Interests in Eurasia*.[36] She warned that Ukraine's stagnant response to its energy problems "create dissatisfaction and apathy in the population, further weakening Ukraine's still unstable democracy. She argued that energy dependence increases the country's weakness and vulnerability in negotiations with Russia."[37] She identified bartering, the resale of discounted IOUs, and the mutual offsetting of loans as practices of a 'grey market', where Russian companies have expertise working profitably and Western investors fear to tread. This grey market has further reduced Ukrainian options for partnership and diversification.[38] The lack of aggressive action, combined with the fact that

---

[34] Ibid., 16.

[35] Ibid.

[36] Balmaceda evaluated Ukraine's strategic position in terms of United States' interest in the region. She identifies a multifaceted problem: Ukraine's dependency on imported energy sources; lack of energy diversification progress; low levels of energy efficiency; lack of transparency in energy markets, and lack of energy policy, Balmaceda, *Ukraine's Energy Policy and U.S. Strategic Interests in Eurasia*, 2.

[37] Margarita Balmaceda, *Ukraine's Energy Policy and U.S. Strategic Interests in Eurasia*, Kennan Institute, 2004, 2.

[38] Balmaceda finds that declining domestic energy production and inefficient energy usage contribute to the overall energy dependency, one of the highest in Central and Eastern Europe, is "sorely outdated," and this affects the Ukrainian economy in farreaching ways. She explains that the share of energy in the cost structure of Ukrainian goods was 25% in the late 1990s, 8.3 times more than in France and 4 times more than in the United States, making Ukrainian products and companies less competitive. This problem is compounded by government subsidies, which give no incentive for improvement or diversification, Ibid., 2.

Russian companies "have repeatedly created hurdles on the way of Ukraine's energy diversification plans," ensure that "Ukraine is bound to remain largely energy dependent [upon Russia] in the long term, no matter what other diversification initiatives are undertaken."[39]

Balmaceda insists that the United States has an interest in a transparent and successful Ukraine, and all of these issues rob the people of resources which could be better utilized to increase infrastructure and prosperity. This further increases the dependency upon Russia, which is keen to reintegrate the former Soviet space with itself as the hub. "A Ukraine that is weak, lacks transparent governance, and is overwhelmingly dependent on Russia for its energy needs cannot be a strong independent state able to put a stop to possible hegemonic designs in that region."[40] Balmaceda predicted that the consequence of American inaction is increased pressure on Ukraine for closer economic and political integration with Russia concurrent with the loss of opportunity for further EU integration.[41]

Following the 2006 Gas Wars,[42] Balmaceda took a bottom-up approach to examine the role of domestic politics in international energy dependencies in her monograph *Energy Dependency, Politics, and Corruption in the Former Soviet Union: Russia's Power, Oligarch's*

---

[39] Ibid., 4.

[40] Ibid., 10.

[41] Balmaceda insists that Ukraine is the only country in the region which must pay Russia a value-added (VAT) tax as well as export duties, whereas other countries in the region pay one or the other, based upon whether they are in the Customs Union. There was no guarantee from Russia that this will change, however, if Ukraine ratified the Single Economic Space agreements of 2003, Ibid.,15.

[42] Russia, Ukraine, and gas: Pipe down, *The Economist*, January 8, 2009, http://www.economist.com/node/12903050.

Profits, and Ukraine's Missing Energy Policy 1995-2006.[43] She argues that "cheap and abundant energy" bound the Soviet states together, thus energy supplies and interdependencies have been central to the processes of both separation…and reintegration in the former USSR."[44]

Balmaceda's work no longer sought to prove that Russia utilizes energy as a weapon, but "takes Russia's use of energy for foreign policy purposes as a given, although it does not in any way justify it."[45] She maintained that Ukraine's different situation is best understood in the domestic conditions of the other non-Russian states, and how these conditions dictate Russia's approach. While many other countries in the FSU and Eastern Bloc are still dependent upon Russia for energy, she insisted that Ukraine is a special case study because "if we include nuclear energy in this picture, its situation of energy dependency becomes more alarming…nuclear energy [should] not to be counted as domestic production — given the fact that its raw materials (fuel cells or nuclear fuel) are almost exclusively imported from Russia"[46]

A 2007 United States Department of Energy press release announced that 42 nuclear assemblies, accounting for one fourth of the fuel required for a reactor over four years of operation, were to be provided to Ukraine by Westinghouse at a cost of $14 million, in order to continue the mission of the UNFQP. According to Deputy Secretary Sell, "The United States and Ukraine are advancing energy security through cooperation in projects like the U.S. -

---

[43] Margarita Balmaceda, *Energy Dependency, Politics, and Corruption in the Former Soviet Union: Russia's Power, Oligarch's Profits, and Ukraine's Missing Energy Policy 1995-2006,* New York: Routledge, 2008, 1.
[44] Balmaceda, *Energy Dependency, Politics, and Corruption in the Former Soviet Union*, 1.

[45] Ibid, 3.

[46] Ibid., 10.

Ukraine Nuclear Fuel Qualification Project that encourage the diversity of energy supplies and suppliers…to ensure a path of economic growth, we must promote policies that encourage open and transparent market principles, increase energy efficiency, and further cooperation in nuclear non-proliferation."[47]

The Ukrainian government agreed to procure $42 million in LEU from Russia, and the meeting in Ukraine occurred immediately after the deputy secretary met with senior Russian officials in Moscow at the U.S. Russia Energy Working Group. By 2007, the United States had invested $52 million in the project as a part of DOE's International Nuclear Safety Program, managed by Pacific Northwest National Laboratory. The laboratory has "provided technical assistance and technology transfer to former Soviet Union countries to improve the safety of their reactors."

Perhaps indicative of her career "following the pipelines," Balmaceda seemed unaware of the Ukraine Nuclear Fuel Qualification Project. She mentioned the opening of Rivne and Khmelnystki nuclear power plants as an effort to ease reliance on gas, but concluded that since Ukraine depends on Russia for nuclear fuel, "increased nuclear power production does not in and of itself resolve the question of energy dependency on Russia."[48] Beyond the further dependence upon Russia, she found diversification through the increase in nuclear energy to be "problematic" due to foreign and domestic tensions. The European Union and international financial

---

[47] "U.S. Commits $14 million to U.S. - Ukraine Nuclear Fuel Qualification Project," The U.S. Department of Energy. March 14, 2007, Accessed March 14, 2015, http://energy.gov/articles/us-commits-14-million-us-ukraine-nuclear-fuel-qualification-project.

[48] Ibid., 33.

organizations opposed more dependence upon nuclear energy given the legacy of Chernobyl, while domestic environmental groups have even stronger feelings about nuclear energy in Ukraine.[49] In 2013, Balmaceda presented the sum of her previous research in *The Politics of Energy Dependency: Ukraine, Belarus, and Lithuania Between Domestic Oligarchs and Russian Pressure.* She argued that the husk of the centralized Soviet system, which had previously ensured energy security and bound the republics together, created an inescapable international disorder centered upon Eastern European energy dependency. The Soviet legacy of these states ensured complications in post-independence state-building, as they lacked strong national-level institutions to deal with the energy challenges meeting their country on day one. Prior to independence, the cost of energy imports was "negligible," but immediately following independence, 50% of all imports were energy.[50] "Between 1992 and 2005 both Ukraine and Belarus followed energy policies that, in the short term, seemed to keep most powerful political and economic actors reasonably happy. However, these policies had serious medium-term consequences…[making the countries] especially vulnerable to terms-of-trade shocks, and limited [their] abilities to respond proactively to changes coming from the outside, for example, Russia's new pipeline initiatives…"[51]

---

[49] Ibid., 69.

[50] From 1992 to 2003, the last year Ignalina NPP was in full operation, Lithuania "was able to reduce its energy dependence by nearly 26 percentage points (from 70% to 44%), whereas Belarus' and Ukraine's situation remained largely unchanged," putting Lithuania in a different category than Belarus and Ukraine. The management of the dependency situation was the reason for the variation, for although the closing of Ignalina NPP seemed to increase Lithuania's dependence upon Russian gas, Lithuania's internal reforms and energy policies ensured the country was better able to handle the transition, Margarita Balmaceda, *The Politics of Energy Dependency: Ukraine, Belarus, and Lithuania Between Domestic Oligarchs and Russian Pressure,* Toronto: University of Toronto Press, 2013, 5.

[51] Ibid., 268.

Method

This paper will utilize both quantitative and qualitative methods to explore a remarkable and often dramatic global nuclear energy competition through an analysis of the Ukraine Nuclear Fuel Qualification Project as a case study. Primary sources include a personal interview with the Pacific Northwest National Laboratory UNFQP project manager, Richard Latorre, who wrote the proposal for the UNFQP. He describes the UNFQP as the capstone project of his career; his patient explanations of technical details and anecdotes offer a detailed and authoritative source on the goals, limitations, and complications of the project. Primary documents include official bilateral agreements, signed statements, and press releases from US, EU, and Ukrainian authorities, as well as corporate propaganda.

The works of Balmaceda and Smith will assist with understanding the politics of energy dominance and dependence. The analysis will also require qualitative sources, including journalistic articles from reputable sources such as the *The New York Times*, *The Washington Post,* and *Radio Free Europe/Radio Liberty*. Foreign news outlets will also provide important sources of domestic insight regarding energy dominance and dependence. Nuclear industry resources, such as *World Nuclear News* and the World Nuclear Association, provide valuable industry-specific perspective and information on nuclear matters which often do not appear in journalistic sources. Finally, foreign language blogs and academic articles offer an insight into the issue of dominance and dependence which will round out the narrative.

Quantitatively, research culled from nuclear industry resources regarding reactors, nuclear energy production, overall energy share, and reactors both proposed and currently under construction has been compiled in several charts to illustrate the overall Near Abroad energy dominance/dependence landscape. Unfortunately, financial information pertaining to the

Russian and Ukrainian energy sector is more opaque and less reliable than in Western energy companies. When available, this information will be provided with the caveat that the rampant corruption prevalent in Russia and Eastern Europe presents a challenge in this area. Likewise, information regarding the impact of sanctions on the Russian nuclear industry is similarly difficult to present with a high degree of confidence in the accuracy of these figures.

III. CHAPTER I: The Energy Troika

Immediately following the Crimean Annexation, Senator John McCain labelled Russia "a gas station masquerading as a country." McCain was arguing for tough economic sanctions, insisting that Russia is "a kleptocracy…a corruption. It's a nation that's really only dependent upon oil and gas for their economy."[52] Russia's economy is energy-driven, but this assessment is incomplete. In 2000, as relatively unknown Vladimir Putin was taking the reigns, Balmaceda insisted that "it should not be assumed that each and every action taken by Gazprom and the

[52] Brett Logiurato, "JOHN MCCAIN: Russia is a "Gas Station Masquerading As A Country," *Business Insider,* March 16, 2014, Accessed March 20, 2014, http://www.businessinsider.com/mccain-russia-putin-gas-sanctions-ukraine-crimea-referendum-20143#ixzz3Rf4J9Jqb.

Russian oil companies vis-a-vis East-Central Europe is motivated by specific policy objectives of the Russian state, [but] the role of the Russian energy sector - known in Russia as TEK or *Teplovoy Energeticheskii Kompleks* — is so significant that it cannot but have an impact on Russian policy overall.[53]

Gazprom, the world's largest gas company, along with the national Russian oil company Rosneft, are only two of the horses in the Energy Troika which pulls the Russian economy — Rosatom is in every way a dark horse.

Rosatom, The Dark Horse of the Energy Troika

Rosatom's stated mission is to "maintain national interests in defence, nuclear safety and nuclear power by achieving global leadership in advanced technologies, competencies and innovations."[54] Rosatom, a national corporation with a vertical power structure, is the world's largest integrated nuclear firm and a leading nuclear fuel producer with ownership of the second largest global supply of natural uranium.[55] A cursory examination of the corporate structure unearths a byzantine maze of 150 nuclear concerns consolidated under the Rosatom Group, headed by a CEO serving at the pleasure of the President of the Russian Federation, Vladimir Putin. Sergei Kiriyenko was appointed by Vladimir Putin to head Russia's Federal Atomic Energy Agency, or "Rosatom," in 2005. A former "young reformer" and one-time Prime Minister, Kiriyenko had previously demonstrated his loyalty and managerial prowess

---

[53] Balmaceda, *The Politics of Energy Dependency*, 207.
[54] "Mission," *Rosatom,* Accessed February 14, 2015, http://www.rosatom.ru/en/about/mission/.

[55] "About," *Rosatom,* Accessed April 11, 2014, http://www.rosatom.ru/en/about/.

when appointed to the position of presidential envoy to the Volga Federal District in 2000, an administrative district created in May of that year as part of Putin's immediate reforms.[56] Nearly all of Putin's appointees have some personal connection or intelligence pedigree, and Kiriyenko is no different.

While his own career was fairly typical of a former Komsomol member in the "messy nineties,"[57] his grandfather was a devoted communist working in intelligence who received an inscribed pistol from Lenin himself.[58]

Unlike Yeltsin's Russia, when the country was highly decentralized and chaotic after the loss of Soviet order, Putin employed the concept of the "power vertical" to ensure a recentralization of power focused upon the executive branch. Kiriyenko's appointment was a part of this recentralization. When Putin ascended to power following Yeltsin's resignation on New Year's Eve, just prior to the new century, he quickly went to work reigning in the oligarchs who had been using Russian energy giants Gazprom and Rosneft as vehicles to plunder Russian

---

[56] Kiriyenko's position in the Volga Federal District is significant because it contains two non-Slav republics, a sizable population of different ethnic minorities, as well as the Russian Federal Nuclear Center in Sarov, which is tasked with designing nuclear weapons. Clearly a man who can get results under challenging conditions, Kiriyenko was also entrusted with the leadership of the State Commission for Chemical Disarmament, responsible for the destruction of the Soviet chemical weapons arsenal in a program partially funded by the United States.Viktor Yasmann, "Sergei Kiriyenko — Russia's 'Kinder Surprise,'" *Radio Free Europe Radio Liberty,* February 15, 2006, http://www.rferl.org/content/article/1065790.html.

[57] Komsomol members were in the best position to take advantage of the chaos in Russian civil institutions following the collapse of the Soviet Union (the 'messy nineties'). Many rose to the status of oligarchs through shady business deals which fleeced the formerly Soviet people of the wealth of their socialist state through privatization.

[58] "Rosatom State Corporation," *Bellona,* November 26, 2007, http://bellona.org/news/nuclear-issues/nuclear-russia/2007-11rosatom-state-corporation.

resources. His goal was not necessarily to end the corruption, but simply to ensure that those who were in power were working toward his own ends.

After he removed the CEOs of these corporations, he replaced them with "*svoi*," or his "own" people from his political days in St. Petersburg under former Mayor Anatoly Sobchak, Putin's old law professor. Principle among these men is Dmitri Medvedev (another former law student of Sobchak's), who headed Putin's campaign in 2000 and was rewarded for his loyalty with a choice position as chairman of the board of Gazprom in 2000, the office of the prime minister in 2004 and 2012, and even the presidency in 2008.

With Gazprom and Rosneft firmly in hand after his first term, Putin moved to elevate the national nuclear program to its appropriate status. During the Soviet era, all nuclear industry was under the jurisdiction of the mysterious Ministry for Medium Machine Building, or "Mindredmash," a ministry which could not even be located in the phone book.[59] Established in 1953, its mission included the development and handling of the Soviet nuclear weapons stockpile and development of the nuclear energy program, answerable directly to the Presidium of the Supreme

Soviet. As a part of *perestroika* and *glasnost*, the cryptic title of the agency was renamed the Ministry of Atomic Energy and Industry of the USSR, or "Minatom."[60]

---

[59] Joesephson, *Red Atom*, 26.

[60] "Rosatom State Corporation," *Bellona,* 2007.

Under Yeltsin, Minatom was one of the lowest priorities in the federal budget, next to the agencies for tourism, fitness and sports.[61] Concerns for the security of the fearsome Soviet nuclear stockpile prompted American intervention through the implementation of the Cooperative Threat Reduction Program, including the Megatons to Megawatts Program.[62] These programs were not renewed in Putin's third term part because their success has allowed Russia to focus on other areas of energy growth, resulting in the ability to perform the mission with little assistance, and in part because Russia fears leaks concerning nuclear security.[63]

Until then, Putin's second term would place a greater emphasis on the importance of the third national champion in his energy troika. On his first day as head of the agency, Kiriyenko vowed to revive the glory days of Mindredmash.[64] In 2007, Putin passed a law upgrading Rosatom to the private State Atomic Corporation Rosatom. Unlike Mindredmash, beholden to the Presidium, a committee of leaders, the CEO of Rosatom would be appointed and answerable only to the President of Russia.

---

[61] Ibid.

[62] "Nunn-Lugar Global Cooperation Initiative," *Defense Threat Reduction Agency,* Accessed May 14, 2014, http://www.dtra.mil/ Missions/nunn-lugar/nunn-lugar-home.aspx.

[63] Will Englund, "Russia no longer wants U.S. aid on nuclear arms security," *The Washington Post,* October 10, 2012, Accessed May 16, 2014. http://m.washingtonpost.com/world/europe/russia-no-longer-wants-us-aid-on-nuclear-arms-security-wont-extendnunn-lugar-pact/2012/10/10/6cde030c-130e-11e2-ba83-a7a396e6b2a7_story.html.

[64] "Rosatom State Corporation," *Bellona,* 2007.

BOO: Build, Own, Operate

On January 14, 2014, Sergei Kiriyenko met with President Vladimir Putin to discuss Rosatom's progress. The official website of the President of Russia presented excerpts from this interviews highlighting the glowing success of Rosatom's global endeavors.[65] Rusatom Overseas, a subsidiary of Rosatom, was established in 2011 to promote Russian nuclear interests abroad, working to integrate a wide range of products and services, including uranium extraction, nuclear power plant construction, developing legal frameworks, training personnel, financing, and even public relations. Foreign projects are implemented using a "build-own-operate" (BOO) structure that make NPPs a turn-key operation for the host nation.

Rusatom's first BOO project was the construction of the Akkuyu Nuclear Power Plant,[66] but there are presently 25 marketing offices worldwide.[67] The construction arm of Rusatom Overseas, Atomstroyexport, has been exceptionally busy since Rosatom is the only nuclear corporation in the world capable of offering the BOO model. Of the nearly 70 nuclear reactors under contraction worldwide, 28 are Rosatom tenders.[68] In his aforementioned meeting with Vladimir Putin, Kiriyenko insisted that "we are doing our best to make sure we have one and a

---

[65] This meeting is particularly interesting given the historical context of 2014. "Working meeting with Rosatom CEO Sergei Kiriyenko," *President of Russia,* January 9, 2014, Accessed May 5, 2014, http://eng.news.kremlin.ru/news/6503

[66] The first in NPP in Turkey.

[67] Rosatom has established twelve public relations offices in as many countries, but with regional offices in Kiev, Prague, and Astana. The first office was established in Ukraine.

[68] In contrast, the French company Areva is presently building four, but Westinghouse as not completed a reactor since 1995. Much of the demand is in the developing world, where the financing is very attractive, "Russian nuclear ambition powers building at home and abroad," *Reuters,* July 22, 2013, Accessed May 12, 2014, http://www.reuters.com/article/2013/07/22/russia-nuclearrosatom-idUSL5N0F90YK20130722.

half to two units in our portfolio of orders for every single unit we commission."[69] At an IAEA ministerial conference in St. Petersburg in 2013, the first since the Fukashima disaster, Kiriyenko boldly declared, "We want to make profits out of nuclear energy. We want to power the world."[70]

The Near Abroad — Nearer

As George Kennan observed in his Long Telegram, security is a traditional Russian preoccupation, expressed in Moscow's historical control over strategic infrastructure in neighboring states. This leverage creates influence that ensures malleable governments are in place to support Russian security and economic interests. Russian economic power projection is not precisely imperialism, but the neocolonial characteristic of Russia's foreign energy policy are readily apparent to those living in the immediate neighborhood.[71]

In the Near Abroad, the Energy Troika works in a coordinated fashion to maintain the energy dominance paradigm which has worked so well for the Russian Federation. Balmaceda and Smith have established that the Nomenklatura, the elites in the former Soviet states, have been malleable under Russian pressure. There is little incentive to change a system which has been profitable for them, especially those elites who seized upon the energy assets in their countries and rose to become oligarchs. The Energy Troika pulls the Russian bear, but tramples upon the ambitions of any leader brave or foolish enough to stand in its way. This 'momentum'

---

[69] "Working meeting with Rosatom CEO Sergei Kiriyenko," President of Russia, January 9, 2014, Accessed May 5, 2014, http:// eng.news.kremlin.ru/news/6503.

[70] "Russian nuclear ambition powers building at home and abroad." *Reuters*. July 22, 2013, http://www.reuters.com/article/ 2013/07/22/russia-nuclear-rosatom-idUSL5N0F90YK20130722.

[71] Smith, *Russian Energy Politics*, viii.

allows the coordination to not just capitalize upon existing dependencies, but create future dependency in the Near Abroad. The Energy Troika approach has been successful in some countries more than others, but where it has been successful, it has been devastating.[72]

The Special Case of Ukraine

Balmaceda insists that Ukraine is the most compelling example of "Russia's use of the energy weapon" insisting that Ukraine is a "testing ground" for this tactic in other former USSR states "and beyond." In February 2013, General Valery Gerasimov, the newly appointed Chief of Staff, confirmed in military journal *VPK* that war and peace are no longer distinct, that states must leverage every tool possible in order to gain and maintain advantages. Methods of conflict now involve "the broad use of political, economic, informational, humanitarian and other nonmilitary measures."[73] Mr Gerasimov quoted the Soviet military theoretician Georgii Isserson, "mobilisation does not occur after a war is declared, but 'unnoticed, proceeds long before that.'"[74] Energy security *is* national security; by attacking such an intrinsic aspect of civic infrastructure, society itself is undermined.

---

[72] See Near Abroad Nuclear Fuel Profiles in Appendix

[73] According to Gerasimov, all these measures may be supplemented by firing up the local populace as a fifth column and by
"concealed" armed forces, which has been arguably occurring in the Donbass region, Valerii Gerasimov, Tsennost' naiukii v predvidenii: noviiye viizovii trebuyut pereocmiicleniya form ii cposobov vedeniya boeviikh deicstbii, *Boenno-promiishlennii kur'ep (VPK)*, February 27, 2013, http://vpk-news.ru/sites/default/files/pdf/VPK_08_476.pdf.

[74] Sam Jones, "Ukraine: Russia's new art of war," *Financial Times*, August 28, 2014, http://www.mediapool.bg/files/224/Ukraine_%20Russia%E2%80%99s%20new%20art%20of%20war%20-%20FT.pdf.

Why were states such as Ukraine, after more than a decade, unable to adopt policies to reduce their energy dependency on Russia and move towards energy diversification until the external price shock of 2007-2008? Ukraine adopted an energy-diversification rhetoric, but it was complicated by domestic dynamics. In Ukraine, energy policy was generally used for the distribution of rents among the main economic-political players.

Elites scrambling for control of transit rents in and a lack of national-level control in Eastern Europe is ultimately an international issue, since Western Europe has depended upon Ukraine's unstable relationship with Russia and itself felt the insecurity in 2006 and 2009. In the winter of 2008-2009, a total stoppage of Russian gas supplies to several EU states jolted the international community to recognition of this dilemma, despite the fact that gas flowed again after only two weeks. In these energy attacks, Ukrainian reliance upon nuclear energy became even more critical. As early as 1995, there was interest in establishing a domestic nuclear fuel fabrication plant in Ukraine,[75] which President Viktor Yushchenko reiterated in 2006.[76]

Ukraine's challenging transition from all-Soviet to republican control of the reactor and EU pressure for the decommissioning of the RBMK reactors at Chernobyl was eased by the strong base of local nuclear specialists, as well as native deposits of uranium and zirconium. These materials have been sent to Russia for the production of fuel rods, which have been sold back to individual Ukrainian power plants, limiting the bulk purchasing power of the state.

---

[75] Westinghouse was interested in the large Ukrainian market, and considered building a fuel fabrication plant at that time, but the corruption and the lack of financial stability kept the project from moving any further than this.

[76] "Ukrainian President Viktor Yushchenko said that his country should produce its own nuclear fuel for power plants," *Associated Press,* January 13, 2006.

Balmaceda insisted that energy is still the most sensitive form of trade with Russia in the former Soviet states. "Trade with Russia is not just trade; it is unavoidably perceived as politically significant trade with the former hegemon."[77]

IV. CHAPTER II: The Ukraine Nuclear Fuel Qualification Project

The political will to help Ukraine diversify its nuclear fuel supply may have arisen from U.S. efforts to prohibit the Islamic Republic from proliferating, but the conception of Ukraine Nuclear Fuel Qualification Project (UNFQP) began in the Czech Republic as a result of the 1989 Velvet Revolution and the subsequent 1993 'Velvet Divorce.' Four reactors were planned for a nuclear power plant in a town named Temelin, located in the modern Czech Republic.[78] However, the first two reactors were not completed before the dissolution. The Czech Republic formally decided to complete the first two reactors in 1993, choosing Westinghouse[79] to replace the entire instrumentation and control (I&C) systems – "the first time that Western digital I&C

---

[77] Margarita Balmaceda,*The Politics of Energy Dependency: Ukraine, Belarus, and Lithuania Between Domestic Oligarchs and Russian Pressure,*

[78] Energoprojekt is currently a Serbian company, but at the time it was a state-owned company of the former SFRY. The plant was designed by Soviets working with Energoprojekt, but the actual construction was by the Czech company VSB. "Country Profile: Czech Republic," World Nuclear News, Last updated January 2015, Accessed March 2015, http://www.world-nuclear.org/ info/country-profiles/countries-a-f/czech-republic/.

[79] As a corporation, Westinghouse is majority owned (51%) by Toshiba Corporation, is an international conglomerate which operates independently of any government (unlike Rosatom and Energoatom), while still enjoying a close relationship with the United States government and national laboratories. Westinghouse developed the first commercial pressurized water reactor in 1957, but now there are over 430 nuclear power reactors operating globally, and Westinghouse technology is "the basis for approximately one-half of these reactors, giving Westinghouse the world's largest installed base of operating plants." Consequently, Westinghouse is the largest supplier of nuclear fuel in the world. "About" http://www.westinghousenuclear.com/About/History [77] Ibid.

was integrated with Russian reactor technology" – as well as the radiation monitoring and diagnostic systems. In addition, Westinghouse agreed to supply fuel for the initial core and four reloads.[77] The reactors were completed by Westinghouse a decade later, with the upgrading having been financed by Czech national operator CEZ, with financial support from the World Bank.[80]

In 1998, PNNL nuclear fuel expert Richard Latorre wrote a proposal for the UNFQP to help Ukraine diversify its supply of nuclear fuel. Because nuclear fuel is outrageously expensive, it was critical that the Westinghouse VVER fuel operate in tandem with the TVEL fuel during the qualification process. He proposed a three-part initiative which included training and technology transfer in Phase One, followed by fuel qualification in Phase Two, and in Phase Three, 42 fuel assemblies (with reloads) would operate over a three year time span with no serious problems.[81]

The bilateral agreement warranted a visit to Kyiv by President Bill Clinton on June 5, 2000. The U.S. Department of State funded the program, the money was disbursed by the Office of Management and Budgets to the Department of Energy, and finally PNNL was tasked with the direct management of the project.

Risky Business

The UNFQP was a risky business venture for Westinghouse, and an uphill climb for

---

[80] Ibid.

[81] Richard Latorre, Personal Interview, Pacific Northwest National Laboratory, Richland, Washington, April 29, 2015.

PNNL, due to the corruption woven into the fabric of Ukrainian and Russian civic institutions. Early efforts to help Ukraine establish a domestic fuel cycle failed miserably. From 1994 to 1999, Ukraine had been trading Soviet nuclear warheads to Russia for nuclear fuel under a program called the Nuclear Fuel Cycle Fund (NFCF).[82] The profits from the electricity generated by the fuel were to be allocated to the NFCF, which was intended help Ukraine to develop its domestic nuclear fuel industry. In 2001, Aleksandr Gudyma, the Nuclear Policy and Safety Committee Chairman of the Supreme Rada Fuel and Energy Complex, described nuclear energy as the "backbone" of Ukraine's energy system, but lamented Ukraine's "absolute dependence" upon "monopolistic" Russia for nuclear fuel, spent fuel storage, and parts. He equally bemoaned the betrayals of corrupt Ukrainian officials. "Energoatom's failure to honor its financial commitments to the NFCF [was] due to the subjective stand its management has taken on disbursements to the fund," an accusation leadership of Energotatom flatly denied.[83]

In 1999, with no more weapons to trade, Ukraine was compelled to barter the Russian Black Sea Fleet debts to Sevastopol for $15 million in nuclear fuel. Ukrainian debt for nuclear fuel totaled $74.66 million for the first half of 1999, and because the debt had gone unpaid, Russia ceased its planned shipment of fuel. Half of Ukraine's reactors shut down, affecting 18,000 consumers. Energoatom claimed that part of the problem was that the consumers

---

[82] Mariya Gudyma, "Realii i perspectivy yaderno-toplivnogo tsikla Ukrainy," *Zerkalo nedeli*, February 9, 2001, Accessed April 14, 2015.

[83] Gudyma reiterated that energy security has always been a matter of Ukrainian national security, insisting that no country should supply more than 30 percent Ukraine's energy needs. He attributed the failure of the fuel cycle project to a strong and pervasive pro-Russia lobby as well as the under-financing of the program. The devaluation of the hrivne also played a strong role. Seriy Syrovatka, "Nuclear Cycle: Who Will Fund It?" *Dyen,* July 22, 2003, Date Accessed, March 3, 2015, http://www.day.kiev.ua/en/article/day-after-day/nuclear-cycle-who-will-fund-it.

themselves had not paid their bills to their electricity producers, impeding the purchase of more fuel, but this unpaid total came to only $1.53 million.[84]

A more likely cause for the debt and the failure to fund the NFCF was revealed in a "damning report" by the Ukrainian Finance Ministry's main supervisory department in 1998. The Kyiv Post alleged rampant corruption within the 60 companies under the Energoatom umbrella on May 17, 2000, just prior to the presidential visit from Bill Clinton to sign the UNFQP agreement. "Around 49 percent of the costs for energy produced by the nuclear energy sector… have nothing to do with the actual production of energy" and "the company management expenses in 1998-99 reached Hr 1.48 billion, which is 190 times higher than permitted in the company's official budget."[85] Additionally, 'middlemen' were taking generous commissions of about 23% on average for handing "gray market" bartering, as "most electrical energy is paid for through bartering schemes rather than cash….the middlemen only appear when the company doesn't want to, or can't, do something by itself."[86]

Western Influence and the Results of Competition

Mycelia Dudchenko, president of Energoatom, was sacked well in advance of President Clinton's arrival in 2000.[87] Gudyma's public appeal occurred around the time Dudchenko's fall,

---

[84] "Ukraine Nuclear Fuel Cycle Chronology," *Nuclear Threat Initiative,* Last Updated April 2005, Accessed February 14, 2015, http://www.nti.org/media/pdfs/ukraine_nuclear_fuel_cycle.pdf?_=1317248570.
[85] Katya Gorchinskaya, "Damning report costs Energoatom boss job," *Kyiv Post*, May 17, 2000, http://www.kyivpost.com/content/ukraine/damning-report-costs-energoatom-boss-job-164.html.

[86] Gorchinskaya, "Damning report costs Energoatom boss job," 2000.

[87] Dudchenko was sacked February 14, 2000. Shortly after Clinton's departure, Energoatom was charged with tax evasion and reforms were planned.

insisting that a domestic fabrication plant is "within Ukraine's technical and financial capabilities."[88] As a model, he pointed to the success of the Tamelin VVER fuel in the Czech Republic, produced by Westinghouse.[89]

In direct response to this pressure from US interest in the diversification of Ukraine's nuclear fuel, TVEL offered a 'buy-direct' option, offering to cut out the middle-men, reducing the cost of nuclear fuel by as much as 30%. However, TVEL demanded cash only, with a 35% upfront payment, accusing Ukraine of ordering more fuel than it bought, resulting in surplus inventory for TVEL.[90] Nevertheless, in that same year, Russia, Kazakhstan, and Ukraine entered into negotiations for the creating of a fuel fabricating plant in Ukraine.[91] It was described as efforts toward diversification, but if successful, it would further integrate the nuclear industries of the three countries through a joint venture deal.[92]

According to Latorre, the training component to the UNFQP also began around this time. Twelve Ukrainian nuclear engineers and technology experts were relocated to the United States

---

[88] This financial assessment was based upon a successful South Korean endeavor which cost half the estimated cost of the Ukrainian fuel fabrication plant.

[89] Aleksandr Gudyma, "Realii i perspektivy yaderno-toplivnogo tsikla Ukrainy," Zerkalo nedeli, 10 February 2001, p.9. http://gazeta.zn.ua/ECONOMICS/realii_i_perspektivy_yaderno-toplivnogo_tsikla_ukrainy.html, http://gazeta.zn.ua/ECONOMICS/realii_i_perspektivy_yaderno-toplivnogo_tsikla_ukrainy.html.

[90] In order to purchase the necessary fuel, Energoatom borrowed the funds from Prominvestbank, a loan which was dependent upon an electricity deal for Krivorozhstal Steel Works, demonstrating the influence of the metallurgy industry. "Ukraine Nuclear Fuel Cycle Chronology," *Nuclear Threat Initiative,* Last Updated April 2005.

[91] The fuel fabrication plant is the Holy Grail for Ukrainians, they would prefer self-sufficiency above all else, and this will be a theme for 20 years.

[92] It is unclear as to whether Ukraine was negotiating in bad faith with the Russians, the negotiations were the project of a particular Ukrainian actor, or Kyiv was hoping to benefit from competition between the two powers. Ibid.

to train at Westinghouse in Pittsburgh, while three went to Columbia, South Carolina. For the next five years they learned Western industry standards and practices as well as core design and Westinghouse codes, which PNNL purchased from Westinghouse.[93] Technology was also provided for the new Center for Reactor Core Design (CRCD) in Kharkiv, which was instrumental in developing the new VVER fuel.[94]

The second phase of the project required the production of six Lead Test Assemblies (LTA) to be manufactured according to the research and development performed in cooperation with

the trained Ukrainian specialists in Columbia, South Carolina.[95] Simultaneously, the third reactor at the South Ukraine NPP had to be retrofitted for the LTAs. Per Western standards, PNNL insisted upon a formal tender process for all aspects of the project.[96] According to Latorre, this

[93] Early nuclear engineers were required to perform complicated algorithms without the aid of technology, but modern reactors are so advanced that these proprietary fuel performance codes are necessary to run the reactor effectively through computers and instrumentation. Latorre, Personal Interview, 2015.

[94] According to Latorre, there were many technical VVER fuel compatibility issues which needed to be understood and resolved, including dimensions, tolerances, performances, radiation growth, and thermohydraulic compatibility. Latorre, 2015.

[95] These LTAs were to "qualify" the fuel, that is, prove that the fuel is safe and reliable in simultaneous operation with the TVEL VVER fuel. Special "hex patterns", which hold the fuel rods together and guide the control rods (safety rods that shot down the reactor) were developed by this team with the support of Westinghouse from a special ZIRLO alloy. For more information, see Appendix 4.

[96] A Request for Tender (RFT) is "an open invitation for suppliers to respond to a defined need…[and] will usually cover not only product and service offerings, but will also include information about the suitability of the business." This process is intended to create a transparent and competitive environment for public projects. Suki Mhay and Calum Coburn, "Request for…Procument Processes (RFT, RFQ, RFP, RFI), Last updated 2015, Accessed April 30, 2015, http://www.negotiations.com/articles/procurement-terms/.

concept was quite foreign the Ukrainians in the industry, "they hated us for it, they couldn't understand why we insisted upon it."[97]

TVEL continued to pressure Ukraine as the project continued. In February 2002, an agreement had been reached between Russia and Ukraine for reactor fuel worth $246 million from Russia in that year alone, with Ukraine paying monthly installments of $22.2 million for the remainder of the year.[98] In 2003, the retrofitting was completed at the South Ukraine NPP,[99] and it was announced that the fuel assembly testing would begin.[98] Shortly thereafter, the Kras-

[97] Latorre explained that from the very beginning, PNNL and Westinghouse had to be wary of corruption. Their only 'champion' in the government, the Deputy Minister of Fuel and Energy, had created a false company to write a tender to compete for the business. He used a defunct company and installed his son as the head, then solicited resumes from around the country to give the appearance of a competent workforce. He was exposed during the tender process by one of his countrymen at the table who threatened worse consequences than embarrassment if he did not withdraw the tender. After this, Latorre said the project was entirely uphill because of a "lack of personal incentives."

[98] "Rossiya postavit yadernoye toplivo," *WPS Yadernyye materialy,* No. 7, 28 February 2002.

[99] According to Latorre, Russian influence cost the U.S. significant time and money in this process. In one case it was necessary to test the hydraulics of an assembly with a massive portable hydraulic test loop shipped from the U.S., including a generator to ensure proper power. After three months of stalling, even with the signature of President Kuchma, the chief engineer refused to allow the assembly to be tested. Instead, a "dummy" assembly was acquired from the Czech Republic. In one case, the chief engineer at the NPP said, "There is no f—ing way we are going to have Westinghouse fuel in my plant." [98] Ibid.

noyarsk Administration refused to allow the importation of Ukraine's spent fuel for storage until a $11.76 million debt was paid from 2002.[100]

By 2004, it had become clear that the experiment was exceeding expectations. The U.S. Department of Energy issued a "Statement of Considerations" regarding a "request by Westinghouse Electric Company for an advance waiver of the government's domestic and foreign patent rights" under PNNL's subcontract. Westinghouse considered VVER fuel "an important commercial product" and did not want to share patent ownership rights with the DOE.[101]

> Usually, DOE expects the Contractor to cost-share the contract by at least 20% before granting an advance waiver. However, this Westinghouse Contract work is to further the USA/Ukraine International Agreement concerning "Ukraine Nuclear Fuel Qualification Project." In addition, there are very few U.S. companies that could even qualify to do the work required under this subcontract. In fact, Westinghouse was the only offer to the solicitation. In view of the objectives of the DOE Program, DOE agrees to waive its possible domestic and foreign patent ownership rights in any future inventions.[102]

---

[100] Krasnoyarsk is the location of the Russian Federation's primary nuclear waste repository and Ukraine is the biggest customer for spent fuel storage. However, there were some domestic embarrassments regarding security around the spent fuel repository in Krasnoyarsk as well as the reprocessing center at Mayak, and these ventures were 40% less profitable than predicted, so it is unclear whether this was targeted at Ukraine, Ukraine was a victim of Russian domestic problems, or both. Recently Ukraine has begun to create its own storage facility within the Chernobyl Exclusion Zone. "Krasnoyarskiy kray otkazhetsya prinimat otrabotannoye yadernoye toplivo iz Ukrainy v sluchaye nepogasheniya 11.76 mln. dollarov dolga," UNIAN, 1 August 2003; in Integrum Techno, www.integrum.com.

[101] "Statement of Considerations: Request by Westinghouse Electric Company for an Advance Waiver of the Government's Domestic and Foreign Patent Rights Under Pacific Northwest National Laboratory Subcontract BOA 332850-A-R5." *The United States Department of Energy,* DOE Waiver No. W(A)-04-030. http://energy.gov/sites/prod/files/gcprod/documents/WA_04_030_EXTENSION_OF_WESTINGHOUSE_WAIVER.pdf.

[102] This is significant because Westinghouse did not cost-share the contract, in fact, Westinghouse invested no capital in the project. The entire project was at taxpayer expense because it was to further international diplomatic efforts. Ibid.

In 2005, South Ukraine's third reactor was the first ever to use VVER fuel assemblies supplied by Westinghouse together with Russian fuel for a period of pilot operation. The LTAs were constructed in Columbia, and the fuel was provided by Areva by reprocessing partially spent research fuel from a DOE repository.[103] The assemblies had to be shipped to Ukraine through the

Mediterranean and Black Seas, which created even more international complications.[104]

In 2006, shaken by the Gas Wars, President Yushchenko commissioned a report, *Energy Strategy to 2030*, which declared the intention of Ukraine to produce its own nuclear fuel in a bid for increased energy independence from Russia.[105] Yet in 2007, Ukraine pragmatically agreed to consider joining Russia and Kazakhstan in the International Uranium Enrichment Centre (IUEC) in Angarsk, and by late 2008 Ukraine was a 10% stakeholder. Ukraine agreed to sell uranium ore to the IUEC for enrichment, which would be purchased by TVEL and then sold to

---

[103] In an impressive feat of project management, Latorre explained how the fuel was acquired for the LTAs at no cost, and in fact saved the U.S. government money. He knew that two metric tons of spent research fuel was being stored at taxpayer expense, and that there was still a significant amount of U_{235} left in this cache. He traded it to Areva in return for only the fuel necessary for the LTAs. Idaho National Laboratory paid to retrieve the containers to create shielding, so acquiring the LTA fuel was actually profitable for several parties.

[104] The issue of finding an acceptable port was a great challenge. The Ukrainians wanted to use a port that was unacceptable to the U.S. because it was near Moldova, and at the time there was some unrest there. They had to agree upon a port, but then the port had to be qualified, and nobody wanted to go through the requisite training and legal procedures. Finally, a port south of Mikolaev was established, although it is not identified on current maps (most likely for security reasons).

[105] It was in this same year that Sergei Kiriyenko became the CEO of Rosatom.

Energoatom.[106] This relationship would prove necessary, as the Ukrainians were required to provide uranium for the fuel assemblies as per the original UNFQP agreement.

According to Latorre, the LTAs "performed flawlessly" in the second phase of the project, and so 42 fuel assemblies were provided by Westinghouse in mid-2009 for a three-year period of commercial operation at the unit, with regular monitoring and reporting.[107] While the LTAs were manufactured in Columbia and the fuel was provided by the United States, the 42 fuel assemblies and all the reloads for Phase Three were manufactured by Westinghouse Sweden with uranium procured by Ukraine from Russia.[108]

Pro-Russian candidate Viktor Yanukovych was elected President of Ukraine in February 2010. Four months later, as a part of the secretive and hotly contested Kharkiv Pact, Yanukovych negotiated a 30% cut in gas prices from Gazprom, as well as a decade of customs waivers, and in exchange offered the extension of the Sevastopol Naval Base until 2045.[109] Three months after the Kharkiv Pact, Energoatom signed a 20 year fuel supply contract with TVEL for all 15

---

[106] The agreement went into effect in 2010. The contracted volume is reported to be 60,000 SWU/yr, proportional to the Ukrainian shareholding. Ukraine requires about 1.96 million SWU/yr overall. http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Ukraine/,

[107] "Nuclear Power in Ukraine," World Nuclear Association, Updated May 2015, Accessed May 13, 2015. http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Ukraine/.

[108] Latorre insists that Westinghouse Sweden is a very different entity from Westinghouse Pittsburgh. While Pittsburgh contributed no capital to R&D on the VVER fuel development, Westinghouse Sweden did invest funds. In his experience, Westinghouse Sweden is more "cooperative and in tune with the European market and willing to start somewhere to build business… they understand the philosophy and mentality of Eastern Europeans better than Americans." They have also given the CRCD contracts for other projects in Europe while buying fuel from TVEL to develop a reciprocal relationship with the Russians.

[109] "Ihor Kabanenko, "Kharkiv Accords: Background, menaces, and lessons," April 7, 2014, Accessed May 12, 2015, http:// www.day.kiev.ua/en/article/society/kharkiv-accords.

reactors at a substantial discount from previous prices.[110] Bundled into the agreement was the financing for the long-desired fuel assembly plant, with a technology handover promised by 2020.[111]

The deal with TVEL was legally feasible because Energoatom inspectors found "scratches" on the Westinghouse fuel assemblies. According to Latorre, Mikhail Gashev, the first deputy head of Ukraine's State Nuclear Regulatory Inspectorate (SNRI), was acting under Russian influence when he discredited Westinghouse VVER fuel, resulting in a lengthy unscheduled outage at two units. Latorre admitted that there was a "glitch" in the design, but explained that it was a combination of loading errors and the need to slightly adjust the design to create more tensile strength in the hex pattern. However, Latorre said that independent experts who had analyzed the reports approved by Gashev found them to be completely fabricated and wildly inaccurate.[112] The issues with the fuel assemblies were addressed by Westinghouse and the testing continued, but success of the UNFQP was in jeopardy following these events.

---

[110] The discount was about $1 billion over the contract. In 2010, TVEL sold Ukraine nuclear fuel for $608 million (€449 million).
"TVEL, Energoatom sign contract on nuclear supplies for plants in Ukraine," *The Kyiv Post*, June 1, 2010, Accessed May 13, 2015, http://www.kyivpost.com/content/business/tvel-energoatom-sign-contract-on-nuclear-fuel-supp.html.

[111] The first fuel assemblies were scheduled to be produced by 2015, although according to Latorre, "the right people got paid and that was the end of it." "Work starts on Ukrainian fuel plant," World Nuclear News, October 4, 2012, Accessed May 12, 2015, http://www.world-nuclear-news.org/ENF-Work_starts_on_Ukrainian_fuel_plant-0410127.html.

[112] In fact, Latorre revealed that throughout the project, leaking TVEL VVER fuel rods were detected through "sipping" processes
(sipping involves hydraulic testing for radiation leakage). Latorre explained that plant workers had come to him with about the fuel rods, which were leaking, twisting, and bowing, sometimes so severely that the control (safety) rods would be unable to function. TVEL ensures all clients sign nondisclosure agreements about their fuel, but what they call "untight" fuel rods is a common problem (according to him) but legally customers may not complain. He insists that this presents serious safety issues for workers which would not be tolerated in the West.

The Crimea Backlash

Substantial unexploited oil and gas fields located around the Crimean peninsula are no longer assets for Ukraine, and this is particularly damaging to a country that seeks to become more energy independent. Russia's seizure of Crimea also removed the Sevastopol Naval Base as a bargaining chip and source of revenue for energy purchases, and this is also a severe blow to Kyiv. Is Putin a rational actor, Gather of Lands, or reactionary? This debate still rages. One thing is certain: the Crimean annexation has completely changed the trajectory of Ukraine's relationship with Russia, and this has extended to all aspects of nuclear energy.

In April 2014, Energoatom extended the original contract with Westinghouse, which provided the initial 42 assemblies as well as reloads, amounting to a total of 630 assemblies for three reactors. Under the amended contract, Westinghouse Sweden would produce fuel for these reactors until 2020, with the potential to increase the demand for more reactors. When questioned about the problems with the fuel, Energoatom saved face by insisted that the problem was related to "the fuel loading, not to the use."[113] Following the October 2014 "Power Purification Act," Gashev was sacked for corruption.

By December 30, 2014, in light of the escalation of violence in the Donbass, the Western sanctions against Russia, and the changed political landscape in Kyiv, Westinghouse and Energoatom further extended the deal to "significantly increase" Westinghouse fuel supplies to

[113] "More Westinghouse fuel for Ukraine," *World Nuclear News*, April 11, 2014, Accessed April 15, 2014, http://www.world-nuclear-news.org/enf-more-westinghouse-fuel-for-ukraine-1104144.html.

Ukraine through 2020. According to Latorre, fuel for six of the 15 reactors will be supplied by Westinghouse, achieving the diversification of nuclear fuel for which Ukrainians and Americans had hoped.[114]

By March 11, 2015, reports indicated Kyiv was hoping to award the contract for the unfinished fuel fabrication plant in Smolino, citing a breach of contract on the part of TVEL. Westinghouse had originally submitted a tender in 2010, but of course TVEL had been selected and the project had quickly stalled. Local Ukrainian media outlets announced that Kyiv now hoped to award Westinghouse the fuel fabrication plant instead, claiming that TVEL has not met the terms of the tender.[115]

However, Latorre insisted that Kyiv does not have the funding for the plant, and despite some unofficial lobbying by unnamed U.S. officials, there is no political will to provide further American taxpayer funds for a fabrication plant. Additionally, Westinghouse is in the business of supplying fuel — why would a company which has just been awarded a contract help its client to service its own needs?[116]

---

[114] Latorre encouraged the Ukrainians to diversify even further, if possible. He explained that fuel assemblies from as many as four different suppliers have been in Western reactors at one time. "If two is good, three is better" if it means lower prices, he explained.

[115] Energoatom seeks to extend links with Westinghouse, World Nuclear News, March 11, 2015, Accessed March 11, 2015, http://www.world-nuclear-news.org/C-Energoatom-seeks-to-extend-links-with-Westinghouse-11031501.html.

[116] Latorre believes that this is the reason TVEL never delivered — it never intended to do so.

The Russian Perspective

Russia's foreign ministry issued a statement in response to the award, saying that it was "alarmed" by news of the contract, accusing Westinghouse of "attempting to gain a foothold in the [VVER-1000] market" for many years:

> Of particular concern is the fact that all this is happening against the backdrop of an unstable situation in Ukraine, in an environment where political engagement takes precedence over the requirements of nuclear safety, and the country's ability to respond to emergencies is severely limited…It seems that the authorities in Kiev have not learned the lessons of the Chernobyl tragedy about a responsible and science-based approach to the use of nuclear energy.[117]

The ministry accused the United States of pursuing "political ambition" over nuclear safety, insisting that the "consequences of possible accidents and incidents, and the responsibility for them, lie entirely with the leadership of Ukraine and the US fuel supplier."[118] Kremlin-backed media outlet RT echoed these warnings with an article ominously titled, "Chernobyl memories faded? Kiev turns blind eye to disaster risk in nuclear deal with US," accusing the West of "muscling in on the [nuclear] relationship" between Russia and Ukraine.[119] RT warned that "if something goes wrong, Kiev may find that they are lonely in facing the consequences," and

---

[117] Ibid.

[118] Ibid.

[119] To counterbalance state corporations like Rosatom, the U.S. Export-Import Bank guarantees loans for companies like Westinghouse and Holtec, a company that won a tender to build the Central Spent Fuel Storage Facility (CSFSF) in the Chernobyl Exclusion Zone in Ukraine. Westinghouse and Holtec claim that federal support is critical to remain competitive with Rosatom, creating hundreds of American manufacturing jobs in places like Ohio and Pennsylvania. "Holtec International Calls Export-Import Bank Critical to the Independence of Ukraine's Nuclear Energy Sector," *Holtec International*, July 28, 2014, Accessed May 10, 2015, http://www.holtecinternational.com/2014/07/holtec-international-calls-export-import-bank-critical-to-the-independenceof-ukraines-nuclear-energy-sector/.

further cautioned that "[i]n this over-politicized case, European capitals would do well to learn how the wind blows beforehand."[120]

EU Policies

Clearly European capitals have a different perception of which way the wind is blowing based upon "tensions in Ukraine." In May 2014, the EU released its *Energy Security Strategy*, making fuel diversification obligatory for any new investment in nuclear reactors to be built in the EU.[121] Nuclear energy is governed within the European Union by the 1957 Euratom Treaty, which established a supranational nuclear regulator, Euratom. While Euratom is a separate legal entity from the EU, it is governed by the EU's institutions and manages nuclear safety, nuclear safeguards, and nuclear security for the 130 reactors in 14 European countries.[122]

While EU energy and environmental policies regarding nuclear power plants have created additional layers of bureaucracy and hoops for former Soviet states to jump through, roughly 30% of all energy in the EU is provided by nuclear. Although the mandated decommissioning of all RBMK reactors, such as Ignalina in Lithuania, and Chernobyl in Ukraine, have made these states temporarily more reliant upon Russian energy, the European public is largely behind the

---

[120] "Chernobyl memories faded? Kiev turns blind eye to disaster risk in nuclear deal with US," *RT*, May19, 2014, Accessed May 25, 2014, http://rt.com/news/159848-ukraine-nuclear-deal-westinghouse/.

[121] "Energy security: Commission puts forward comprehensive strategy to strengthen security of supply," *European Commission*, May 2014, Accessed February 14, 2015, http://europa.eu/rapid/press-release_IP-14-606_en.htm.

[122] "Nuclear Energy: Safe Nuclear Power," *European Commission*, Last Updated May 14, 2015, Accessed May 4, 2015, http:// ec.europa.eu/energy/en/topics/nuclear-energy.

effort.[123] However, Finland has not fallen in line with EU pressure to cancel its contract for the new Fennovoima NPP,[124] primarily because Finland has a long, painful history with botched NPP construction in the past and Rosatom's comprehensive services are very attractive.[125] As a sign of both determination and desperation in the face of Western sanctions, Russia is dipping into its pensions fund, accumulated through oil and gas profits, to finance this NPP in Finland.[126]

V. CONCLUSIONS

Implications for the Near Abroad

For the United States, the outcome of the UNFQP is a boon on several levels. This concrete victory offers tangible, meaningful support for Ukraine, and the importance of this success cannot be overstated from the perspective of U.S. officials who have been pressured to provide lethal military support to the Ukrainian military to fight pro-Russian forces.

Western companies have long avoided investment in Ukraine, but the UNFQP is a model for how Western companies may successfully compete without fear of catastrophic losses. While many, including Latorre, are skeptical of true transparency in Ukrainian civil institutions for the

---

[123] A public policy document released by the European Commission on Ignalina addressed the most relevant public concerns as well as the EU contribution to Lithuania's energy security. "FAQ on Ignalina Nuclear Power Plant for public affairs," *European Commission*, August 21, 2008, Accessed May 10, 2015. http://ec.europa.eu/lietuva/documents/skelbimai/2008_08_21_frequently_asked_questions_on_inpp.pdf.

[124] David Crouch and Peter Spiegel, "Row deepens over Finland's nuclear plant," *Financial Times*, September 29, 2014, Accessed October 10, 2014, http://www.ft.com/intl/cms/s/0/b659d358-47a5-11e4-ac9f-00144feab7de.html#axzz3a9vx2hWb.

[125] "Olikiluoto 3 Delayed Beyond 2014," World Nuclear News, 2012, Accessed November 23, 2014, http://www.world-nuclearnews.org/NN-Olkiluoto_3_delayed_beyond_2014-1707124.html.

[126] "Russia to use pensions funds for Rosatom-funded nuclear power plant in Finland," *Yle*, August 10, 2014, Accessed December 12, 2014, http://yle.fi/uutiset/russia_to_use_pensions_funds_for_rosatom-funded_nuclear_plant_in_finland/7516625.

foreseeable future, activities in the Ukrainian nuclear industry are already becoming more transparent. The Westinghouse-trained Ukrainian experts in Kharkiv are now considered the nuclear authorities within their own country.[127] This is a substantial departure from the previous model, where all power over the industry was concentrated in the national regulating authority, which was often infiltrated by Russian influence. The CRCD in Kharkiv is quickly becoming a hub for international training, bringing the Ukrainian nuclear physics legacy full circle.[128]

It is possible that the seizure of Crimea will be a short-term gain for Russia, but now TVEL is forced to compete with Westinghouse for its biggest market, as well as in the Near Abroad, while Westinghouse provides jobs for Americans. United States Secretary of Energy, Ernest Moniz, praised the success of the UNFQP at the 2015 Carnegie International Nuclear Policy Conference:

> The research and development cost was around $70 million over the lifetime of the project, but the return on that investment is many times over that initial investment. Today, Ukraine has an alternative vendor for its nuclear fuel. Other countries with Russian- designed reactors have a viable and reliable choice of vendors. And Westinghouse has the opportunity to finalize contracts abroad, and this could mean an increase in U.S. manufacturing jobs.

Russia's influence over Ukraine's access to nuclear fuel is only part of the energy security equation. Nuclear waste was, in many ways, equally important. If Russia stopped removing the used fuel, after a period of time Ukrainian reactors would not be able to operate due to a buildup of used nuclear fuel.[129]

---

[127] According to Latorre, they have even corrected Westinghouse codes and created codes for to reduce the time required for reloading reactors. He says Westinghouse is seeking to purchase the patent for this code.

[128] According to Latorre, the Ukrainians from the CRCD will soon be offering training to nuclear experts in Kazakhstan.

[129] Ernest Moniz, "Secretary Moniz's Remarks at the 2015 Carnegie International Nuclear Policy Conference — As Delivered,

The media has begun to report a rush to engage Westinghouse in talks and agreements. In August 2014, Bulgaria and Westinghouse signed a shareholder agreement for a new NPP costing $5 billion, in which Westinghouse would hold a 30% stake.[130] In October 2014, Slovakia was reportedly considering an "unnamed" fuel provider to diversify its nuclear fuel supply,[131] and the Czech Republic is now considering offer of financing from Westinghouse for expansion on current NPPs. Rosatom had previously offered the Czechs 100% financing, but would not guarantee the price.[132] As sanctions hit the Russian economy, it became even more difficult for Russia to honor initial estimates for reactor construction.[133] Even countries which have seemed somewhat supportive of Putin have shown interest in diversification. Under pressure to diversify by the EU, Hungary engaged Westinghouse in advanced talks concerning fuel for the Paks-2

U.S. Department of Energy, March 23, 2015, Accessed May 13, 2015, http://energy.gov/articles/secretary-monizs-remarks-2015carnegie-international-nuclear-policy-conference-delivered.

[130] Sean Carney, "Bulgaria Signs Deal With Westinghouse on Nuclear Power Plant," *The Wall Street Journal,* August 1, 2014, Accessed February 14, 2015, http://www.wsj.com/articles/bulgaria-signs-deal-with-westinghouse-on-nuclear-powerplant-1406890323.

[131] Sean Carney, "Slovak Utility Diversifies Enriched Uranium Supply Chain Away from Russia," *The Wall Street Journal,* November 11, 2014, Accessed February 14, 2015, http://blogs.wsj.com/emergingeurope/2014/11/11/slovak-utility-diversifies-enriched-uranium-supply-chain-away-from-russia/.

[132] Foreshadowing the future competitiveness of the nuclear fuel market, Westinghouse lost its contract at Temelin. Latorre insisted that this was avoidable, and simply a matter of hubris on Westinghouse's part. Still, when TVEL reentered the market, it was unable (or unwilling) to make its VVER fuel work in tandem with Westinghouse's VVER fuel as the Ukrainians had done, which meant scrapping millions of dollars in nuclear fuel assemblies. The Czechs were *not* happy.

[133] John C.K Daly, "Will Western Sanctions Damage Russia's Global Nuclear Energy Business?" *Eurasia Daily Monitor* (Volume 11) 63, April 3, 2014, www.jamestown.org/single/?tx_ttnews%5Btt_news%5D=42177&no_cache=1#.VCukcitdVf8.

NPP in March 2015.[134] If the fuel talks are fruitful, it would became a first for an EU state with a VVER reactor.

Broader Conclusions

Under the guidance of Vladimir Putin, the Energy Troika has successfully pulled the economy of the Russian Bear, but the landscape is quickly changing and the future feasibility of this model is in question. Rosatom may be on its heels at the moment, but recent victories in Egypt and South Africa, as well as continued cooperation with Turkey and China, are helping keep the national corporation a viable and reputable option globally. Nevertheless, this may change if

Westinghouse, supported by the United States government, is capable of globe-trotting behind Rosatom and undercutting TVEL's fuel business. The entire BOO model is dependent upon servicing financed NPPs for the lifetime of the facility, which may last more than fifty years. Russia has absolutely viewed the Ukrainian Nuclear Fuel Qualification Project as a prolonged act of aggression toward interests in its sphere of influence, and has tried to work against it at every angle. Westinghouse's success may very well change the landscape of the nuclear energy industry, making it more competitive. Given Rosatom's global ambition, some experts believe that this may be the new "nuclear" issue of a "New Cold War."

VI: WORKS CITED

"About." *Rosatom.* Accessed April 11, 2014. http://www.rosatom.ru/en/about/.

[134] Leonid Bershidsky, "Be Glad About Russia's Nuclear Setback," Bloomberg View, March 13, 2015, Accessed May 5, 2015, http://www.bloombergview.com/articles/2015-03-13/be-glad-about-russia-s-nuclear-setback.

"Armenia Joins Russia-Led Eurasian Economic Union." *The Moscow Times.* January 2, 2015. Accessed February 18, 2015. http://www.themoscowtimes.com/business/article/armenia-joins-russia-ledeurasian-economic-union/514035.html.

Balmaceda, Margarita. Editor. *On the Edge: Ukrainian-Central European-Russian Security Triangle.* Budapest: Central European University Press, 2000.

———. *Ukraine's Energy Policy and U.S. Strategic Interests in Eurasia.* Occasional Paper #291, Woodrow Wilson International Center for Scholars, 2004.

———. *Energy Dependency, Politics and Corruption in the Former Soviet Union: Russia's Power, Oligarch's Profits, and Ukraine's Missing Energy Policy 1995-2006.* New York: Routledge, 2008.

———. *The Politics of Energy Dependency: Ukraine, Belarus, and Lithuania Between Domestic Oligarchs and Russian Pressure.* Toronto*:* University of Toronto Press, 2013.

"Beginning of talks with President of Armenia Serzh Sargsyan." *Official Website of the President of Russia.* December 2, 2013. Accessed March 9, 2015. http://eng.kremlin.ru/transcripts/6357.

Bershidsky, Leonid. "Be Glad About Russia's Nuclear Setback." *Bloomberg View*. March 13, 2015. Accessed May 5, 2015. http://www.bloombergview.com/articles/2015-03-13/be-glad-about-russia-snuclear-setback.

Bresolin, Justin and Gautam, Brenna. "Fact Sheet: Nunn-Lugar Cooperative Threat Reduction Program." *The Center for Arms Control and Non-Proliferation.* Accessed May 14, 2014. http://armscontrolcenter.org/publications/factsheets/fact_sheet_the_cooperative_threat_reduction_program/.

Carney, Sean. "Bulgaria Signs Deal With Westinghouse on Nuclear Power Plant." *The Wall Street Journal.* August 1, 2014. Accessed February 14, 2015. http://www.wsj.com/articles/bulgaria-signs-dealwith-westinghouse-on-nuclear-power-plant-1406890323.

———. "Slovak Utility Diversifies Enriched Uranium Supply Chain Away from Russia." *The Wall Street Journal.* November 11, 2014. Accessed February 14, 2015. http://blogs.wsj.com/emergingeurope/2014/11/11/slovak-utility-diversifies-enriched-uranium-supply-chain-away-from-russia/.

"Chernobyl Accident 1986." *World Nuclear Association.* Updated December 2014. Accessed February 9, 2015. http://www.world-nuclear.org/info/Safety-and-Security/Safety-of-Plants/ChernobylAccident/.

"Chernobyl memories faded? Kiev turns blind eye to disaster risk in nuclear deal with US." *RT.* May19, 2014. Accessed May 25, 2014. http://rt.com/news/159848-ukraine-nuclear-deal-westinghouse/.

David Crouch and Peter Spiegel. "Row deepens over Finland's nuclear plant." *Financial Times.* September 29, 2014. Accessed October 10, 2014. http://www.ft.com/intl/cms/s/0/b659d358-47a5-11e4ac9f-00144feab7de.html#axzz3a9vx2hWb.

Daly, John C.K. "Will Western Sanctions Damage Russia's Global Nuclear Energy Business?" *Eurasia Daily Monitor* (Volume 11) 63, April 3, 2014. www.jamestown.org/single/?tx_ttnews%5Btt_news%5D=42177&no_cache=1#.VCukcitdVf8.

"Energoatom seeks to extend links with Westinghouse." *World Nuclear News.* March 11. 2015. Accessed March 11, 2015. http://www.world-nuclear-news.org/C-Energoatom-seeks-to-extend-links-withWestinghouse-11031501.html.

"Energy security: Commission puts forward comprehensive strategy to strengthen security of supply." *European Commission.* May 2014, Accessed February 14, 2015. http://europa.eu/rapid/press-release_IP-14-606_en.htm.

Englund, Will. "Russia no longer wants U.S. aid on nuclear arms security." *The Washington Post.* October 10, 2012. Accessed May 16, 2014. http://m.washingtonpost.com/world/europe/russia-no-longerwants-us-aid-on-nuclear-arms-security-wont-extend-nunn-lugar-pact/ 2012/10/10/6cde030c-130e-11e2-ba83-a7a396e6b2a7_story.html.

"Excerpts from Gorbachev's Speech on Chernobyl Accident." *The New York Times.* May 15, 1986. Accessed February 9, 2015. http://www.nytimes.com/1986/05/15/world/excerpts-from-gorbachev-sspeech-on-chernobyl-accident.html?pagewanted=1.

"FAQ on Ignalina Nuclear Power Plant for public affairs." *European Commission.* August 21, 2008. Accessed May 10, 2015. http://ec.europa.eu/lietuva/documents/skelbimai/2008_08_21_frequenthttp://ec.europa.eu/lietuva/documents/skelbimai/2008_08_21_frequently_asked_questions_on_inpp.pdfly_asked_questions_on_inpp.pdf.

"Gazprom Becomes Formally Full Owner of Armenia's Natural Gas Distribution Company." *Arka News.* February 5, 2015. Accessed February 9, 2015. http://arka.am/en/news/economy/gazprom_behttp://arka.am/en/news/economy/gazprom_becomes_formally_full_owner_of_armenia_s_natural_gas_distribution_company/comes_formally_full_owner_of_armenia_s_natural_gas_distribution_company/.

Gerasimov, Valerii. "Tsennost' naiukii v predvidenii: noviiye viizovii trebuyut pereocmiicleniya form ii cposobov vedeniya boeviikh deicstbii." *Boenno-promiishlennii kur'ep (VPK).* February 27, 2013. Accessed February 14, 2015. http://vpk-news.ru/sites/default/files/pdf/VPK_08_476.pdf.

Gorbachev, Mikhail. "Turning Point at Chernobyl." *Project Syndicate.* April 14, 2006. Accessed February 10, 2015. https://www.project-syndicate.org/commentary/turning-point-at-chernobyl.

"Holtec International Calls Export-Import Bank Critical to the Independence of Ukraine's Nuclear Energy Sector." *Holtec International.* July 28, 2014. Accessed May 10, 2015. http://www.holtecinternational.com/2014/07/holtec-international-calls-export-import-bank-critical-to-the-independence-ofukraines-nuclear-energy-sector/.

Jones, Sam. "Ukraine: Russia's new art of war." *Financial Times.* August 28, 2014. Accessed February 14, 2015. http://www.mediapool.bg/files/224/Ukraine_%20Russia%E2%80%99s%20new%20art%20of%20war%20-%20FT.pdf.

Josephson, Paul R. *Red Atom: Russia's Nuclear Power Program from Stalin to Today.* Pittsburgh, University of Pittsburgh Press, 2000.

"Krasnoyarskiy kray otkazhetsya prinimat otrabotannoye yadernoye toplivo iz Ukrainy v sluchaye nepogasheniya 11.76 mln. dollarov dolga." *UNIAN.* August 1, 2003. Integrum Techno, www.integrum.com.

Kucera, Joshua. "Armenians Protest Putin - But Not His Military Aid." *Eurasianet.* December 3, 2013. Accessed March 9, 2015. http://www.eurasianet.org/node/67826.

Logiurato, Brett. "JOHN MCCAIN: Russia is a "Gas Station Masquerading As A Country." *Business Insider*. March 16, 2014. Accessed March 20, 2014. http://www.businessinsider.com/mccain-russiaputin-gas-sanctions-ukraine-crimea-referendum-2014-3#ixzz3Rf4J9Jqb.

"Mission." *Rosatom*. Accessed February 14, 2015. http://www.rosatom.ru/en/about/mission/.

Moniz, Ernest. "Secretary Moniz's Remarks at the 2015 Carnegie International Nuclear Policy Conference — As Delivered. *U.S. Department of Energy*. March 23, 2015. Accessed May 13, 2015. http://energy.gov/articles/secretary-monizs-remarks-2015-carnegie-international-nuclear-policyconference-delivered.

"More Westinghouse Fuel for Ukraine." *World Nuclear News.* April 11, 2014. Accessed April 18, 2014. http://www.world-nuclear-news.org/enf-more-westinghouse-fuel-for-ukraine-1104144.html.

"Nuclear Energy: Safe Nuclear Power." *European Commission.* Last Updated May 14, 2015. Accessed May 4, 2015. http://ec.europa.eu/energy/en/topics/nuclear-energy.

"Nuclear Matters: Nuclear Fuel Qualification Project." *Agreement Between the United States of America and Ukraine.* Signed at Kiev June 5, 2000. http://www.state.gov/documents/organization/195304.pdf.

"Nuclear Power in the USA." *World Nuclear Association.* Updated March 13, 2015. Accessed March 13, 2015. http://www.world-nuclear.org/info/country-profiles/countries-T-Z/USA--Nuclear-Power/.

"Nuclear Power in the Czech Republic." *World Nuclear Association.* Updated January 2015. Accessed April 25, 2015. http://www.world-nuclear.org/info/country-profiles/countries-a-f/czech-republic/.

"Nuclear Power in Ukraine." *World Nuclear Association.* Updated May 2015. Accessed May 13, 2015. http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Ukraine/.

"Nunn-Lugar Global Cooperation Initiative." *Defense Threat Reduction Agency*. Accessed May 14, 2014. http://www.dtra.mil/Missions/nunn-lugar/nunn-lugar-home.aspx.

"Olikiluoto 3 Delayed Beyond 2014." *World Nuclear News*, 2012. Accessed November 23, 2014. http://www.world-nuclear-news.org/NN-Olkiluoto_3_delayed_beyond_2014-1707124.html.

"Rosatom State Corporation." *Bellona.* November 26, 2007. Accessed May 5, 2014. http://bellona.org/news/nuclear-issues/nuclear-russia/2007-11-rosatom-state-corporation.

"Rosneft and Armenia's Oil Techno Sign Joint Venture Agreement." *Arka News*. December 3, 2013. Accessed March 9, 2015. http://arka.am/en/news/business/rosneft_armenia_s_oil_techno_sign_joint_venture_agreement/.

"Russia, Ukraine at odds over naval base." *China Daily*. July 16, 2009. Date Accessed, May 5, 2015. http://www.chinadaily.com.cn/world/2009-07/16/content_8435312.htm

"Russian nuclear ambition powers building at home and abroad." *Reuters.* July 22, 2013. Accessed May 12, 2014. http://www.reuters.com/article/2013/07/22/russia-nuclear-rosatom-idUSL5N0F90YK20130722.

"Russia's Nuclear Fuel Cycle." *World Nuclear Association.* Last Updated April 2014. Accessed May 11, 2014. http://www.world-nuclear.org/info/Country-Profiles/Countries-O-S/Russia--Nuclear-FuelCycle/.

"Russia to use pensions funds for Rosatom-funded nuclear power plant in Finland." *Yle.* August 10, 2014. Accessed December 12, 2014. http://yle.fi/uutiset/russia_to_use_pensions_funds_for_rosatomfunded_nuclear_plant_in_finland/7516625.

Sabol, GP. "ZIRLO — An Alloy Development Success." *Journal of ASTM International.* Philadelphia, Vol 2:2, 2005, 3-24.

Schecter, Jerrold. *Russian Negotiating Behavior: Continuity and Transition.* Washington DC: United States Institute of Peace, 1998.

Smith, Keith. *Russian Energy Politics in the Baltics, Poland, and Ukraine: A New Stealth Imperialism?* The Center for Strategic and International Studies. Washington DC: Center for Strategic and International Studies Press, 2004.

"Statement of Considerations: Request by Westinghouse Electric Company for an Advance Waiver of the Government's Domestic and Foreign Patent Rights Under Pacific Northwest National Laboratory Subcontract BOA 332850-A-R5." *The United States Department of Energy*, DOE Waiver No. W(A)-04-030. http://energy.gov/sites/prod/files/gcprod/documents/WA_04_030_EXTENhttp://energy.gov/sites/prod/files/gcprod/documents/WA_04_030_EXTENSION_OF_WESTINGHOUSE_WAIVER.pdfSION_OF_WESTINGHOUSE_WAIVER.pdf.

Syrovatka, Seriy. "Nuclear Cycle: Who Will Fund It?" *Dyen.* July 22, 2003. Date Accessed, March 3, 2015. http://www.day.kiev.ua/en/article/day-after-day/nuclear-cycle-who-will-fund-it.

"The 17 Countries Countries Generating The Most Nuclear Power." *Business Insider.* Accessed January 29, 2015. http://www.businessinsider.com/countries-generating-the-most-nuclear-energy-2014-3#8ukraine-10.

"Top 10 most nuclear dependent nations: Ukraine." *CS Monitor.* Accessed January 29, 2015. http://www.csmonitor.com/Business/2011/0311/Top-10-most-nuclear-dependent-nations/Ukraine-48-percent.

"Ukraine Nuclear Fuel Cycle Chronology." *Nuclear Threat Initiative.* Last Updated April 2005. Accessed February 14, 2015. http://www.nti.org/media/pdfs/ukraine_nuclear_fuel_cycle.pdf?_=1317248570.

"Ukrainian officials try to sell radioactive material for 'dirty bomb.'" *Russia Times.* April 16. 2009. Accessed February 8, 2015. http://rt.com/news/ukrainian-officials-tried-to-sell-radioactive-materialfor-dirty-bomb/.

"U.S. Commits $14 million to U.S. - Ukraine Nuclear Fuel Qualification Project." *The U.S. Department of Energy.* March 14, 2007. Accessed March 14, 2015. http://energy.gov/articles/us-commits-14million-us-ukraine-nuclear-fuel-qualification-project.

"Working meeting with Rosatom CEO Sergei Kiriyenko." *President of Russia.* January 9, 2014. Accessed May 5, 2014. http://eng.news.kremlin.ru/news/6503.

Yasmann, Viktor. "Sergei Kiriyenko — Russia's 'Kinder Surprise.'" *Radio Free Europe Radio Liberty.* February 15, 2006. Accessed April 30, 2014. http://www.rferl.org/content/article/1065790.html.

"Yushchenko Wants Ukraine to Produce Nuclear Fuel." *Radio Free Europe Radio Liberty*. January 13, 2006. Accessed February 11, 2015. http://www.rferl.org/content/article/1064700.html.

Tables and Figures

Drozdov, Nikolai. "Rosatom Global Development: projects in South East Asia Region." *Rosatom*. Presentation, Nuclear Industry Suppliers Forum Atomex Asia, 2014. Accessed November 2014. www.atomeks.ru-mediafile…011_Nikolay_Drozdov.

"Overview of US Cooperative Safety Work." *International Nuclear Safety: Pacific Northwest National Laboratory*. Last Updated 11/29/2001. Accessed May 2014. http://insp.pnnl.gov/-reportsstatus-2001status_rpt-statrpt2001_overview.node.htm.

"Nuclear Fuel Cycle." *Women in Nuclear Global*. Accessed May 2014. http://www.win-global.org/athttp://www.win-global.org/attachments/image/188tachments/image/188.

"VVER." *Wikipedia*. Last Updated March 16, 2015. Accessed March 18, 2015. http://en.wikipedia.org/wiki/VVER.

Appendices

Appendix 1: Near Abroad Nuclear Energy Statistics, by region. Information courtesy of World Nuclear Association.

European States	Production (TWh)	Share %	# of Power Reactors	# Proposed or Construction
Russia	161.7	17.5	32	22
Ukraine	78.2	43.6	15	11
Belarus	NA	NA	0	4
Moldova	NA	NA	0	0
Estonia	NA	NA	NA	NA
Latvia	NA	NA	NA	NA
Lithuania	0	0	1 DC 2009	0

Transcaucasus	Production (TWh)	Share %	# of Power Reactors	# Proposed or Construction
Armenia	2.2	42.9	1	1
Azerbijan	NA	NA	0	1medical
Georgia	0	0	1 DC	0

Central Asia	Production (TWh)	Share %	# of Power Reactors	# Proposed or Construction
Kazakhstan	0	0	0	4
Tajikistan	NA	NA	NA	NA
Kyrgystan	NA	NA	NA	NA
Turkmenistan	NA	NA	NA	NA
Uzbekistan	NA	NA	NA	NA

EASTERN BLOC/ ALIGNED	PRODUCTION (TWH)	Share %	# of Power Reactors	# Proposed or Construction
E. Germany	0	0	4 DC	0
Poland	NA	NA	0	6
(Czech Republic)	29.0	35.9	6	
(Slovakia)	14.6	51.7	4	3
Hungary	14.5	50.7	4	2
Bulgaria	30.7	13.3	2	2
Romania	10.7	19.8	2	3
YUGOSLAVIA (SLOVENIA & CROATIA)**	5.0	Slovenia 30.0 Croatia 15.0	1	1

Appendix 2: European reactors requiring VVER fuel, circa 2000

Courtesy of International Nuclear Safety Program, Pacific Northwest National Laboratory.

Appendix 3: Near Abroad Nuclear Energy Profiles

Armenia

In 2013, Armenia was negotiating a free trade agreement with the EU, but according to trade economist Alexander Knobel, Armenian President Serzh Sargsyan was personally promised by Putin the budget price of $170 to $180 per 1,000 cubit meters on all gas imports to halt the agreement. It was then that Armenia chose to switch to the Eurasian Customs Union, a precursor to full membership in the Eurasian Economic Union.[134] In December 2013, a joint venture deal between Rosneft and Armenia's Oil Techno was signed in the presence of Putin and Sargsyan, making Rosneft the primary supplier of Armenia's oil.[135] The Sargsyan's public statement for the event, which is documented on the President of Russia's official website, also cites the increased presence and investment in the Russian military base at Gyumri.[136] While at the military base, Putin insisted, "…Russia will never leave this region. On the contrary, we will make our place here even stronger."[137]

By February 2014, Armenia signed a 30 year contract giving Russia exclusive access to its energy markets as well as full ownership of ArmRosGazprom, which became Gazprom Armenia. The energy and natural resources minister reported that Armenia owed Russia a

debt of $300 million, which was half forgiven and half paid for with the sale of the 20% minority share which had remained in Armenia's possession.[138] On February 5, 2015, Armenia agreed to suspend operations at Metsamor nuclear power plant by 2017

for reconstruction and plant extension by Rosatom which will be funded by a $270 million loan and a $30 million grant under soft terms for 15 years at a 3% per annum rate.

Hungary

In September 2014, Hungary signed an agreement with Gazprom for gas reserve supplies, despite the ongoing bloodshed in Ukraine, and days later the government cut off the reverse-flow of gas to Ukraine that had been helping to stabilize supplies. Just two months later, in November 2014, the Hungarian government "shrugged off warnings from Brussels" over the construction of a "Kremlin-backed pipeline" by passing a law allowing the project to move ahead by changing national procurement rules for pipelines. [139] Earlier in March, Reuters reported in a Gazprom source revealing a discussion "involving Croatia, Gazprom oil unit Gazprom Neft, and Russian state-owned oil firm Rosneft, which threatened to culminate in the sale of a Croatian energy firm to one of the Russian energy companies, giving Russia a foothold in the middle of the EU.[135] That same month, Hungary received €10bln to refurbish the
Paks NPP.[136]

Bulgaria

January 2015, South Stream pipeline killed after Bulgaria complied with EU request to halt work in June 2014, during Ukrainian invasion. Bulgaria is 90% reliant upon Russian gas, the death of the pipeline cost 6,000 jobs and $3bln in investment (RT). After EU Treaty of Accession in 2005, Rosatom used Fukushima to raise price of Belene NPP. Bulgaria cancelled, Rosatom is suing for €1 bln.

[134] "Armenia Joins Russia-Led Eurasian Economic Union," The Moscow Times, January 2, 2015, http://www.themoscowtimes.com/business/article/armenia-joins-russia-led-eurasian-economic-union/514035.html.

[135] "Rosneft and Armenia's Oil Techno Sign Joint Venture Agreement, *Arka*, http://arka.am/en/news/business/rosneft_armenia_s_oil_techno_sign_joint_venture_agreement/.

[136] "Beginning of talks with President of Armenia Serzh Sargsyan," *Official Website of the President of Russia*, December 2, 2013, http://eng.kremlin.ru/transcripts/6357.

[137] Joshua Kucera, "Armenians Protest Putin - But Not His Military Aid," *Eurasianet*, December 3, 2013, http:// www.eurasianet.org/node/67826.

[138] "Gazprom becomes formally full owner of Armenia's natural gas distribution company," *Arka*, http://arka.am/en/news/economy/gazprom_becomes_formally_full_owner_of_armenia_s_natural_gas_distribution_company/.

[139] Andrew Byrne, "Hungary paves way for Gazprom pipeline," *Financial Times,* November 5, 2014, Accessed February 14, 2015, http://www.ft.com/intl/cms/s/0/1920dae2-6513-11e4-91b1-00144feabdc0.html#axzz3Uwnb75Sj.

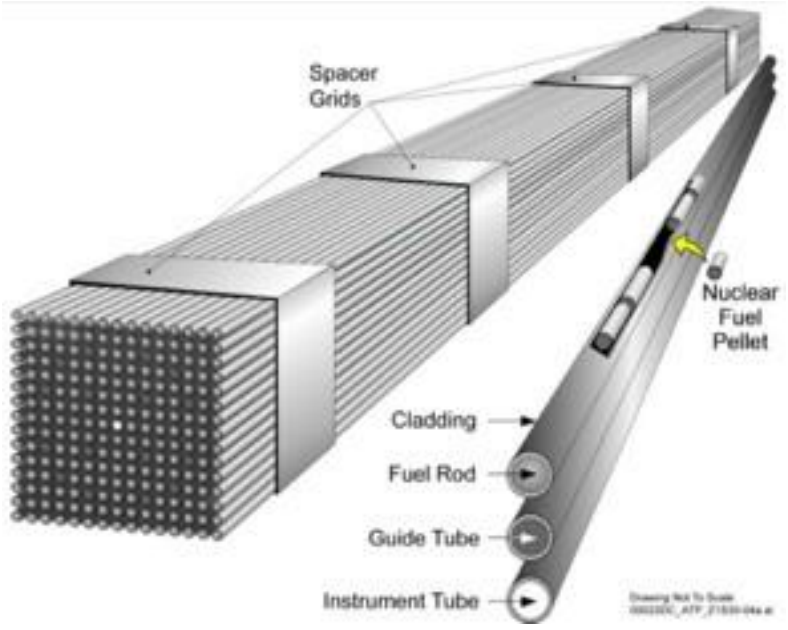
[135] Zoran Radosavljevic and Krizstina Than, "Washington tries to check Hungary's drift into Kremlin orbit, *Reuters*, November 1, 2014, Accessed February 14, 2015, http://www.reuters.com/article/2014/11/01/us-hungary-russia-energy-idUSKBN0IL2OB20141101.

[136] Andrew Byrne, "Hungary paves way for Gazprom pipeline," November 5, 2014.

Appendix 4: VVER vs. Westinghouse Fuel Assemblies

VVER fuel assemblies are hexagonal in design, as opposed to all other fuel assemblies in the world. Fuel rods, which are hermetically sealed with fuel pellets inside, are bundled in this shape by a hex pattern. The hexagonal design, made of a ZIRLO alloy, [137] is more difficult and costly to manufacture, but saves on neutron economy. The more efficient operation of the fuel rods saves on the cost of uranium enrichment.

Images courtesy of wikipedia.com



[137] ZIRLO is an acronym for zirconium low oxidation, and is a successful alloy for PWR fuel cladding. GP Sabol, "ZIRLO — An Alloy Development Success, Journal of ASTM International, Philadelphia, Vol 2:2, 2005, 3-24.

Appendix 5: Nuclear Fuel Cycles & Rosatom

Figure 1: The Nuclear Fuel Cycle

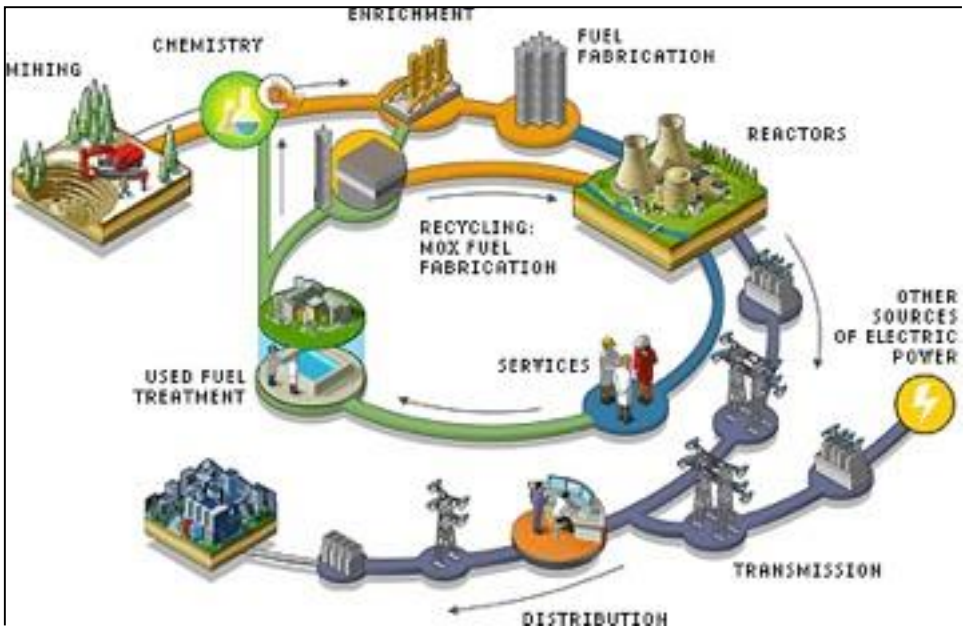


Image courtesy of Women in Nuclear Global

Figure 2: Key Activities of Rosatom

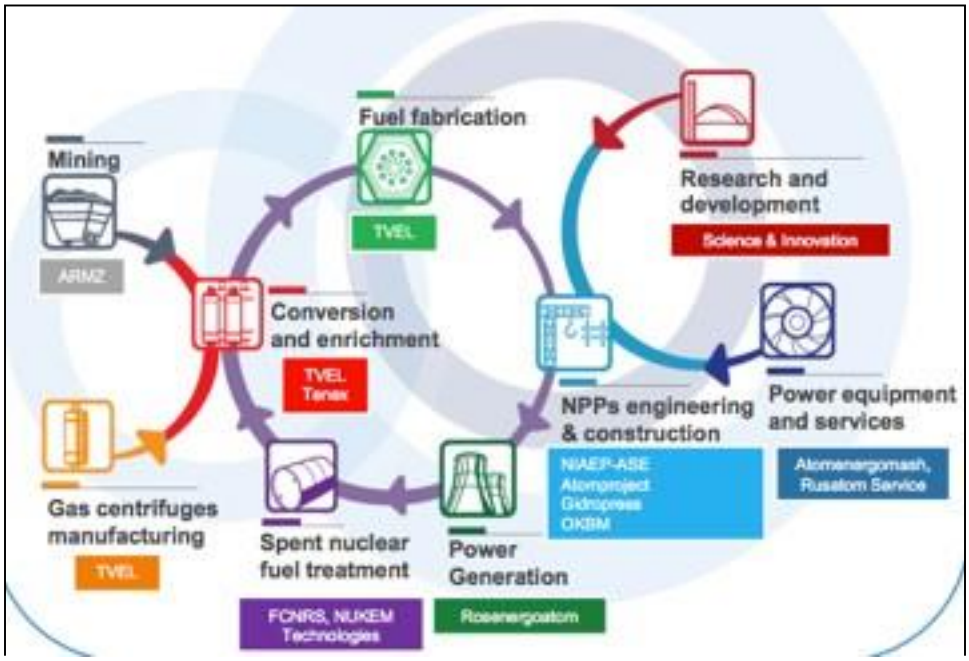


Image courtesy of Rosatom

Figure 3: Rosatoms unique NPP integrated construction model

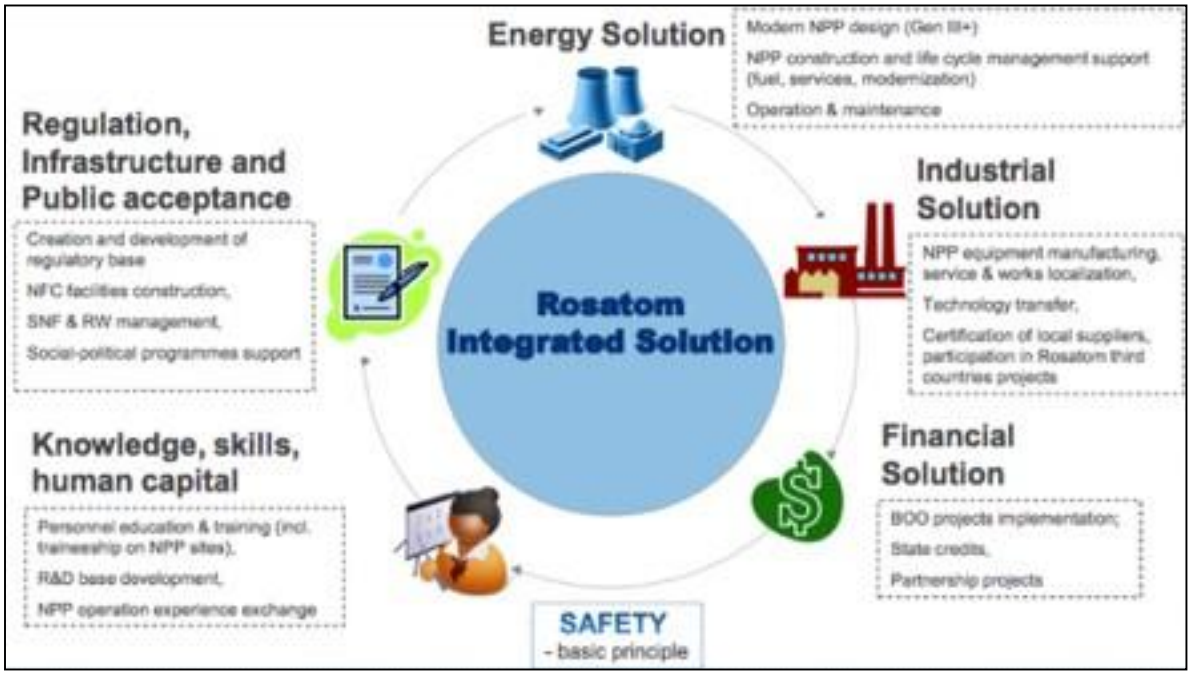


Image courtesy of Rosatom