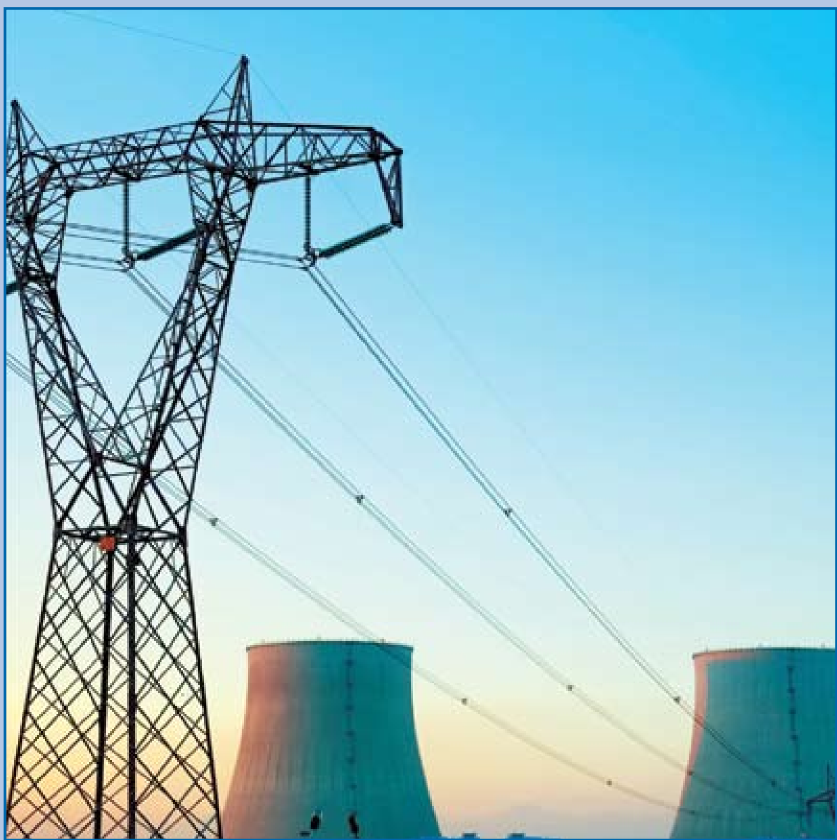
Eurasian Development Bank

Nuclear Energy Complexes in Russia and Kazakhstan:

Prospects for Development and Cooperation



Industry Report
April 4, 2008

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Table of Contents

1. Summary

1. 2005–2006 was a critical period in the development of the nuclear complexes of Russian Federation and the Republic of Kazakhstan. These years have ushered in a “nuclear renaissance”. Russia’s nuclear sector was subject to a total systemic review; the Federal Target Program (FTP) allocated to it funds totaling more than USD 55 billion. A decision was taken to consolidate all nuclear assets within one state corporation. Kazakhstan implemented the “15000 tons uranium by 2010” state development program. Its development programs for reactors and nuclear power plants are worked out jointly with Russia. Closer cooperation is also being pursued with other leaders in the field, primarily Japanese companies. Cooperation agreements between the two countries were adopted. The foundation of three joint ventures (JV) was the first tangible outcome of above agreements.

2. Meanwhile Kazakh uranium has become a focus of attention and fierce competition between the world’s largest consumers, including France, Canada, USA, Japan, China, South Korea, and Russia. Early this decade, Russia’s substantial production capacity and highly competitive uranium ore conversion technologies added to calls for the country to renew its economic links with Kazakhstan in the uranium mining and nuclear industries. Given Russia’s ambitious plans to develop nuclear energy, and the fact that its uranium stocks are practically depleted, the benefits of closer cooperation with Kazakhstan are clear. However, Russia will have to compete with well-established players on Kazakhstan’s uranium market.

3. Kazakhstan has aspirations to become a world leader in uranium mining and to focus production at the highly processed end of the nuclear fuel cycle. This was the backdrop for a recent transaction which will have a significant impact on the country’s nuclear industry. In the autumn of 2007, KazAtomProm purchased Toshiba’s 10% share in Westinghouse Electrics, a leading producer of nuclear reactors, for USD 540 million. This transaction has secured a permanent nuclear alliance between KazAtomProm, Toshiba and Westinghouse Electrics. For Kazakhstan, this creates new opportunities to develop a hi-tech nuclear industry and to market its output in the West. Supplying high-end nuclear products to Western markets is one of KazAtomProm’s development priorities, along with continued cooperation with Russia in supplying Soviet-type reactors.

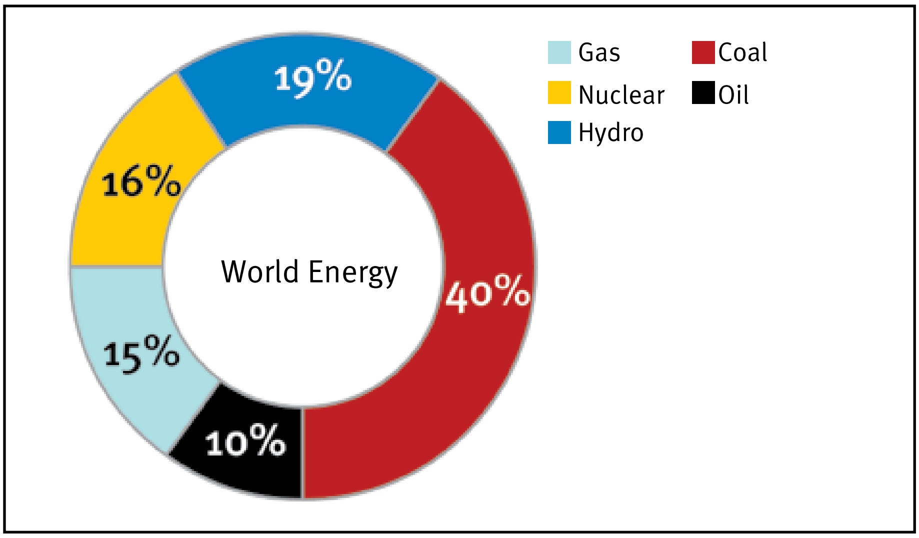
4. The need to integrate the nuclear power complexes of Kazakhstan and Russia along the entire production chain is a logical response to their urgent need to reduce their energy deficit, and to the synergies which exist between their production capacities and technologies at each stage of the nuclear fuel production chain: (1) uranium mining, (2) uranium enrichment, (3) production of fuel pellets and fuel elements, (4) reactor design and production, primarily 300 MW VBER-300 power reactors, (5) construction and operation of nuclear power plants, and (6) nuclear waste processing and disposal.

5. Kazakhstan has plans to develop its own nuclear power industry and is likely to base this on 300 MW Russian-Kazakh reactors and, in the longer-term, 1000 MW Westinghouse reactors.

6. The development of this capital-intensive sector will require extensive financing based on credit from a number of sources. International and national development banks are one promising potential source of such funding. The ability to secure this capital from international and national development banks rests entirely upon the nuclear energy industry’s potential for development, innovation, diversification and integration. The Eurasian Development Bank, VEB (Russian Development Bank) and the Development Bank of Kazakhstan have indicated their recognition of this. E.g., the EDB has extended credit to the Russian-Kazakh Zarechnoye JV.

2. Global Development Trends in Nuclear Energy and Uranium Mining

Nuclear power plants generate every sixth kilowatt of electricity produced in the world.
Nuclear is third largest source of energy after coal (39%) and hydro energy (19%). Today 440 nuclear reactors in 31 countries generate a total 370 GW, which is double Russia's thermal and electric energy output.



Graph 1. Nuclear's Contribution to World Energy Supplies

Canada, Australia, South Africa and Kazakhstan are the world's major suppliers of natural uranium. Russia has almost no uranium production but generates uranium under the warheads disposal program.
Russia's TekhSnabExport, USEC of America, AREVA of France and the Anglo-German company Urenco are leaders in uranium enrichment.
Moreover, Russia has a 20% per cent share in the fuel elements market, specifically fuel pellets for reactors. It is a leading builder of nuclear reactors, alongside America's General Electric and Westinghouse, AREVA of France and the Franco-German company Siemens-Framatom.
In 2005–2006, nuclear energy sector saw a global renaissance. After two decades of environmental protest and most projects being frozen in the wake of the Chernobyl nuclear accident in the USSR and Three Mile Island in the USA, many countries are set to increase the share of nuclear energy in their national power supply. The safety and economic viability of this form of energy at a time of record high and still rising hydrocarbon prices have played a significant role in decision-making process.
The International Energy Agency (IEA) has predicted that there will be a 53% increase in global energy consumption by 2030. The International Atomic Energy Agency (IAEA) estimates that the cost of nuclear energy development will exceed USD 200 billion by 2030. Finland, Switzerland, Spain, India and the USA have specific plans to ramp up their nuclear capacity. Vietnam, Egypt and Turkey are considering building nuclear power plants. Ambitious plans for the construction of nuclear power plants may be introduced in South Korea, China and Japan and it is evident that developing Asian economies will be responsible for considerable growth in the nuclear energy sector.
AREVA has estimated that some 500 nuclear reactors will be commissioned by 2030 (20 new reactors annually). The expansion of nuclear capacity will be curtailed to some extent by the relatively small number of companies capable of building the reactors. Given the predicted rate of growth, the concept of competition between companies may prove to be redundant. At a conference on International Cooperation in NPP Construction Projects held in Moscow in late October 2006, representatives of Westinghouse, a nuclear reactor producer which controls 25% of the market, emphasized that a shortage of engineering capacity was a major problem. The company has

received six orders for new AP-100 reactors, which takes Westinghouse to the limit of its existing capacity. AREVA also has a full order book and plans to build five nuclear reactors by 2010.
The leading consultancy firm, Ux Consulting, has predicted that global uranium mining and consumption are set to increase dramatically (see tables 1 and 2). Significant growth is expected in Kazakhstan and Russia. However, Russia ranks third in terms of uranium stocks, and since deposits are hard to access, will have to make huge investments in order to develop uranium mining.

Table 1. Global Uranium Recovery, 2005–2015, t.

Source: Uranium Market Outlook. Ux Consulting, 2007

	2005	2010	2015	Average annual rowth, 2005–2015, %
Canada	13713	16500	21772	4,7
Kazakhstan	5144	14800	19200	14,1
Russia	3921	6400	8000	7,4
Africa	8154	12445	12645	4,5
Australia	11222	10874	16654	4,0
other	7123	8943	8122	1,3
Total recovery:	49277	69962	86393	5,8
HEU supply[1]	7258	9072	-	-
Other recoverable resources	18733	13744	11703	-4.6
Total supply	75267	92778	98096	2,7

Table 2. Largest Uranium Consumers, 2005–2030, t.

Source: Uranium Market Outlook. Ux Consulting, 2007

	2005	2010	2015	2030
USA	24765	25086	25923	30916
Canada	2118	1931	1931	2370
EU	27195	24593	24156	19376
Japan	9651	9908	13084	16940
South Korea	3551	4247	5910	7983
Taiwan	1126	2211	1562	1593
Russian Federation	4020	6880	8069	10427
China	1594	3378	3806	15771
India	414	474	1229	4177
Worldwide consumption:	78818	84786	91719	117193

[1] HEU – highly enriched uranium

3. Nuclear Energy Demands in the Republic of Kazakhstan and Russian Federation

Kazakhstan: On the Way to No.1 Uranium Producer, Striving to Add Value

There are a number of factors prompting Kazakhstan to develop its nuclear energy sector:

- The country's generating capacity is rapidly ageing. By 2012-2014, production capacity will be 80-90% obsolete, compared to 60-70% currently.
- Generating capacity is poorly diversified. Over 80% of all electricity is produced by combined heat-and-power (HPP) plants. The sustainability of Kazakhstan's grid would be improved if more generating capacity was built in southern and western parts of the country.
- The production and consumption of electricity are geographically too divided. The largest generating capacity is in Pavlodar Oblast in the north of Kazakhstan, whereas core consumption is in the south. The annual rate of growth of electricity consumption in southern Kazakhstan is 12-13% compared to 6-7% for the country as a whole. To avert a widening of energy deficit in the south, an extra plant needs to be built. The Balkhash power plant is one planned way of spreading energy production more evenly across the country[2].
- The growth in electricity consumption is outstripping the rate of supply increase in western Kazakhstan (the Mangistau and Atyrau oblasts).
- Constructing new capacity in southern and western Kazakhstan will allow the country to increase its energy exports to Russia. Currently, energy exports are generated mostly in northern Kazakhstan.

Kazakhstan's ambitious plans to expanding nuclear power generation reflect Kazakhstan's desire to forge ahead in world energy markets and to avoid a force-majeure situation in the domestic energy market. Kazakhstan is at risk of changing from an energy-abundant country into one with a significant energy deficit. Against an annual rate of growth in GDP of 9%, the average annual rate of energy consumption stands at 6%. There are 71 power plants in the country, half of them built before 1980. The maximum generation capacity of these plants is currently below 73 billion kilowatt hours, yet annual energy consumption is predicted to reach 74 billion kilowatt hours by 2008.

The uneven development of the national grid has exacerbated the situation. Major generating capacities are located in the northern part of the country. Three oblasts – Pavlodar, Karaganda and East Kazakhstan – account for over 70% of total power generated, but power loss in transit amounts to 20% of the total, on average. The construction of small- and medium-capacity power plants is one way of reducing power loss and geographical inequality. The greater the distance between generating capacity and feedstock supply, the lower the cost effectiveness of the power plant; it is very costly to transport coal across the entire country or to lay a dedicated gas pipeline.

Developing hydro-electric generation in some Kazakh regions will not be a significant factor in reducing the energy deficit. Nuclear power plants are a more effective solution to this since nuclear reactors are refueled every five years. Also, Kazakhstan is able to supply nuclear fuel for all its domestic requirements. According to KazAtomProm's president, Mr. M. Dzhakishev, a new nuclear power plant should be ready for commissioning in 2014–2015. The design and feasibility study for the plant will take three years, and its construction will take a further five years.

Russia: Breaking the "Infrastructural Bottleneck"

The development of nuclear energy in Russia is particularly expedient for the following reasons:

[2] Earlier discussions have envisaged construction of a 2 GW NPP on Balkhash but final decision has been taken in 2008 in favor of an HPP (600x4 MW) on Ekibastuz coal

1. Russia's anticipated near-term energy deficit is a major "infrastructural bottleneck".

2. The development of nuclear energy will allow for further growth in gas exports.

Russia's existing technological capacity and the fact that energy deficits may soon become (have already become in some regions) a major infrastructural barrier to economic development, make the development of nuclear power in the country a particularly urgent priority. In addition, there is significant potential for Russia to increase gas exports if nuclear plays a larger role in domestic energy supply.

Nuclear energy capacity is currently exploited to its maximum limit. Current feedstock reserves are only sufficient to supply existing generating capacity. In Russia the ratio of reserves to capacity is just over 70%, compared to the average European level of 83-85%. Large-scale investment is required to increase this ratio. It is expected that up to USD 10 billion will be invested in a program to extend uranium mining; 60-70% of Russia's uranium needs will be met domestically and 30-40% by uranium mined by joint ventures in Kazakhstan, Ukraine and other states.

Environmental Aspects of Nuclear Energy Development

The relatively limited environmental impact of nuclear energy is another factor favoring NPP development in Russia and Kazakhstan. It is a more important factor for Kazakhstan than for Russia, since Kazakhstan's existing domestic generating structure means that over 80% of its energy is produced in combined heat and power plants.

According to statistics from the AES Corporation, it costs USD 800 for each new kilowatt hour of generating capacity from a co-generation plant compared to $1600-$1800 for each new kW of nuclear capacity (preliminary estimates for the Russian-Kazakh VBER-300 reactor are around $1000-$1200. However, both estimates were subject to high inflation over the last years. Our current estimates are in the range of $2000-3000/kW, depending on the type and location). However, it is a lot cheaper to operate a nuclear power plant and the environmental cost is also smaller. Generating 1 gigawatt hour in a coal-fired plant produces 766 tonnes of carbon dioxide, compared to 3 tonnes from a NPP (Table 3).

Nuclear plants are regarded as one of cleanest sources of energy. The economic indicators of nuclear plants bear comparison with fossil fuel plants. As an illustration, the operating parameters of 4,000 MW co-generation and nuclear power plants are given below (the table shows typical data for the USSR).

Table 3. Quantitative Indicators for Operating 4,000 MW coal-fired HPP and Nuclear Power Plants

Source: T. Zhantikin, A. Bladov, S. Koltyshev (2005), Report. Nuclear Energy Development in the Republic of Kazakhstan. See also Appendix 4.

Note: Fuel consumption is expressed in conventional fuel tonnes; the actual quantity of fuel consumed depends on its calorific value and varies for coal, depending on grade, by 15-20 MM t/y.

Description	Quantity (t/y)	
	CHP	NPP
Fuel consumption	* 12 000000	4
Atmospheric oxygen intake	32 000 000	0
Carbon dioxide waste	36 000 000	0
Sulphur dioxide waste	800 000	0
Nitrogen oxide waste	400 000	0
Solid wastes	8 000 000	200
Particulate emissions	400 000	0
Environmental heat discharge capacity, MW	6 000	8 000

4. Russian Nuclear Industry

Picture 2. Russia's Operating NPPs

1. Rostov NPP VVER-1000 – 1 unit
2. Novovoronezh NPP VVER-440 – 2 units VVER-1000 – 1 unit
3. Kursk NPP RBMK-1000 – 4 units
4. Smolensk NPP RBMK-1000 – 3 units
5. Kalinin NPP VVER-1000 –2 units
6. Leningrad NPP RBMK-1000 – 4 units
7. Kolsk NPP VVER-440 –2 units
8. Bilibinsk NPP EGP-6 – 4 units
9. Beloyarsk NPP BN-600 – 1 unit
10. Balakov NPP VVER-1000 – 4 units

NPP Name	Unit #	Reactor Type	MW, gross	Power Unit Generation	Operation	End of Service Life, yr
Beloyarsk	3	BN600	600	II	1980	2010–2020**
Bilibinsk	1 2 3 4	EGP-6 EGP-6 EGP-6 EGP-6	12 12 12 12	I I I I	1974 1974 1975 1976	2004–2014** 2004–2014** 2005–2015** 2006–2016**
Balakov	1 2 3 4	VVER-1000 VVER-1000 VVER-1000 VVER-1000	1000 1000 1000 1000	II II II III	1985 1987 1988 1993	2015 2017 2018 2023
Kalinin	1 2	VVER-1000 VVER-1000	1000 1000	II II	1984 1986	2014 2016
Kolsk	1 2 3 4	VVER-440 VVER-440 VVER-440 VVER-440	440 440 440 440	I I II II	1973 1974 1981 1984	2003–2013** 2004–2014** 2011 2014
Kursk	1 2 3 4	RBMK-1000 RBMK-1000 RBMK-1000 RBMK-1000	1000 1000 1000 1000	I II III IV	1976 1979 1983 1985	2006–2016** 2009–2019** 2013 2015
Leningrad	1 2 3 4	RBMK-1000 RBMK-1000 RBMK-1000 RBMK-1000	1000 1000 1000 1000	I II III IV	1973 1975 1979 1981	2003–2013** 2005–2020** 2009–2019** 2011
Novovoronezhsk	3 4 5	VVER-440 VVER-440 VVER-1000	417 417 1000	I I II	1971 1972 1980	2001–2011** 2002–2012** 2010
Smolensk	1 2 3	RBMK-1000 RBMK-1000 RBMK-1000	1000 1000 1000	II II II	1982 1985 1990	2012 2015 2020

Table 4. Description of Operating NPPs

* First and second generating units of above NPP have been shutdown for decommissioning

** A 10 year extension of service life taken into account

Crucial 2006

2006 was a crucial year for the Russian nuclear industry. Reforms were introduced throughout the industry in that year, and the attitude of the Russian authorities and the public towards nuclear industry changed. V. Gagiyev, General Director of Russia's Union of Nuclear, Energy and Scientific Industry Employers, described some of more notable achievements of Russia's nuclear industry in 2006:

- The regulatory framework for nuclear industry reform was established. The Government of Russian Federation approved a Federal Target Program (FTP), entitled "The Development of Russia's Nuclear and Energy Complex in 2007–2010 and Potential Development to 2015". In 2007, a Federal Law on "Management and Disposal of Property and Assets of Organizations Active in the Nuclear Energy Sector and on Amendments to Certain Legislative Acts of Russian Federation" was adopted.
- In 2006, work began on the construction of a fourth generating unit at the Beloyarsk BN-800 fast-neutron reactor nuclear power plant. Construction work began on a fourth generating unit began at the Kalinin NPP, and on the first offshore KLT-40S ice-breaker reactor.
- In 2006, Russian nuclear engineers bid successfully for the contract to build the Belene nuclear power plant in Bulgaria, the first post-Soviet nuclear construction project in Europe to be awarded to Russian engineers. The contract was awarded to AtomStroyExport, which is also building five generating units at nuclear plants in China, India and Iran.
- Zarechnoye, the Russian-Kazakh JV, began mining uranium and has planned capacity of 1000t/y U. Russia's first overseas uranium mining project is financed by a five-year, USD 63 million loan from the Eurasian Development Bank
- Kazakh uranium will be enriched at a dedicated site at the Angarsk Electro-chemical Complex.
- TVEL Corporation expanded its exports of nuclear fuel, bidding successfully to supply the Temelin nuclear power plant in the Czech Republic.
- Joint ventures were established with engineering companies producing equipment for nuclear power plants. Social progress was made, too.
- Finally, public attitudes towards the nuclear power industry changed radically; the sector regained its priority status[3].

FTP "Development of Russia's Nuclear Power Complex in 2007–2010 and Potential Development to 2015"

On October 4, 2006, the Government of Russian Federation approved the Federal Target Program entitled "The Development of Russia's Nuclear Energy Complex in 2007–2010 and Potential Development to 2015".[4] The program establishes the timetable for the startup of new nuclear power generation units serving the 'hotspots' of Russian economic growth (Moscow Oblast, European Russia, Russia's Far East and the Urals). It envisages that ten new generating units with a total capacity of over 11 gigawatts will be commissioned by 2015. Today, ten nuclear power plants are operating in Russia and these have a total output of 23.3 gigawatts; nuclear power accounts for 15.5% of Russia's total power generation. As a result of this FTP, nuclear's share of total power generation will increase to 22% according to the baseline scenario, and up to 30% according to the optimistic scenario.

Overall funding for the program totals 1.47 trillion rubles (USD 55 billion), including 674.8 billion rubles from the federal budget and 796.6 billion rubles from the industry. It is assumed that the nuclear power industry will not require central funding after 2015 since the foundations built over the next eight years are designed to ensure the industry becomes self-financing. The unit cost of nuclear power plant construction is expected to fall by 10% and the net cost of power generation by 20%.

[3] http://www.rosatom.ru/comments/3437_16.01.2007, as at October 2007
[4] http://www.government.gov.ru/government/governmentactivity/rfgovernmentplans/8123133.htm, as at October 2007

Due to the insufficient funding of a previous project, the "The Safety and Development of the Nuclear Power Industry", which received only 70.6% of its planned budget, the Federal Target Program "Energy Effective Economy for 2002–2005 and Potential Development until 2010" is behind schedule. Only two generating units were commissioned, adding two gigawatts of new capacity, out of a planned three new units which were due to bring on stream three gigawatts of new generating capacity.

The government-approved FTP does not concern itself with RosAtomProm's development. The industry's organizational development is addressed in the Federal Law on the Management and Disposal of the Property and Assets of Organizations Active in the Nuclear Energy Sector, which came into force on February 20, 2007.[5] The main premise of this law is to consolidate nuclear assets in a single corporation, i.e., AtomEnergoProm. The corporation will control the entire nuclear energy production chain, including uranium mining, power and fuel production, domestic and overseas power plant construction, nuclear machine building, and design and research organizations[6]. AtomEnergoProm's assets are estimated at USD 40-50 billion.

In the second half of 2007, the decision was taken to consolidate nuclear assets in the state firm RosAtom. This company will comprise the industry's scientific base, nuclear safety facilities and 100% of the assets of AtomEnergoProm, which, in turn, will manage all the civic entities within the nuclear industry. The relevant draft law was passed by State Duma by the end of 2007.

Finally, in April 2007, Russia began constructing the first offshore nuclear power plant in the world. The 70 MW plant is scheduled for completion by 2010. Its output will mainly be consumed by Sevmash, and around 20% will be sold. Project costs stand at USD 200 million. The investment will pay for itself in less than seven years. A total of seven offshore nuclear power plants, including high-capacity plants, are due to be commissioned by 2016. Offshore nuclear power plants may be positioned in any coastal area to generate power and heat and also to desalinate sea water. These plants are considered safer and have a re-fuelling interval of 12-15 years.

A Swing of Public Opinion

Public opinion towards nuclear power in Russia is changing, and attitudes are becoming more positive. In a survey, 45% of respondents answered "yes" to the question, "Do you think new nuclear power plants or nuclear generating units should be constructed in Russia?"; 28% said "no" and 27% gave no answer.

Those who supported nuclear expansion gave the following reasons. "They are more environmentally friendly than fossil fuel heat-and-power plants and hydro-electricity plants"; "Nuclear power has no cheaper alternative as yet"; "Wind power is still a 'futuristic' option"; "Nearly all Western countries rely on nuclear power whereas we produce only 12% of our energy in nuclear power plants"; "It is inevitable given current energy demand"; "Natural resources have limits; sooner or later oil and gas will run out"; "Nuclear power is the future, whether we like it or not".[7]

[5] Federal Law on Factors for Management and Disposal of Property and Assets of Organizations Operating to Use Nuclear Energy as of February 5, 2007. Rossiyskaya Gazeta, #4291 of February 9, 2007.
[6] http://www.minatom.ru/News/Main/view?id=40957&idChannel=73 as of June 2007.
[7] http://www.rosatom.ru/news/3348_09.01.2007 as of October 2007.

5. Nuclear Power Industry of Kazakhstan: Current Situation and Development Prospects

KazAtomProm after the Year 2000

In 2006, KazAtomProm's position in world markets supplying the nuclear power industry was as follows:

- It supplied 8% of the world's mined uranium, putting KazAtomProm in fourth place in the world compared to 16th place in 1999;

- It supplied 29% of the world's beryllium products (3% in 1999), putting it in second place globally;

- It supplied 8% of all tantalum products (0.4% in 1999) and was fourth in the world.

After a long crisis in the world's uranium industry, KazAtomProm commissioned three new mines: South Moinkum, South Karamurun and Akdala.

In 2002, the High-Technology Institute was founded to conduct scientific follow up on KazAtomProm's projects.

In 2003, KazAtomProm purchased, by tender, the former Mangistau Nuclear Power Plant and established the MAEK-KazAtomProm company.

In 2004, management of the Stepnogorsk Mining and Chemical Combine (Tselinny Mining & Chemical Co.) was handed over to KazAtomProm.

Today, the KazAtomProm holding manages six areas of activity: geological exploration; uranium mining; metallurgical engineering; energy; scientific support for production and staff training; and social security. KazAtomProm owns shares in several uranium mining joint ventures: KatCo (with French company Cogema/Areva); Inkai (with Canadian company Kameko); Zarechnoye (with Russian TekhSnabExport): and UKR TVS (producing nuclear fuel with Russian-Ukrainian partners).

In 2004, KazAtomProm highlighted the global uranium production crisis. Company experts suggested that the global uranium shortage would grow to 16,000 tonnes in six years. By 2010, KazAtomProm plans to produce 15,000 tU, making it a leading player in the world's industry. Its confident predictions are based on the solid commercial relationships it has forged with the world's largest energy and commercial companies, and upon its financial stability, advanced scientific knowledge base and a strong network of peer enterprises.[8]

The company's management estimates that Kazakhstan's uranium stocks amount to around 900,000 tonnes.

Program "15 000 tU by 2010"

Having identified growing world demand and hence competition for uranium fuel, KazAtomProm drafted its "1500 tU by 2010" development program. If the program is implemented successfully KazAtomProm will become a world leader on the uranium market.

The Program includes:

1. Upgrading and extending uranium extraction and production of uranium fuel.

2. Constructing and commissioning new mines.

3. Constructing and optimizing power distribution, and new road and rail infrastructure

4. Financial reorganization.

5. Uranium extraction will increase to a planned 15 000 tU to meet increasing demand for uranium fuel.

[8] http://www.KazAtomProm.kz/cgi-bin/index.cgi?p8&version=ru as at October 2007

Mines	2005	2006	2007P	2008P	2009P	2010P	Planned Capacity
Uvanaz	420	300	300	300	300	300	300
East Kynkuduk	633	500	1000	1000	1000	1000	1000
Central Mynkuduk	-	-	200	600	1200	2000	2000
Akdala (JV, Canada)	726	700	1000	1000	1000	1000	1000
South Inkai (JV, Canada)	176	308	508	300	1970	2000	2000
Inkai	-	-	100	300	600	1000	2000
Kanzhygan	440	400	400	400	400	400	400
West Mynkuduk (JV, Japan)	-	-	-	100	300	600	1000
Budenovskoe (JV, Russia)	-	-	-	100	300	600	1000
South Moinkum	502	500	500	500	500	500	500
Moinkum (JV, France)	39	400	500	500	500	500	500
Tortkuduk (JV, France)	-	100	350	750	900	1000	1000
North Karamurun	700	750	800	980	980	1000	1000
South Karamurun	214	200	200	150	250	250	250
Irkol (JV, Japan)	-	-	100	250	500	750	750
Kharasan (JV, Canada)	-	-	100	300	600	1000	2000
Zarechnoye (JV, Russia)	-	250	500	500	1000	1000	1000
SMCC mines	507	525	545	645	815	450	500
Total:	4357	4933	7103	8675	13115	15350	18200

Table 5. Uranium Recovery by Mine

Source: KazAtomProm

Note: according to preliminary data, KazAtomProm produced 6637t U in 2007. The production target for 2008 is 9600t U. The 2007 data for mines is as follows: 0.6 million pounds at Inkai; 871t at South Moinkum; 300t at Irkol in 2008, 500t in 2009 and 750t in 2010, and 0.5 million pounds planned for South Inkai in 2008 (Ux Consulting, January 2008). Zarechnoye has produced 100 tU in 2007 but is expected to see substantial increase in 2008.

Program's Investment Needs

KazAtomProm requires USD 700 million in order to implement the "15 000t U by 2010" program. The program's financial sources were initially identified as follows:

1. KazAtomProm's own funds: USD 170 million;
2. Uranium pre-payments: USD 220 million;
3. Bank loans: USD 210 million;
4. Eurobonds: USD 100 million.

Later in September 2005, a more precise estimate for the program was announced, totaling USD 660 million. By then, KazAtomProm had already raised USD 210 million in loans and USD 60 million in pre-payments for uranium; the company's own contribution will eventually total USD 224 million. It is expected that the remaining USD 166 million will be raised by a Eurobond issue.[9]

Given Kazakhstan's success to date in raising funds there seems little reason to doubt that the company will raise the full amount required to fund its program. The national company enjoys credit ratings at the sovereign level for Kazakhstan.

The Development of Kazakhstan's Nuclear Complex in 2000–2006

In mid-June 2001, KazAtomProm's President, M. Dzhakishev, stated that Kazakhstan could become a world leader in the world's uranium market within ten years.[10] Uranium prices had slumped in recent years, he said, after the market was flooded with military uranium after the end of the cold war. These stocks, however, would run out some time between 2005 and 2008, and prices would increase rapidly, making uranium effectively 'priceless' by 2010, in that there would be "no uranium at any price". His estimate was based on the development targeted by the nuclear states.

In 2002, the Kazakh government published its "Development Strategy for the Uranium and Nuclear Energy Industries 2002–2030[11]. The plan was conceived to transform the country's nuclear energy complex into a hi-tech, dynamic and progressive sector that would be the keystone of vigorous and sustainable economic development. It emerged as the result of KazAtomProm's crisis management and in response to the rapid growth of the Kazakh economy.

The strategy targeted production of 15,000t/y U by 2028, which would make Kazakhstan the world's largest producer. To implement the project would cost USD 540 million. The uranium produced would be worth USD 82-85 million annually, and the national budget would receive USD 2 billion annually in tax revenues.

In 2004, the Uranium Industry Development Strategy for the Republic of Kazakhstan 2004–2015 was approved.

In recent years, the company has been increasing uranium extraction. In 2002, KazAtomProm was the fourth largest uranium producer in the world (accounting for 8% of global uranium ore production), according to statistics from the World Nuclear Association. Uranium production volumes were increased by revamping old mines (Uvanas, East Mynkuduk, Kanzhugam, South Moinkum, North Karamurun) and exploiting new deposits (South Karamurun and South Moinkum). Further increases in uranium production would be achieved by developing deposits which had been discovered but which had not, up to now, been exploited (Zarechnoye, Ilpak, Irkol, Central Mynkuduk, Budenovskoye and part of the Inkai deposit which was estimated to contain 473,000 tonnes uranium). In pursuit of its goals, KazAtomProm increased uranium production from 794 tonnes in 1998 to 2,850 tonnes in 2002. In 2003, Kazakhstan increased uranium recovery to 2,952 tonnes. In 2004, Kazakhstan produced 3,719 tonnes uranium and became the third largest

[9] To implement the program "15000 tU by 2010", Kazakhstan will require $660 Million". M. Dzhakishev. Kazakhstan today. September 14, 2005.
[10] 7 Kazakhstan may become a leader in the world's uranium trade. Kazakhstan today. June 18, 2001.
[11] Decree of the Government of the Republic of Kazakhstan #926 of August 20, 2002.

producer in the world. Interim data estimates uranium production in 2005 totaling 4,300 tonnes. This rapid production growth prompted KazAtomProm to issue more optimistic forecasts. In March 2005, the company announced its development strategy aimed at increasing uranium recovery to 15,000t/y U by 2010, making Kazakhstan the world's top producer.

To achieve this ambitious growth rate, the company pursued radical measures to rehabilitate and develop Kazakhstan's nuclear industry. As well as revamping its infrastructure, KazAtomProm expanded by acquiring nuclear enterprises. In late April 2003, the Mangyshlak Nuclear Power Plant, which had been placed in bankruptcy a month before, was sold to KazAtomProm for USD 800,000. The plant was a strategic enterprise engaged in the entire production cycle, supplying constant heat and power from a safe reactor. The new company, MAEK-KazAtomProm, was registered on May 1, 2003.

Competition for Kazakh Uranium

Kazakh uranium is becoming the focus of fierce competition between the world's large consumers, primarily France, Canada, Japan, China, South Korea, and Russia. External investors are poised to "conquer" the market through direct investment, loans and trade funding to guarantee supply. In such circumstances, KazAtomProm has no worries about raising capital.

In late September 2004, KazAtomProm and Kazsabton Ltd. (Cyprus) signed a contract placing Stepnogorsk Mining and Chemical Plant under trust management. At the time, the uranium mines in northern Kazakhstan were producing some 100t U. Although production was due to rise to 600t/y uranium ore (the maximum possible production from the northern deposits), for two years the Stepnogorsk complex could only work at full capacity for two months in a year. KazAtomProm worked out a plan to enable the plant to operate using ore supplied from southern deposits. However, because of the high estimated cost of implementing this project (USD 75 million), the company temporarily delayed any investment in it while it pursued its "corporate strategy to increase uranium production five-fold by 2010". A year later, the company announced plans to invest over USD 180 million developing Stepnogorsk in 2005–2007.

In late February 2004, a new uranium refining plant was commissioned in Taukent in the Suzaksk Region of the South Kazakhstan Oblast. The project cost was USD 4.3 million, and plant capacity, 1500-1700t/y U.

In August 2005, KazAtomProm declared that it intended to build a molybdenum ore processing plant in Stepnogorsk within three months. The plant was to produce 1,000 tonnes of molybdenum oxide a year. A Kazakh-British JV enterprise, Moliken, was set up to supply ore to the enterprise by developing the 21,000 tonne estimated deposit at Shorskoye. During 2005–2007, around USD 180 million would be invested in the plant.

KazAtomProm has been very successful in leveraging finance from the banks in recent years. In June 2005, the company signed a three-year pre-export financing contract with a syndicate of 11 of the world's largest banks (organized by Natexis Banques Populaires and Citibank) in the amount of USD 150 million. KazAtomProm intended to use these funds to finance geological exploration, mining and the production of natural uranium concentrate. In September the same year, a USD 60 million pre-export loan was extended to KazAtomProm by Mizuho Corporate Bank Ltd for a ten-year period. Collateral for the loan was an export contract for the supply of uranium oxides (natural uranium concentrate) which had been struck with Itochu Corp.

KazAtomProm has been actively developing new deposits. In 2006, it commissioned the East Mynkuduk mine, which has a design capacity of 1000t/y U. In 2007, similar mines with on-site leaching facilities were due to be commissioned, as follows: Central Mynkuduk (2,000t/y), South Inkai (2,000t/y), Irkol (750t/y) and Kharasan (2,000t/y). In 2008, there are plans to begin ore extraction at West Mynkuduk (1,000t/y) and Budenkovskoye (1,000t/y). Kazakhstan's total uranium resources amount to 900,000 tonnes, around 600,000t of which, according to estimates, can be extracted at the current level of commercial technology.

France boasts the world's largest nuclear and energy complex and most up-to-date nuclear technology. In 2001, the French-Kazakh joint venture KatCo was founded (AREVA holds 51% and

KazAtomProm 49%) and will consist of an experimental uranium plant at the Moinkum deposit in South Kazakhstan. Development of the deposit will require investment of nearly USD 90 million which will be provided by the AREVA group. Reserves at Moinkum are estimated at 43,700t U.

Canada has a well-established uranium industry and is the largest uranium producer in the world. It made its first foray into the Kazakh market back in the 1990's, but was initially unsuccessful. In 1996, the Government of Kazakhstan and Canada's World Wide Minerals signed a contract to take over the joint management of the Northern Uranium Production Plant and the Tselinny Mining and Chemical Combine. A year later, WWM applied to the Kazakh government for a license to sell uranium to the USA, but was refused, since there are strict quotas governing such imports into the USA. As a result, the company halted production, citing poor sales. The Kazakh government therefore took over the management of the complex and terminated the contract with WWM since the latter had failed to fulfil contract obligations. The government transferred the complex to KazAtomProm. WWM filed numerous suits with the US courts but all were dismissed. In February 2003, the US Supreme Court finally ruled in Kazakhstan's favor. In March 2006, however, the company filed a suit with the International Arbitration Court, claiming USD 3.8 billion in compensation. Cameco, another Canadian company and one of the world's largest uranium producers, was more successful in its business ventures in Kazakhstan. In 1998, it founded the Inkai joint venture KazAtomProm to develop uranium deposits in the Suzaksk Region of South Kazakhstan Oblast.

The USA is the largest investor in Kazakhstan's economy overall. It accounts for more than one third of the direct investment in Kazakhstan since independence, amounting to USD 40 billion.[12] However, large-scale joint projects in the nuclear power industry between the US and Kazakhstan are currently limited to one joint venture involving KazAtomProm and the US Nuclear Energy Ministry. Based at the Ulba Metallurgical Plant, the company refines scrap containing uranium into fuel pellets for nuclear power plants. The second stage of this project includes plans to increase capacity and revamp production of beryllium bronze alloy. The USA is represented in this project by Brush Wellman and RWE NUKEM, which invested USD 4 million. The US Government invested USD 1.5 million and provided consultants' reports on the project. The Ulba Metallurgical Plant invested USD 4.5 million. Analysts expect this project to make profits of around USD 10 million per year.

In March 2004, the ground-breaking ceremony took place at the BN-350 liquid metal reactor coolant refinery. Project cost is estimated at USD 3 million which is being supplied in full by the US State Department in accordance with nuclear non-proliferation agreements. The plant will refine spent liquid-metal coolant into a concentrated alkaline solution.

Japan's influence will continue to grow in Kazakhstan in the years to come in terms of uranium recovery. Nuclear energy accounts for one third of the Japan's energy complex, and the country has several leading nuclear industry enterprises.

In September 2005, Itochu Corp and KazAtomProm signed a ten-year, USD 60 million loan agreement under which the Kazakh company would supply Itochu with 3,000 tonnes of uranium concentrate. In January 2006, KazAtomProm concluded an agreement with Japanese companies Sumitomo Corporation and Kansai Electric Power Co. on the development of West Mynkuduk field. The Japanese partners will invest in the APPAK JV founded by KazAtomProm with KazAtomProm, Sumitomo and Kansai taking 65%, 25% and 10% shares respectively. This project is being financed with USD 100 million.

In May 2007, various contracts were agreed relating to the supply of uranium concentrate to Japan. In the longer term, Kazakh may begin exporting some 8,000 t/y uranium to Japan, which would be equivalent to 30% of total Japanese import market. The agreements also envisage the opening of a USD 500 million trade insurance credit line funded by Japan's NEXI, and, in the medium term, the supply to NEXI of refined uranium products such as fuel pellets produced at the Ulba Metallurgical Plant. These agreements alone will double or triple the added value of uranium products made in Kazakhstan.

Three months after the above agreements were concluded, KazAtomProm took the ambitious step of buying out Toshiba's 10% share in Westinghouse Electric, the leading US producer of nuclear reactors, for USD 540 million. This transaction sealed a long-term alliance between KazAtomProm, Toshiba and Westinghouse Electric in the nuclear energy industry.

For Kazakhstan, this step constitutes a major step forward in creating new opportunities to develop its hi-tech nuclear industry and increase its presence on western markets. Supplying processed uranium products to western markets is the Kazakh company's top development priority alongside cooperation with Russia in the supply of Soviet-type reactors. The production of fuel for western reactors at Ulba Metallurgical Plant by the Cameco JV will be a major contribution to the Kazakh company's goal of producing processed uranium fuel. It has stated that the first output will be available in 2012.

South Korea is showing a keen interest in Kazakhstan's nuclear complex. The two countries are exchanging scientific and technical expertise, and South Korea's government has declared its interest in further cooperation with Kazakhstan.

China. No Kazakh-Chinese joint ventures have yet been founded in Kazakhstan, although Ulba Metallurgical Plant has a representative office in China. The Ulba-China JV company registered in

[12] The outcomes of the investment conference in California: USA is willing to and will develop cooperation with Kazakhstan. Kazakhstanskaya Pravda, September 15, 2005.

the Waigaochao free trade zone near Shanghai in June 2004 to sell and market Ulba's beryllium products in the Chinese market. In November 2004, KazAtomProm and China National Nuclear Corporation (CNNC) signed a long-term strategic partnership agreement and a program of works in the nuclear industry. Negotiations are under way relating to the co-development of the Zhalpak field in the southern part of Kazakhstan.

The low interest rates on credit extended to KazAtomProm are testament to the keen interest that overseas firms are showing in its uranium industry. The company has raised loans from Citibank at 6.3%, from West LB loan at 7.7% and from Natexis Banques Populaires's at 6.7%.[13]

Prospects for Russian-Kazakh Cooperation amid Competition for Kazakh Uranium

In the first half of this decade, Kazakh uranium became a highly sought-after product, much scrutinized by the world's leading uranium producers and consumers alike. This created an environment of intense competition, and has enabled Kazakhstan to be discerning in its choice of partners and investors. Nevertheless the country remained steadfast in its policy of diversifying its trade and economic relations in order to avoid dependency on any one partner, be it France, Russia or Japan.

Concurrent with this development, Russia, with its large production capacity and highly-competitive uranium refining technologies, had sought to restore its economic ties with Kazakhstan based on uranium recovery and the nuclear sector. Given its ambitious plans to develop nuclear energy, with an all but depleted uranium stock, it is very much in Russia's interest to pursue cooperation with Kazakhstan.

However, Russia will be competing in the uranium feedstock market with some highly accomplished competitors. As the cost of developing its own uranium deposits increases, and demand for nuclear fuel spirals as the role of nuclear energy expands globally, Russia will have to be resolute if it is to have influence in a strategically important region controlling a significant proportion of the world's uranium stocks.

Russia does have a number of competitive advantages which will favor Russian-Kazakh cooperation in the nuclear sector.

- Both countries wish to further economic integration. They are members of EurAsEC, CSTO, SCO, CES and the CIS and are pursuing the creation of a customs union.

- The nuclear complexes of Russia and Kazakhstan complement each other: Kazakh uranium production feeds into Russian uranium enrichment; Kazakhstan produces elements and Russia fuel pellets. The joint development and construction of VBER-300 reactors is the logical completion of this vertically integrated nuclear production cycle.

- Many leading Kazakh scientists, businessmen and researchers in the nuclear industry studied in Russian higher education institutions and maintain close relations with their Russian colleagues. Scientific exchange programs and traineeships have been established in Russia, which may favor the selection of Russian technologies and cooperation with Russian partners.

Practical steps are being taken to launch an integration project in the nuclear sector. The foundations for this have been laid in the form of strategic partnerships already forged between Russian Federation and the Republic of Kazakhstan in the use of nuclear energy.

Russia's moves to enhance the integration of the Russian and Kazakh economies along the whole nuclear production chain is a crucial step in its quest to resolve its own energy problems. The Kazakh economy will benefit similarly from cooperation with Russia. One further benefit of this cooperation between Russia and Kazakhstan in the construction and operation of a nuclear power plant is that it may lead to a breakthrough in the machine building industry.

[13] KazAtomProm. Report for nine months of 2005. www.kase.kz

6. Cooperation of Russian Federation and the Republic of Kazakhstan

1998–2005: Post-Crisis Cooperation

The first steps towards Russian-Kazakh nuclear cooperation were made after the collapse of their integrated economic systems in the late 1990's. In 1998, the governments of the Republic of Kazakhstan and Russian Federation signed agreement on the integration of nuclear fuel enterprises (Moscow, July 6, 1998). The main provision of the agreement was Russia's purchase of a stake in Ulba Metallurgical Plant (as TVEL OJSC).

After the break-up of USSR, the Ulba complex was the only link in the nuclear fuel production chain to be located outside Russia. The plant began producing uranium pellets to be used in the downstream assembly of reactor fuel elements (fuel cells). Fuel cells are produced in Russia at a plant close to Novosibirsk, and pellets are made in Kazakhstan by Ulba Metallurgical Plant in Ust-Kamenogorsk.

A joint venture to produce nuclear fuel for NPPs was one of the first projects founded since 2000 by KazAtomProm. Its partners were TVEL (Russia) and EnergoAtom (Ukraine). The three companies took an equal share in the JV and its USD 0.45 million charter capital. The venture was aimed at integrating the entire nuclear production cycle in a single enterprise: uranium production and processing, fuel assembly production and nuclear energy generation. In early June 2001, the agreement establishing the JV was signed.

In May 2003, Kazakhstan, Russia and Ukraine signed a further JV agreement on joint production of fuel assemblies for VVER-1000 reactors and the supply of nuclear fuel to Ukrainian NPPs. The agreement resulted in numerous orders for Ulba Metallurgical Plant and requests for it to produce nuclear fuel elements. Russia's TVEL began producing fuel assemblies for Ukrainian NPPs and the National Nuclear Energy Company of Ukraine launched production of zirconium tubes for fuel assemblies.

The Beryllium JV was another big project established in September 2002 by the Ulba Metallurgical Plant (UMP) and Moscow Non-Ferrous Metal Processing Plant (MZOTsM), each with a 50% share. The JV's operations include the fabrication of ingots at UMP and the flat-rolling of these ingots at MZOTsM. These are widely used in hi-tech electronic instruments and in other specialist electronic components. The beryllium plant at Ulba signed contracts to supply Chinese consumers and made its first shipment to China. This UMP plant is the world's second largest beryllium producer and performs the entire processing cycle from ore concentrate to beryllium metal and its alloys.

2006: Economic Integration within Nuclear Cycle

Russian-Kazakh cooperation in the civilian use of nuclear energy gained momentum in 2006. On January 25 that year, Russia's President, Vladimir Putin, and the President of Kazakhstan, Nursultan Nazarbaev, made a joint declaration on cooperation in the non-military use of nuclear energy. The declaration launched a number of initiatives aimed at integrating the nuclear industrial enterprises of both countries.

On July 25, 2006, MAEK-KazAtomProm held a meeting in the city of Aktau attended by Sergey Kiriyenko, the head of Russia's Federal Nuclear Energy Agency. The meeting was called to discuss the strategic partnership between Russia and Kazakhstan on use of nuclear energy for non-military purposes. This program was the outcome of the joint statement made by Putin and Nazarbaev in January.

The program outlines six major areas of cooperation:

- Cooperation in nuclear fuel production;
- Cooperation in the nuclear energy industry;
- Development of transport infrastructure to deliver uranium products to the world market;

- Improved regulation of Kazakh-Russian cooperation in the non-military use of nuclear energy;
- Scientific and technical cooperation;
- Cooperation in training personnel to work in the nuclear industry.

Under the program for strategic cooperation in nuclear fuel production, a memorandum of understanding was signed between KazAtomProm (Kazakhstan) and TekhSnabExport OJSC (Russia) establishing two joint ventures.[14]

The first JV is established in Kazakhstan to produce natural uranium fuel for Russian-designed reactors.

The second JV is established in Russia to enrich uranium. Subject to completion of feasibility studies the partner companies will contribute equally to the initial asset base for the joint ventures:

- uranium production facilities will be provided by Kazakhstan;

- uranium enrichment facilities will be provided by Russia.

At a meeting of the presidents of Russia and Kazakhstan on October 3, 2006 in the city of Uralsk, it was agreed that Kazakhstan would participate in the introduction of a Russian initiative to establish, in Russia and under IAEA monitoring, an international nuclear fuel services centre, including uranium enrichment. On October 12, 2006, Russian and Kazakh representatives signed documents in Moscow establishing three Russian-Kazakh joint ventures in the non-military use of nuclear energy. On May 10, 2007, the presidents of Kazakhstan and Russia witnessed the signing of the agreement which established the International Uranium Enrichment Center (IUEC) in the city of Angarsk.

Under the program of strategic development of the nuclear energy industry, a third JV of is due to be established between KazAtomProm and AtomStroyExport. This JV will design a Russian-Kazakh nuclear reactor with VBER-300 power units designed by OKBM. The charter documents were signed in October 2006.

A revolutionary new 300 MW generating unit is also due to be built in Kazakhstan. Although reactors now commonly generate 1000 MW and more, these units are unsuitable for the extensive Kazakh grid because of the amount of reserve energy they require when the reactor is shut down for re-fuelling.

The new VBER-300 generator will be a key export opportunity for the Russian-Kazakh JV. Its principal design concepts were based on naval reactors which have accumulated over 6,000 reactor years of accident-free operation.

The new reactor has no direct competitors, but this may change before long. The Japanese Atomic Energy Agency (JAEA), for example, has already completed the design concept for a 180 MW reactor. Also, the fast-breeder reactors designed in many countries will certainly be used well into the future (a 65 MW fast-breeder reactor designed with Russian assistance is due to be commissioned in China in 2008).

On the whole, Kazakhstan is likely to select both 300 MW Russian-Kazakh reactors and, in the longer term, 1,000 MW Westinghouse reactors.

[14] http://www.KazAtomProm.kz/15000/?nc4&version=ru

7. Nuclear Fuel Cycle Business Chain

(1) Uranium Mining

Uranium mining, refining and export are the major activities of KazAtomProm. In 2005 the company mined 4,032t U of the total 41,000t U mined globally. Around 19% of estimated global uranium stocks (900,000t) are in Kazakhstan. Over half of Kazakhstan's uranium can be extracted using mineshaft leaching, the cheapest and least environmentally damaging form of extraction.

The Ore Mining Company, a wholly owned subsidiary of KazAtomProm founded in 2004, extracts uranium using the method of mineshaft leaching at seven sites: Uvanas, Mynkuduk, South Moinkum, Kanzhugan, North Karamurun, South Karamurun, and Irkol.

In 2005, Russia's RosAtomProm mined 3,431t U, or 8% of global production. Its output comprised natural and converted uranium. Uranium mining in Russia has a much less certain future than in Kazakhstan. Deposits are exhausted in Russia, and if it is to expand its nuclear energy capacity, the way forward is based on Kazakh uranium supplies.

(2) Uranium Enrichment

Yellowcake (a chemical concentrate of natural uranium and an intermediate product) produced by the Ore Mining Company is refined at the Ulba Metallurgical Plant and Stepnogorsk Mining and Chemical Combine.[15]

Kazakh uranium mined by the Russian-Kazakh Zarechnoye JV will be enriched in a dedicated part of the Angarsk Electro-chemical Combine.

(3) Fabrication of Fuel Pellets and Fuel Elements

Ulba Metallurgical Plant, based in Ust-Kamenogorsk, is a leading producer of fuel pellets.

US businesses have expressed interest in this strategic enterprise. As mentioned above, the US Nuclear Energy Ministry and some American companies invested in a joint venture which makes fuel pellets by refining scrap containing uranium. The capacity of the JV is due to be expanded, and production of beryllium bronze alloy will be added.[16]

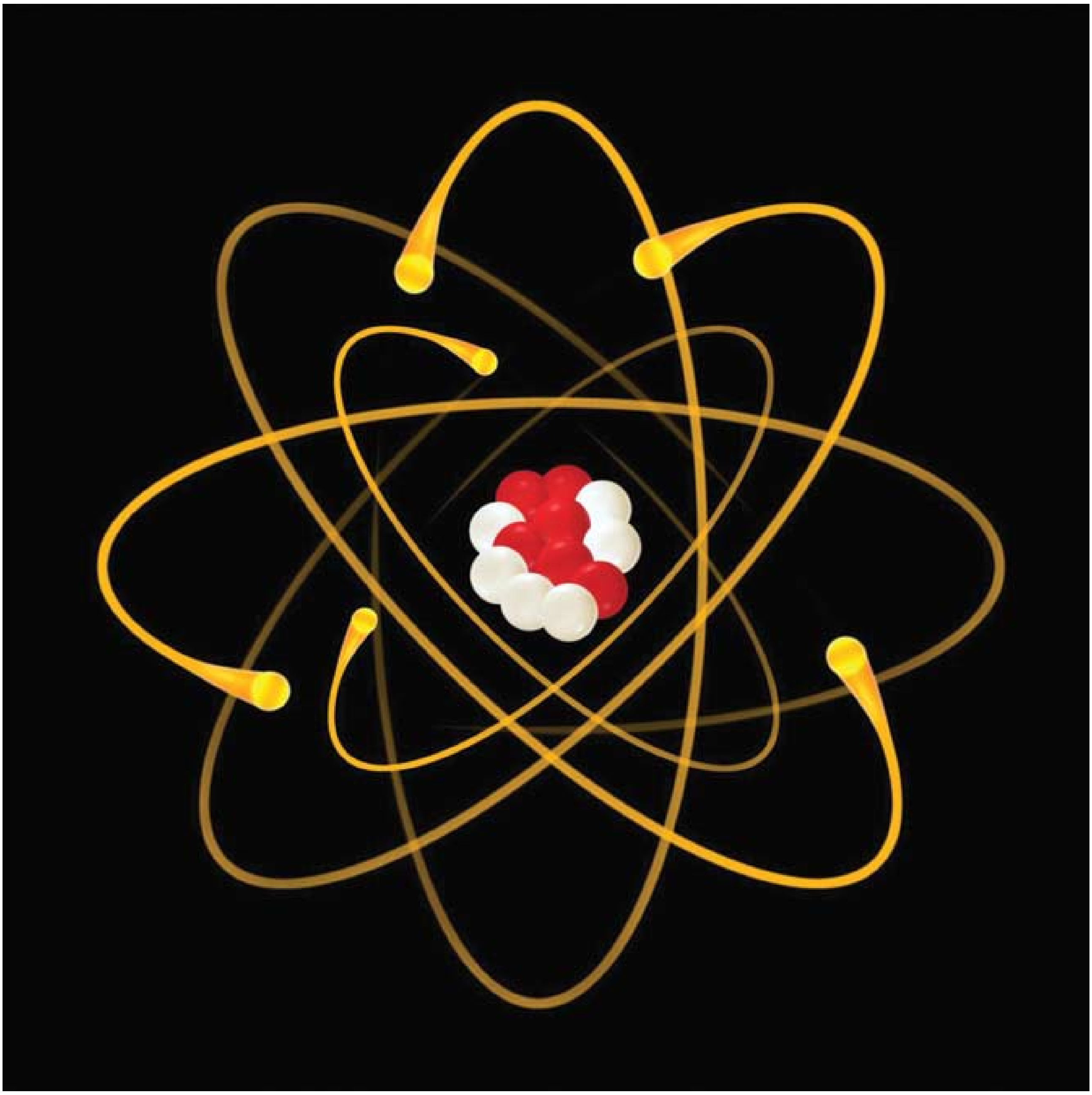
Russia's TVEL, a world leader in nuclear fuel production, manufactures fuel assemblies (fuel elements). The Machine Building Works (Mashinostroitelny zavod) and Novosibirsk Chemical Concentrate Plant are Russia's leading producers of fuel assemblies. Chepetsk Mechanical Plant and the Chemical Metallurgical Plant (Khimiko-metallurgicheskiy zavod) supply the construction materials, components and uranium products required by these companies.[17]

(4) Small and Medium Power Reactors

In October 2006, AtomStroyExport OJSC of Russia and KazAtomProm founded JV Nuclear Power Plants, a new joint stock company which will build small- and medium-capacity reactors. As yet, there is nothing to compete with this 300 MW reactor anywhere in the world. This project is currently in development. Designing a nuclear power plant which uses two VBER-300 reactors will take around three years and requires investment of USD 60-70 million, all of which will come from Kazakhstan.

High-capacity plants capable of producing 1,000 MW and more do not represent an optimal decision for the Kazakh energy system. When such nuclear reactors are re-fueled, equivalent reserve capacity must be made available, and this is not possible given the huge distances between Kazakhstan's power plants. It is more economical for Kazakhstan to commission three 300 MW plants rather than a single 1,000 MW one, thereby reducing its energy losses when capacity is idle. This also reduces power losses incurred in long-distance power distribution.

[15] http://www.KazAtomProm.kz/cgi-bin/index.cgi?p23&version=ru.
[16] Ligature is an additional alloy applied in metallurgy to add to liquid metal of alloying component.
[17] Seventy-three energy reactors (17% of the world market) and 30 research reactors in 13 world countries operate with TVEL brand fuel. These include all reactors in Russian NPPs: RBMK-1000 (Leningrad, Kursk and Kalinin NPPs); VVER-1000 (Novovoronezhsk, Rostov, Balakovsk and Kalinin NPPs); VVER-440 (Kolsk and Novovoronezhsk NPPs); BN-600 (Beloyarsk NPP) and EGP- 6 (Bilibinsk NPP). As well as producing nuclear reactor fuel, TVEL supplies all Russian research reactors and nuclear icebreakers (Arktika, Rossiya, Taimyr, Sovetskiy Soyuz, Vaigach, Yamal, Sevmorput).



It is likely that the first nuclear plant with a VBER reactor will be built in Aktau. There are several reasons for this. Firstly, Mangyshlak did have a BN-350 fast-neutron reactor and also has good staffing levels. Secondly, a nuclear project stands a better chance of recouping its costs in this region. Mangistau Oblast takes its power from a gas-fired HPP plant with a capacity of up to 500 MW, which is rather expensive electricity for Kazakhstan. To make gas affordable, the government has set domestic gas prices five times below the market value. According to a KazAtomProm estimate, the construction of a 500 MW nuclear plant will cost USD 600 million and will pay for itself within five years. Our estimates run higher than that, probably closer to USD 1000 million.

Resolving the domestic energy deficit is a matter of urgency. At the same time, VBER-300 is likely to prove attractive if promoted in world markets, primarily to large and under-populated countries. Market research conducted by RosAtom suggests that the world market can potentially absorb 30-50 VBER-300s, creating revenue of USD 15-20 billion. The Russian-Kazakh JV stands a good chance of becoming the leader in small-capacity reactor segment if the project is implemented successfully.

(5) NPP Construction

Russia. One of the primary goals of Russia's FTP is "to speed up the development of the nuclear energy industry and provide geopolitical and energy security for Russian Federation by commissioning new generating units in nuclear power plants with a total capacity of over 2 GW a year...".[18]

The following activity is planned on this basis:

- Two generating units with VVER-1000 reactors (Unit No. 2 at Rostov NPP and unit No. 4 at Kalinin NPP) will be commissioned in 2009 and 2011 respectively.

- In 2007–2008, three new generating units with VVER-1000 reactors will be constructed at Novovoronezhsk NPP #2 and Leningrad NPP #2. These will be ready for commissioning in 2012-2013. From 2009 onwards, two new generators for NPPs with VVER reactors will be constructed annually; the completion of each will take five years.

Thus, upon completion of the program, ten new power units with a total power capacity of over 9.8 GW will have been commissioned at nuclear power plants. A further ten generating units will be at various stages of completion.

The program entitled "Transition to Innovative Technologies in Nuclear Energy Development" incorporates the following activity:

- generator #4 will be built at Beloyarsk NPP. This will have a BN-800 reactor which works using closed nuclear fuel cycle technology; the BN-800 unit will be supplied with MOX-fuel and is due to be commissioned in 2012.

The program requires investments totaling 1.47 trillion rubles (USD 55 billion), including 674.8 billion rubles from the federal budget and 796.6 billion rubles from industry funds.

Kazakhstan. The first NPP with two generating units will be built at the MAEK site in Aktau. The first generating unit (300 MW out of a total 600 MW) is to be commissioned in 2014. Earlier there were plans for a second NPP at Ulken near Balkhash.[19] However, the choice was made in favor of a coal-fired HPP.

(6) Nuclear Waste Disposal and Refinery

It is possible and indeed essential for countries to cooperate in the processing and disposal of nuclear waste.

Cooperation between nuclear complexes in Kazakhstan and Russia along the entire nuclear energy production chain is necessitated both by the acute needs of both national economies and by the synergies which exist between their capacities and technological accomplishment at each stage of the nuclear fuel production cycle. These conclusions are borne out by national industrial development programs which focus on the complementarity and interdependence of the Kazakh and Russian nuclear complexes along the entire nuclear fuel production cycle.

[18] FTP "The Development of Russia's Nuclear Energy Industrial Complex 2007-2010 and Potential Future Development to 2015 ", p. 2
[19] Business i Vlast, 29.12.2006, p. 4

8. Nuclear Energy Industrial Complex Financing: Development Banks come into play

The nuclear sector is dominated by state-owned companies. The nuclear energy complexes of Russia and Kazakhstan are state-owned; Kazakhstan's uranium assets are concentrated in the hands of the state company, KazAtomProm, while Russia controls uranium, nuclear energy and scientific and research assets through RosAtom. Both countries regard the nuclear complex as being of extreme strategic importance and state funding is allocated accordingly. The nuclear industry is financed by the following:

- The national budget. Financing under Russia's Federal Target Program may reach USD 55 billion. The federal budget is expected to provide 47% of this amount (USD 26 billion). Funds from the national budget will not be required after 2015 if the sector becomes self-financing, as expected.
- State companies maintain their investment programs by raising commercial loans. Owing to the nature of its business and the state support it receives, nuclear holdings are able to raise long-term credit on relatively favorable terms. For example, in 2005 KazAtomProm received loans from Citibank at 6.3%, from West LB at 7.7% and from Natexis Banques Populaires at 6.7%.
- Joint ventures with leading international companies can help to shape capital structure and technological progress.
- Funding from international and national development banks.

The financing of the nuclear energy industry by international and national development banks is of particular international interest. On the one hand, development banks can become one of the larges sources of financing for the sector (e. g., the World Bank has historically been the largest creditor of the hydro energy industry and has been allocating an average USD 1.25 billion to this sector annually for the last 60 years). On the other hand, there are obvious reasons why financing the nuclear industry represents a challenge: fear of nuclear accidents, the Chernobyl and Three Mile Island incidents in recent memory, nuclear waste issues, etc. However, public attitudes towards nuclear energy have been more positive in recent years. This has been encouraged by the growing energy deficit and relatively limited ecological impact of nuclear power plants (provided their safety is assured and waste issues are resolved).

The scale and duration of nuclear energy projects (billions of dollars of financing required, with a 10 to 15-year investment horizon) make them a highly suitable investment opportunity for development banks. The innovative nature of the sector adds to their investment potential. As outlined above, the nuclear energy production cycle incorporates uranium production, enrichment, the production of fuel pellets and fuel elements, the construction of nuclear reactors and NPPs, the operation of these NPPs, and finally nuclear waste processing and disposal. The processing elements of the chain have obvious potential. Furthermore, a number of developing countries, especially those which export oil and gas, face a pressing need to diversify their national economies. Therefore, the development of the nuclear energy complex, including its high-tech elements, is especially attractive. This is particularly the case for Kazakhstan and Russia in view of the competitive advantages both countries enjoy in this sector.

The Eurasian Development Bank (EDB) established by Russia and Kazakhstan in 2006 is committed to facilitating the sustainable economic growth of participating states and to expanding the trade and economic relations pursuant to its mission. The Bank offers long-term credit facilities to development projects in sectors prioritized by participating countries. Developing the innovative achievements of the nuclear energy complex and the hi-tech industries within it thus complies entirely with the mission of the EDB. The Bank regards the nuclear energy industry as one of its key priorities.

One of the Bank's first projects was a USD 60 Million loan to the Zarechnoye JV founded by KazAtomProm and TekhSnabExport to develop the Zarechnoye uranium deposit in South

Kazakhstan. The opportunities for integration represented by projects which bring together the nuclear energy complexes of Russia and Kazakhstan add to their suitability as investment targets for the EBD. The Bank is currently reviewing other projects undertaken by post-Soviet countries which also offer significant potential to expand mutual trade and investments.

The Bank has certain competitive advantages in relation to nuclear sector projects:

- The nuclear sector is a strategic one for the Bank's member countries and these countries therefore limit the amount of foreign equity that may be invested in it. The EBD offers borrowers long-term and relatively cheap loans (interest rates are commensurate with western financial institutions and below those of CIS banks).
- The Bank offers considerable political support to member states.
- There is minimal attendant political risk for borrowers working with the EBD.

The development strategies being applied within the nuclear complexes of Russia and Kazakhstan and the integration agreements between them can be facilitated by the Bank and the financing it is able to extend to all stages of nuclear technology cycle.

VEB (Russian Development Bank) and the Development Bank of Kazakhstan (DBK) have yet to participate in the development of this sector. However, the charter and other regulatory documents of these national development banks do not exclude their involvement in the nuclear energy industry. In fact, given the close interaction of the national development banks and relevant state entities, and the Banks' role in enhancing the efficacy of targeted programs, both these financial institutions are expected to focus on the development of the nuclear energy complex. This is further corroborated by recent events: RosAtom and GasPromBank have opened discussions on the establishment of a large nuclear machine-building holding based on the AtomStroyExport CJSC (which builds NPPs overseas). RosAtom will own 51% of this enterprise and GasPromBank 49%. The holding will integrate the entire production process from nuclear plant design to supply of equipment. It will be co-owned by RosAtom, GasPromBank and the State Development Bank. VEB will hold 10-15% of the equity.[20]

Generally, the current status and the future requirements of the Kazakh and Russian economies will rely on the economically viable development of nuclear energy complexes and on close cooperation between the two countries. The development of this capital- intensive sector requires generous funding from a number of sources. In order to secure long-term credit facilities from international and national development banks, the electricity industry must be efficient, and the nuclear energy complex must remain innovative and diversified while offering opportunities for greater integration.

[20] Kommersant, 06.11.2007

Eurasian Integration journal

The Journal of Eurasian Integration is a quarterly academic and analytical journal published by the Eurasian Development Bank. The members of Editorial Board are distinguished academicians, practitioners and reputable experts in regional integration. Eurasian Integration publishes academic and analytical papers, book reviews on the issues of regional integration, interviews as well as quarterly chronicles of regional integration. Being largely focused on economics, the journal publishes materials addressing wide spectrum of urgent issues in Eurasian integration. These are the theories of integration, including its relevance to the development context; economic integration (trade, investment, financial institutions); institutional integration; other cooperation issues in the post-soviet space; international experience of regional integration. The first issue will be launched in the third quarter of 2008.

Requirements for submissions

Papers should be sent by e-mail to editor@eabr.org for blind review. There are no strict limitations regulating the size of a paper. However, editorial board recommends authors to adhere to 6-8 thousands words or 30-40 thousands characters. In addition to the main text, submission of brief author(s)' biodata (100-150 words), executive summary (100-150 words) and bibliography are obligatory. These materials must be enclosed in a separate file.

EDB Eurasian Integration Yearbook

Eurasian Integration Yearbook publishes wide range of articles and other materials in English language on theory and practical aspects of Eurasian integration. The major part of the annual Yearbook consists of English versions of selected articles published in the Journal of Eurasian Integration and other analytical publications of EDB. These will be supplemented by integration chronicles for the respective year. The Yearbook will improve access of the world community to the best papers on various issues of regional integration published in Russian language. Apart from papers published in the Journal of Eurasian Integration, papers written specifically for the Yearbook are also welcome (submission in English or Russian).

Industry Reports

As of today the following Industry Reports have been published and distributed:

Nuclear Energy Complexes in Russia and Kazakhstan: Prospects for Development and Cooperation. April 2008. In Russian.
Water and Energy Resources in Central Asia: Utilization and Development Issues. April 2008. In Russian.

The following Industry Reports are in the process of preparation:

The CIS Common Electric Power Market
The EurAsEC Transport Corridors

Consultancy

The Bank provides consultancy services to its strategic partners and clients. The Bank's Strategy and Research Department has in-house expert resources and can involve specialists from other departments, such as project managers, corporate financing, treasury, legal department. External experts from the extensive pool of CIS countries' experts could be mobilized to work on consultancy projects.

Areas of expertise:

- Analysis of current status and dynamics of development in selected sectors in the member states of the Bank and other EurAsEC countries;
- Financial markets analytical reviews in the EurAsEC countries;
- Economic and legal analysis of integration agreements and institutions in the Eurasian space;
- Development banks' operations and activities in the CIS countries and issues of cooperation;
- Analysis of investment projects, including feasibility studies.

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