KAZAKHSTAN

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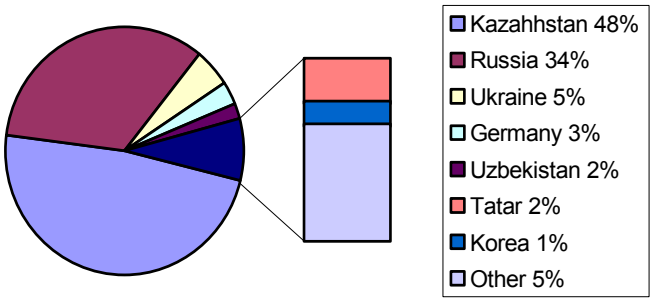
1. ENERGY, ECONOMIC AND ELECTRICITY INFORMATION

1.1. General Overview

Kazakhstan is a newly independent Euro-Asian republic, created in 1991 with the dissolution of the former USSR. The total length of its borders is more than 15,000 kilometres and it has an area of 2.7 million square kilometres. To the west of the country is Eastern Europe. To the east and to the southeast are the Altai and Tyan Shyan mountains. Kazakhstan borders with China in the southeast, with Ural and Siberia regions of Russia in the north, and with Central Asian countries, Uzbekistan, Kyrgyzstan and Turkmenistan, in the south. It has a coastline of 2 320 kilometres on the Caspian Sea. The climate is strongly continental, but with wide variations throughout the territory. Average temperatures in January range from -18°C in the north to -3°C in the south; July averages are 19°C in the north and 30°C in the south. Levels of precipitation are equally varied with average annual rainfall in mountainous regions reaching 1,600 mm and central desert areas less than 100 mm.

Kazakhstan's population is 14.9 million from more than 100 nationalities (Figure 1), but mainly Kazakh and Russian. In July 2003, the population growth rate was about +0.3%. The population density is estimated at 5.59 people per square kilometre (Table 1). The government disposes in Astana, the capital of the Republic of Kazakhstan.



Titles for Table:
Kazakh 48%
Russian34%
Ukrainian5%
German3%
Uzbek2%
Tatar2%
Korean1%
Other 5%

FIG. 1. Composition of population of the Republic of Kazakhstan

TABLE 1. POPULATION INFORMATION

	1970	1980	1990	2000	2001	2002	Jul. 2003
Population (millions)				15.6	15.5	15.5	14.9
Population density (inhabitants/km²)				5.9	5.8	5.8	5.59

Predicted population growth rate (%) 2002 to 2010	2.1
Area (1000 km²)	2669.8
Urban population in July 2003 as percent of total	56.7

Source: IAEA Energy and Economic Database.
July 2003 – Statistical Bulletin 9/2003

1.1.1. Economic Indicators

The break-up of the USSR in December 1991 and the collapse of demand for Kazakhstan's traditional heavy industry products resulted in a short-term contraction of the economy, with the steepest annual decline occurring in 1994. In 1995-97, the pace of the government programme of economic reform and privatization quickened, resulting in a substantial shifting of assets into the private sector. The Caspian Pipeline Consortium agreement to build a new pipeline from western Kazakhstan's Tengiz oil field to the Black Sea increases prospects for substantially larger oil exports in several years. Kazakhstan's economy again turned downward in 1998 with a 2% decline in GDP due to slumping oil prices and the August financial crisis in Russia. The recovery of international oil prices in 1999, combined with a well-timed tenge devaluation and a bumper grain harvest, pulled the economy out of recession in 2000. The government has embarked upon an industrial policy designed to diversify the economy away from over dependence on the oil sector by developing light industry. Historical Gross Domestic Product (GDP) data are given in Table 2.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1980	1990	2000	2001	2002	July 2003
GDP (millions of current US$)			18,264	17,795	16,983	13,899
GDP (millions of constant 1990 US$)			49,900	51,434	53,193	
GDP per capita (current US$/capita)			1,168	1,146	1,098	

Source: IAEA Energy and Economic Database.
July 2003 – Statistical Bulletin 9/2003

1.1.2. Energy Situation

Kazakhstan, the second largest of the former Soviet republics in territory, possesses enormous fossil fuel reserves (see Table 3) as well as plentiful supplies of other minerals and metals. It also is a large agricultural - livestock and grain - producer. Kazakhstan's industrial sector rests on the extraction and processing of these natural resources and also on a growing machine-building sector specializing in construction equipment, tractors, agricultural machinery, and some defence items.

TABLE 3. ESTIMATED ENERGY RESERVES

	Estimated energy reserves in (Exajoule)					
	Solid	**Liquid**	**Gas**	**Uranium (1)**	**Hydro (2)**	**Total**
Total amount in place	942.20	31.16	66.28	326.84	15.71	1382.19

(1) This total represents essentially recoverable reserves.

(2) For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 2002) by a factor of 10.

Source: IAEA Energy and Economic Database.

Power plants fuelled with coal and black oil are the basis of Kazakhstan's electrical energy. Coal is the country's largest industry, with planned further development if corresponding investments are secured. Coal reserves are estimated at 64 billion tons. Annual hard coal production is about 111.8 million metric tons, brown coal production is estimated at 4.6 million metric tons. Kazakhstan also has a well developed oil and gas industry. More than 1 600 oil and gas fields have been located in Tengiz and Karachaganak containing more than 2.9 billion tons of conditional fuel. Natural gas production was estimated at 5 416 million cubic metres in 1993. Kazakhstan has begun building a major oil pipeline, 1 200 kilometres from the west to the east. Construction of three new oil refineries is planned. Every year, about 25 million tons of liquid hydrocarbons and seven billion cubic meters of natural gas are extracted. About 20% of the world's uranium reserves are in Kazakhstan. Table 4 shows the energy statistics.

TABLE 4. ENERGY STATISTICS(*)

							Average annual growth rate (%)	
	1970	**1980**	**1990**	**2000**	**2001**	**2002**	**1970 To 1990**	**1990 To 2002**
Energy consumption								
- Total (1)				2.87	2.87	2.89		
- Solids (2)				2.03	2.01	2.01		
- Liquids				0.31	0.32	0.32		
- Gases				0.43	0.45	0.46		
- Primary electricity (3)				0.10	0.10	0.10		
Energy production								
- Total				4.76	5.41	5.95		
- Solids				2.73	3.11	3.47		
- Liquids				1.49	1.67	1.76		
- Gases				0.47	0.55	0.64		
- Primary electricity (3)				0.07	0.07	0.07		
Net import (Import - Export)								
- Total				-1.93	-2.44	-3.15		
- Solids				-0.72	-0.97	-1.33		
- Liquids				-1.17	-1.38	-1.66		
- Gases				-0.04	-0.09	-0.16		

(1) Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

(2) Solid fuels include coal, lignite and commercial wood.

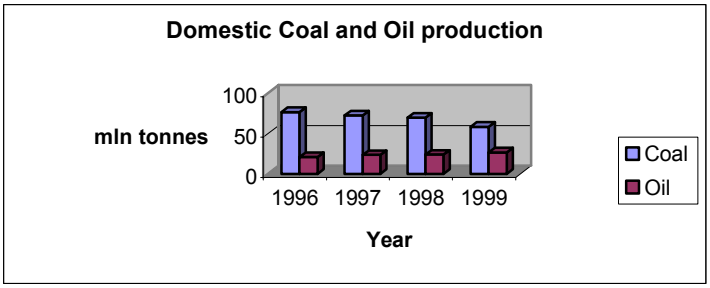
(3) Primary electricity = Hydro + Geothermal + Nuclear + Wind.

(*) Energy values are in Exajoule except where indicated.

Source: IAEA Energy and Economic Database.

1.2. Energy Policy

The energy policy of Kazakhstan aims to achieve energy independence through electric power production with maximum use of its cheap, low-grade coal. Figure 2 shows the production of coal and oil in the last four years.



	Coal (mil. tonnes)	Oil (mil. tonnes)
1998	69.773	23.819
1999	58.378	26.736
2000	74.872	30.648
2001	79.135	36.060

Source: **"Statistical yearbook of Kazakhstan 2002"**, Almaty, 2002

FIG. 2. Domestic Coal and Oil Production

1.3. The Electricity System

The structure of the energy sector of the Republic is shown in Figure 3. The total length of electric lines of all voltages is 460,000 kilometres. The first section of the international Siberia-Kazakhstan-Ural transmission line (1,900 kilometres) has been placed in operation. This line is expanded to the south to connect north and south Kazakhstan and the power grids in Central and Middle Asian countries. Electricity data are given in Tables 5 and 6 and the energy related ratios in Table7.

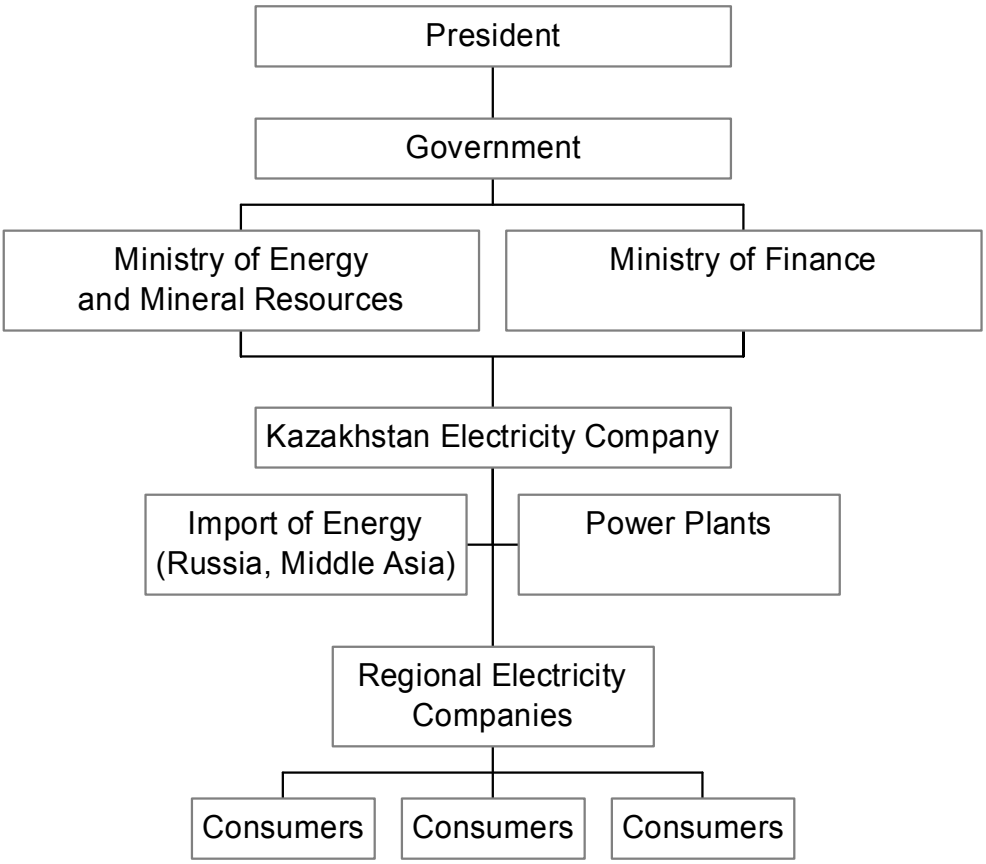


FIG. 3. Structure and management of the energy sector

The biggest producers of electricity in Kazakhstan are - the "Euro-Asian Power Corporation" (in 1998 14% from total power production), the Joint-stock Company "GRES-2" Pavlodar Region (8.9%), the "Kazakhmis Corporation" (8.5%), the Closed Joint-stock Company "Almaty Power Consolidated" (7.8%), the Open Joint-stock Company "Ispat-Karmet" (6,8%), Ltd. "Karaganda Power" (4.4%) and the Joint-stock Company "Aluminium of Kazakhstan" (3.9%).

TABLE 5. ELECTRIC POWER BALANCE

Electric energy, TW·h	1995	1996	1997	1998	1999
Total Production	66.7	57.8	52.3	49.1	47.5
Consumption	73.5	64.0	56.0	53.1	50.3
Export	19.5	11.3	5.61	4.63	5.68
Import	12.0	4.58	1.32	0.68	2.98

Source: Country Information

TABLE 6. INSTALLED CAPACITY OF ELECTRICAL PLANTS (1999)

Source	GW(e)
Thermal, (coal – 79%; gas, black oil – 21%)	16.31
Hydro	2.27
Nuclear	0.07
Total	18.65

Source: Country Information

TABLE 7. ENERGY RELATED RATIOS

							Average annual growth rate (%)	
	1970	1980	1990	2000	2001	2002	1970 To 1990	1990 To 2002
Electricity production (TW.h)								
- Total (1)				51.62	52.02	52.26		
- Thermal				44.09	44.48	44.67		
- Hydro				7.53	7.54	7.60		
- Nuclear								
- Geothermal								
Capacity of electrical plants (GWe)								
- Total				18.89	18.89	18.89		
- Thermal				16.76	16.76	16.76		
- Hydro				2.14	2.14	2.14		
- Nuclear								
- Geothermal								
- Wind								

(1) Electricity losses are not deducted.

Source: IAEA Energy and Economic Database.

2. NUCLEAR POWER SITUATION

2.1. Historical Development and current nuclear power organizational structure

2.1.1 Overview

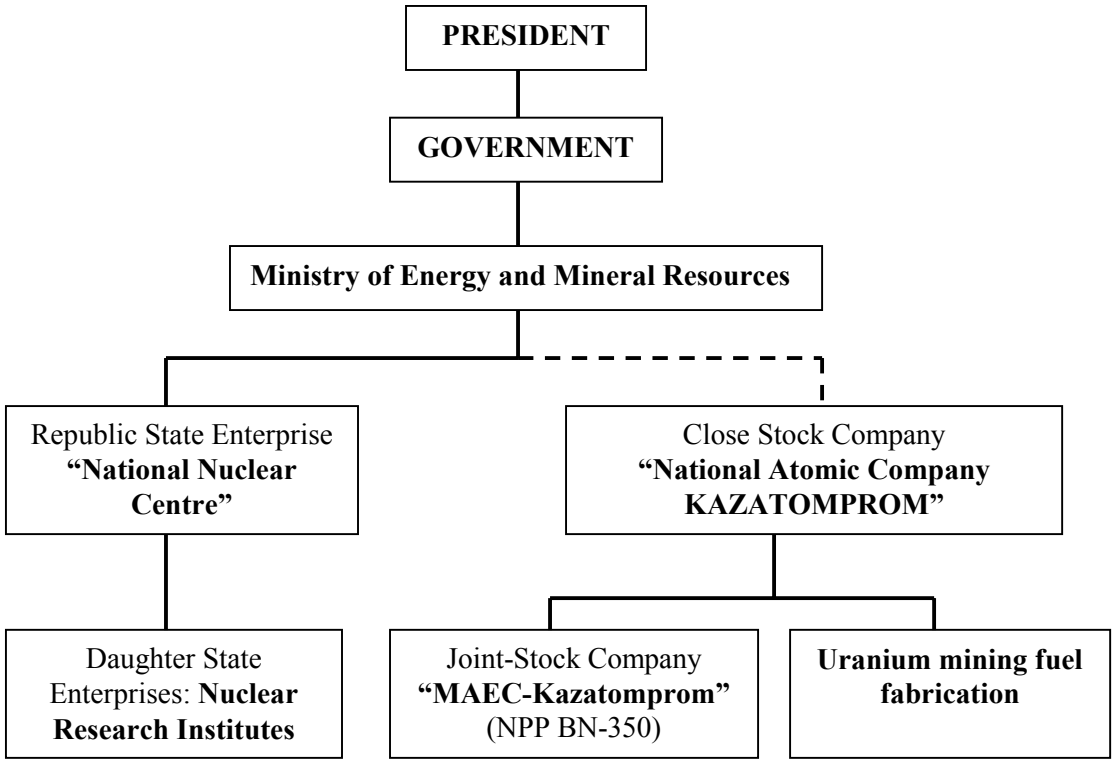
The nuclear scientific industrial complex in Kazakhstan was established as a unified part of atomic industry and science in the former Soviet Union.

Kazakhstan's uranium industry consists of uranium prospecting firms, a number of natural mines using mining and underground leaching techniques, two U_3O_8 production plants at Aktau and Stepnogorsk, and a metallurgical plant producing metaloceramic fuel pellets for RBMK and VVER reactor fuel assemblies. The power plant at Aktau (MAEK) has been shut down in June 1999 and defuelling took place in October 2000. It consisted of natural gas units and a nuclear unit. The latter unit is a BN-350 fast neutron reactor with sodium coolant.

On the territory of the former Semipalatinsk Nuclear Test Site, three research reactors are engaged in testing and development of nuclear space engines and safe nuclear power plants. In 1992, the National Nuclear Centre was created (based on Semipalatinsk reactors) along with the Institute of Nuclear Physics in Almaty.

2.1.2. Current Organizational Chart(s)

Figure 4 shows the institutional organization of the nuclear industry in Kazakhstan



Source: Country Information

FIG. 4. Institutional Organization of the Nuclear Industry in Kazakhstan

2.2. Nuclear Power Plants: Status and Operations

2.2.1. Nuclear reactor

Type:	BN-350, sodium-cooled fast breeder reactor
Location:	Aktau (former Shevchenko) at the coast of the Caspian Sea, in western part of Kazakhstan
Operator:	Joint-Stock Company **"MAEC-Kazatomprom"**
Units:	One
Total capacity:	520 MW (thermal)
Start of operation:	1972
Fuel:	Uranium enriched to 17%, 21%, and 26%
Status:	The plant is shutdown since June 1999 and defuelling took place in October 2000.

Source: Country Information

The BN-350 reactor has been shutdown in June 1999, after a decision by the Government of the Republic of Kazakhstan had been taken in April 1999, to decommission the BN-350. An International Workshop on Decommissioning Planning had been held in Kazakhstan in May 1999. A plan of high-priority nuclear safety measures had been developed prior to a safe storage period. Preparation works for sodium cleaning and draining are going ahead (technologies, documentation, etc.). Activities on spent fuel management under a US – Kazakhstan agreement (packaging, stabilization etc.) have been finished.

2.2.2. Research reactors

Type:	WWR-K, water cooled, moderated and reflected tank-type reactor
Location:	Alatau, near Almaty
Operator:	Owned by the National Nuclear Centre (NNC) and operated by the Institute of Nuclear Physics (INP)

Total capacity:	10 MW
First criticality:	1967
Fuel:	U-A1 fuel with a U-235 enrichment of 36%
Type:	IGR, impulse homogeneous uranium-graphite thermal neutron reactor with graphite reflector
Location:	Kurchatov (former Semipalatinsk-21)
Operator:	Owned by the National Nuclear Centre and operated by its Institute of Atomic Energy (IAE)
Start operation:	1961
Fuel:	Enriched to over 90% U
Heat release:	Maximum 5,2 Gjoules (1 GJ in a pulse)
Neutron flux:	Maximum thermal $0.7 \times 10^{17} cm^{-2} s^{-1}$

Type:	EWG1.M, thermal light water heterogeneous vessel reactor with light water moderator and coolant, beryllium reflector
Location:	Baikal Test Facility, Kurchatov (former Semipalatinsk-21)
Operator:	Owned by NNC and operated by IAE
Total capacity:	60 MW (thermal)
First criticality:	1972
Fuel:	U-Zr fuel with U-235 enrichment of 90%
Neutron flux:	$1.7\text{-}3.4 \times 10^{14} cm^{-2} s^{-1}$

Type:	RA thermal neutron high temperature gas heterogeneous reactor with air coolant, zirconium hydride moderator, beryllium reflector
Location:	Baikal Test Facility, Kurchatov
Operator:	Owned by NNC and operated by IAE
Total capacity:	up to 0.4 MW
First criticality	1986, now is in extended shutdown
Fuel:	Ampoule bodies with 90%U-235 enrichment, the core has been discharged and the fuel has been returned to Russian Federation
Neutron flux:	Up to $5 \times 10^{12} cm^{-2} s^{-1}$

Source: Country Information

2.3. Supply of NPPs

A joint resolution on nuclear safety and technical support for nuclear energy facilities in Kazakhstan was signed between KAEA and Russian Federation's Ministry of Atomic Energy.

The BN-350 reactor was designed and constructed by organizations of the former Soviet Union, under the supervision of the Ministry of Atomic Energy (MINATOM). The chief scientific supervisor is the Institute of Physics and Power engineering (IPPE, Obninsk). The chief designer is the Experimental Design Bureau on Machinery Building (OKBM-N, Novgorod), and main constructor is the All Russian Scientific Research and Design Institute for Power Technologies (VNIIPIET, Saint-Petersburg). The plant is operated by Joint-Stock Company "MAEC-Kazatomprom". At the present, the regulatory body supervising the plant safety is the Kazakhstan Atomic Energy Committee (KAEC).

2.4. Operation of NPPs

The BN-350 reactor is owned by Close Stock Company "National Atomic Company KAZATOMPROM" and operated by Joint-Stock Company "MAEC-Kazatomprom". About 500 people are working at the power plant, organized to two sections: the Operations Section with shift teams and technical division; and, the Maintenance Section divided into seven divisions. MAEC-Kazatomprom nuclear power plant has six shifts, each shift containing 24 people (radioprotection not included). Sixteen of these shift workers are for surveillance and early maintenance. The required qualifications for each person are specified. Periodic (every one to three years) examinations to confirm the competence of the personnel, including the plant management, are administered by KAEA. Examinations for reactor operators are given by a plant committee. The plant is shutdown as mentioned earlier.

Special training for each new staff member includes classroom instruction, on the job training, and examinations at appropriate intervals. Nuclear plant procedures are prepared in written form for all normal operations and for foreseeable accidents. These procedures are revised every three years. There is no simulator at BN-350.

2.5. Fuel Cycle and Waste Management

Kazakhstan has more than 50 uranium deposits in six provinces: the Kokshetau province in the north and the Pribalkhashsky province in the south have endogenetic type uranium deposits; Iliskay, Chu-Sarusu, Sur-Darya, and Prikaspiy provinces have endogenic type deposits. Deposits in Chu-Sarusu and Sur-Durya provinces are located in sand penetrating sediments and are useful for in-situ leaching processes.

Waste from uranium mining and milling constitutes more than 90% of all radioactive waste in Kazakhstan. Therefore, implementation of the Republic's Concept on the radioactive waste management is the main task.

The Open Stock Company **"Ulba Metallurgical Plant"** (UMZ) started production of UO_2 fuel pellets in 1976. Physical and chemical technologies are used at all stages of production, from treatment of UF_6 material, to conversion into UO_2, production of UO_2 pellets, and sintering of the pellets. Quality control is maintained during all process stages. The design capacity of the plant is 2,000 tons of pellets per year. Fuel assemblies from UMZ are used at nuclear power plants in Russia, the Ukraine, and other countries. The U^{235} content is 1.6-4.4%. UMZ also produces rare earth metal products and super conducting materials.

2.6. Research and Development

Kazakhstan has four research reactors at the National Nuclear Centre where the following research is carried out:

i) radiation material science; study of the interaction between construction materials and coolants; investigation of fission produced emission from fuel rods, its precipitation and filtration under different conditions;
ii) safety of nuclear power plants; fuel assemblies and rod tests at transition and break-down modes of operation; simulation of reactor core fragment melting and interaction of melted material with coolant;
iii) development and implementation of nuclear physics methods and technologies; production of isotopes for different applications, for example, thallium-201 chloride for early diagnostics of heart decease.

2.7. International Co-operation and Initiatives

In 2000-2002, Kazakhstan has activities in two the national project "Nuclear Power Siting" (KAZ/9/006).

Also, there are efforts under the Co-ordinated Plan of Technical Support of the Republic Kazakhstan to establish a national system for nuclear materials accountancy, control and physical protection as detailed by the International Atomic Energy Agency.

3. NATIONAL LAWS AND REGULATIONS

3.1. Safety Authority and the Licensing Process

The Kazakhstan Atomic Energy Committee (KAEC) is the Nuclear Regulatory Body of the Republic of Kazakhstan. The following laws and regulations determine the procedure for licensing:

- Law on licensing;
- Law on use of nuclear energy;
- Regulations on licensing of the activity connected with atomic energy use.

The licensing stages for nuclear installations can be briefly represented as follows:

- License demand (submission of application documents);
- KAEC decision on the demand control;
- Analysis of substantiating materials of demand;
- Inspection at the nuclear installation;
- Conclusion on substantiating materials examination;
- Conclusion on nuclear installation inspection;
- General conclusion on obtaining license;
- License.

3.2. Main National Laws and Regulations in Nuclear Power

The following laws are relevant for nuclear energy:

- Law on the use of nuclear energy;
- Law on radiation protection of the Kazakh population;
- Law on licensing;
- Regulations on licensing of activity connected with atomic energy use;
- Regulation on the Atomic Energy Committee of the Republic of Kazakhstan.

All regulating documents have been compiled into a "List of main technical documents of the Republic of Kazakhstan in the field of atomic energy use". The programme of developing atomic legislation implies two basic laws:

- Law on radioactive waste management;
- Law on export-import control (new version).

4. CURRENT ISSUES AND DEVELOPMENTS ON NUCLEAR POWER

4.1. Energy Policy

The current policy in the field of atomic energy emphasizes:

i) maintenance of existing facilities in accordance with international safety standards;
ii) support of scientific, technical, design and construction connections with Russian Federation and other CIS countries and establishing contacts with international organizations;
iii) creation of state system of accountancy and control of nuclear materials in accordance with Non-Proliferation Treaty obligations and Agreement on Safeguards that is expected to be ratified by Presidential Decree in the near future;
iv) improvement of regulations for congruence with other CIS regulations;
v) liquidation of results of nuclear explosions;
vi) creation of a radioactive waste storage and disposal system.

REFERENCES

[1] IAEA Energy ands Economic data base (EEDB)

[2] IAEA Power Reactor Information System (PRIS)

[3] Data & Statistics, the World Bank, www.worldbank.org/data

Appendix 1

INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

AGREEMENTS WITH THE IAEA

• NPT related agreement INFCIRC/504	Entry into force:	11 August 1995
• Additional protocol	Not signed	
• Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	25 March 1997
• Agreement on privileges and immunities	Entry into force:	9 April 1998

OTHER RELEVANT INTERNATIONAL TREATIES etc.

• NPT	Entry into force:	14 February 1994
• Convention on physical protection of nuclear material	Non Party	
• Convention on early notification of a nuclear accident	Non Party	
• Convention on assistance in the case of a nuclear accident or radiological emergency	Non Party	
• Vienna convention on civil liability for nuclear damage	Non Party	
• Joint protocol	Non Party	
• Convention on nuclear safety	Signed	20 September 1996
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Signed	29 September 1997
• ZANGGER Committee	Non Member	
• Nuclear Export Guidelines	Not adopted	
• Acceptance of NUSS Codes	Not accepted	

BILATERAL AGREEMENTS

- The Agreement between the Russian Federation and the Republic of Kazakhstan on the Peaceful use of Atomic Energy.
- The Agreement between the Russian Federation and the Republic of Kazakhstan on Transportation of fission materials.

- Agreement of KAEA and GAEN of the Russian Federation on co-operation in the field of nuclear safety.

- Agreement of KAEA and NRC of the USA on technical information exchange and co-operation in the field of nuclear safety.

- The Agreement for Co-operation between the United States of America and the Republic of Kazakhstan concerning Peaceful uses of nuclear energy.

- The Agreement for co-operation between European Atomic Energy Community and the Republic of Kazakhstan in the field of nuclear safety

Appendix 2

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL ATOMIC ENERGY AUTHORITIES

Atomic Energy Committee
of the Ministry of Energy and Mineral
Resources of the Republic of Kazakhstan
Lisa Chaikinoi St. 4
Almaty, 480020
Tel: 7 3272 646 701
Fax: 7 3272 633 356
Email: adm@atom.almaty.kz

Nuclear Technology Safety Centre
Lisa Chaikinoi St. 4
Almaty, 480020
Tel: 7 3272 646 801
Fax: 7 3272 646 803

OTHER RELEVANT ORGANIZATIONS

Institute of Radiation Safety and Ecology
of the National Nuclear Centre
Krasnoarmejskaya St. 4
Vostochno-Kazakhstanskaya oblast,490021

Institute of Atomic Energy
of the National Nuclear Centre
Krasnoarmejskaya St. 10
Vostochno-Kazakhstanskaya oblast,490021
Tel: 7 3225 123 858
Fax: 7 3272 338 585

Institute of Nuclear Physics
of the National Nuclear Centre
Ibragimova St.1
Almaty , 480082
Tel: 7 3272 546 467
Fax: 7 3272 546 417

Republican State Enterprise
Mangyshlak Atomic Energy Complex
Aktau
Mangistauskaya oblast', 466210
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of Experimental and Theoretical Physics
Tole bi St. 1
Almaty, 480082

State Corporation for Atomic Energy
and Industry "KATEP"
Vogenbaj Batyra St. 168
Almaty, 480012
Tel: 7 3272 691 917
Fax: 7 3272 506 288

Joint Stock Company
"KAZATOMPROM"
Vogenbaj Batyra St. 168
Almaty, 480012
Tel: 7 3272 675306
Fax: 7 3272 503541
http://www.kazatomprom.kz/

Joint Stock Company
"ULBA"
Abai St. 102
Ust-Kamenogorsk, 492026
Tel: 7 3232 407 707
Fax: 7 3232 473 642
http://www.pjsc-ulba.com/eng/index.htm