UKRAINE

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1. GENERAL INFORMATION.

1.1. General Overview

Ukraine is a sovereign state in Eastern Europe. It has its own territory, higher and local bodies of State power (the Supreme Rada and Local Soviets), Government, national emblem and a state flag). The capital of the Ukraine is Kiev, which has a population of about 3 million. There are 24 administrative regions, one autonomous republic (Crimean autonomous republic) and two municipalities in Ukraine. Ukraine is bounded on the north by Belarus, on the northeast by the Russian Federation, on the west by Poland, Slovakia, on the southwest by Hungary, Romania, and Moldova, and on the south by the Black Sea and the Sea of Azov.

The total area of Ukraine is 603,700 square km. The area spans from west to east 1,300 km and from north to south 900 km. Ukraine's state border extends for a total of 7,698 km: with Russia - 2,484 km; Belarus - 952 km; Romania - 608 km; Poland - 542 km; Slovakia - 98 km; Hungary - 132 km; Moldova - 1,194 km. The total length of Ukraine's seacoast is 1,758 km (Black Sea - 1,533 km; Sea of Azov - 225 km).

Ukraine has a moderate-continental climate; in the southern most region of the Crimea the climate is sub-tropical. The largest river of Ukraine is the Dnipro. Its length is 2,201 km, of which 981 km flows through Ukraine. The largest mountainous area (the Carpathian Mountains) in Ukraine is more than 270 km long and about 100 km wide. The highest peak is the Hoverla (2061 m).

The population of Ukraine is about 50.1 million (Table 1): 80% of the population is Ukrainian, the remaining 20% is Russian, Belarussian, Jew, Crimean, Tatar, Moldavian, Polish, Hungarian, Rumanian, Greek, German, Bulgarian or representatives of other numerically small nationalities. The urban population comprises 68% of the total population and the population density is 83 people per square km.

TABLE 1. POPULATION INFORMATION

									Growth rate (%)
	1960	1970	1980	1990	1998	1999	2000	2001	1980 to 1998
Population (millions)	42.5	47.1	49.9	51.8	51.3	50.1	49.7	49.3	0.02
Population density (inhabitants/km²)	69	78	83	86	85	83	82.3	81.7	0.0
Urban population as percent of total	47	55	62	67	68	68	68	68	0.5
Predicted population growth rate (%) 1998 to 2000	0.0								
Area (1000 km²)	603.7								

Source: IAEA Energy and Economic Database; Country Information.

The Ukraine is one of the largest republics of the former Soviet Union. As a constituent member of the USSR, the Ukrainian republic, in accordance with the Soviet Constitution, formally enjoyed certain rights and features of a sovereign state: territory, organs of state power and administration, budget, state emblem, flag, national anthem, and Constitution. In 1944, in accordance with a decision of the Supreme Council of the USSR, the Union republics, including the Ukrainian SSR, were granted the right to conduct their own foreign relations. One year later, the Ukrainian SSR became a founding member of the United Nations. Despite its dependence on Union decision and structures, the international status of Ukraine as a state in its own right increased over the years. During the period of 1944-1990, Ukraine was a signatory of 156 international treaties, a member of 16 international organizations, and participated in the work of approximately 60 permanent and interim international organs.

On 16 July 1990, the Supreme Soviet of Ukraine adopted an important historic document - the Act proclaiming Ukrainian state sovereignty, independence and indivisibility of power within the boundaries of Ukrainian territory, and independence and equality in conducting foreign relations. On 24 August 1991, the Verkhovna Rada, in effecting this Declaration and proceeding from the right to self-determination, proclaimed the act of independence of Ukraine. Its territory was proclaimed indivisible and inviolable and the Constitution and laws of Ukraine have exclusive validity. On 1 December 1991, an all-Ukrainian referendum was held. Results of this national referendum indicated that more than 90% of the population favoured independence. Leonid Kravchuk, the former head of the Supreme Rada of Ukraine was elected President of Ukraine.

On 28 June 1996, a new Constitution was adopted in accordance with which Ukraine was proclaimed an independent republic consisting of the autonomous Crimea Republic and 24 administrative regions. The State is headed by a president who acts on behalf of the State. He is elected by citizens of Ukraine on the basis of the universal, equal and direct voting through secret election for a 5 years period and not more than for 2 successive terms. The uniform legislative authority is the Parliament - Verkhovna Rada of Ukraine (Supreme Soviet of Ukraine). The higher level of the executive authority is the Cabinet of Ministers of Ukraine. The Ukrainian is only source of power, the possessor of the power and sovereignty in the State. The main national holiday is Independence Day, 24th of August, when the independence of Ukraine was proclaimed.

1.2. Economic Indicators

Table 2 shows the historical Gross Domestic Product statistics.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	Growth rate (%) 1992 to 1998
GDP [1]	24,197	32,666	37,973	37,011	44,558	50,150	41,883	31,581	31,792	31.8
GDP [2] per capita	473	597	731	720	872	989	829	630	640	33.0
GDP by sector (%):										
-Agriculture	20	20	15	15	13	14	14	13	14	-16.3
-Industry	42	28	38	34	31	28	28	33	34	-18.4
-Services	31	45	40	43	49	51	52	49	47	29.5
-Construction and Utilities	7	7	7	8	7	7	6	5	5	-7.4

[1] Millions of current US$.
[2] Current US$ per capita.
Source: IAEA Energy and Economic Data Base; Country Information.

1.3. Energy Situation

The estimated energy resources are shown in Table 3. The historical energy supply and demand data are given in Table 4. The decrease in electric power production and coal mining continued (Table 5), as well as the import of energy sources. These facts lead to a lower supply of energy resources to the national economy. Table 6 shows the specific fuel consumption by the various sectors.

TABLE 3. ESTIMATED ENERGY RESERVES

Exajoule

	Solid	Liquid	Gas	Uranium [1]	Hydro [2]	Total
Total amount in place	971.69	9.11	37.85	45.86	4.34	1068.86

[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 - 1998) by a factor of 10.
Source: IAEA Energy and Economic Data Base.

TABLE 4. ENERGY STATISTICS

Exajoule

	1970	1980	1990	1993	1994	1995	1996	1997	1998	1999	2000
Energy consumption											
- Total [1]	N/A	N/A	N/A	7.5	6.2	5.8	5.4	5.0	4.8	4.9	4.7
- Solids [2]	N/A	N/A	N/A	2.95	2.07	1.99	1.62	1.48	1.42	1.47	1.48
- Liquids	N/A	N/A	3.07	0.79	0.82	0.67	0.62	0.58	0.61	0.58	0.42
- Gases	N/A	N/A	4.13	3.42	3.00	2.81	2.89	2.67	2.47	2.56	2.45
- Primary electricity [3]	0.04	0.10	0.31	0.31	0.30	0.29	0.32	0.32	0.33	0.33	0.32
Energy production											
- Total	7.7	7.1	5.4	3.9	3.4	3.1	2.8	3.0	2.9	3.1	3.0
- Solids	4.84	4.61	3.86	2.71	2.21	1.96	1.65	1.80	1.80	1.91	1.89
- Liquids	0.62	0.34	0.24	0.19	0.19	0.18	0.18	0.18	0.18	0.17	0.17
- Gases	2.18	2.03	1.01	0.69	0.66	0.65	0.66	0.65	0.64	0.65	0.64
- Primary electricity [3]	0.04	0.10	0.31	0.31	0.30	0.29	0.32	0.32	0.33	0.33	0.32
Net import (import - export)											
- Total	N/A	N/A	N/A	2.21	2.50	4.94	N/A	N/A	N/A	N/A	N/A
- Solids	N/A	N/A	N/A	0.00	0.01	0.06	N/A	N/A	N/A	N/A	N/A
- Liquids	N/A	N/A	N/A	0.00	0.00	0.09	N/A	N/A	N/A	N/A	N/A
- Gases	N/A	N/A	N/A	2.21	2.49	4.79	N/A	N/A	N/A	N/A	N/A

[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.
Source: IAEA Energy and Economic Data Base; Country Information.

TABLE 5. DOMESTIC ENERGY PRODUCTION

Resources	Unit	1992	1993	1994	1995	1996	1997	1998	1999	2000
Electricity	TW·h	252.5	229.9	202.9	194.0	183.0	178.0	172.8	172.1	171.4
Annual growth rate	%		-9.0	-11.7	-4.4	-5.7	-2.7	-2.9	-0.4	-0.4
Oil, including gas condensate	mln ton	4.5	4.2	4.2	4.1	4.1	4.1	3.9	3.8	3.7
Annual growth rate	%		-6.7	0.0	-2.4	0.0	0.0	-4.9	-2.6	-2.6
Natural Gas	bln cubic metre	20.9	19.2	18.3	18.2	18.4	18.1	17.9	18.1	17.9
Annual growth rate	%		-8.1	-4.7	-.06	1.1	-1.6	-1.1	1.1	-1.1
Coal	mln ton	133.7	115.8	94.6	83.8	70.5	76.9	77.0	81.7	81.0
Annual growth rate	%		-13.4	-18.3	-11.4	-15.9	9.1	0.1	6.1	-0.9

Source: Country Information.

Among the primary energy sources used worldwide — oil, coal, gas and uranium - Ukraine possesses sufficient reserves of only two of them, namely: coal and uranium. The Coal Industry of Ukraine is based on substantial enough coal reserves that are able to cover Ukraine's needs for 200—300 years. Taking into account these reserves as well as the availability of substantial energy capacities using the coal as a primary energy source, the future leading role of coal is projected within the energy sector of Ukraine. At the same time, the very important aspect should be taken into account that more than 40% of electric power in Ukraine is produced by nuclear power plants, but only 30% of needs for raw components required for nuclear fuel manufacturing is produced in Ukraine (natural uranium concentrate). However, Ukraine has all opportunities for providing national nuclear power plants with domestic raw materials. For the total uranium reserves, Ukraine is in the first ten of countries. The majority of its reserves were widely explored, that defines their high level of preparedness to the commercial mining.

1.4. Energy Policy.

The energy policy of Ukraine and its top priorities are established in the "National Energy Programme of Ukraine for the period till 2010" (NEP). This programme approved by the Verkhovna Rada (Parliament) on 15 May 1996 includes the following main tasks:

TABLE 6. SPECIFIC FUEL CONSUMPTION

1994					
Fuel type	Total in Ukraine	Sector (%)			
		Industry	Construction	Agriculture	Transport
Coal, 10^6 ton	88.5	86.5	0.4	1.3	0.8
Gas, 10^9 m^3	83.6	66.9	0.9	2.2	4.1
Oil and Gas condense, 10^6 ton	18.3	100	-	-	-
Crude oil, 10^3 ton	8947.4	88.6	1.2	1.5	3.9
Furnace Fuel domestic use, 10^3 ton	208.8	27.2	4.6	16.8	5.7
Peat, 10^3 ton	902.8	96.3	-	0.2	0
Firewood for heating, 10^3 m^3	2567.7	32.8	0.4	13.2	1.7
1996					
Fuel type	Total in Ukraine	Sector (%)			
		Industry	Construction	Agriculture	Transport
Coal, 10^6 ton	69.3	90.9	0.3	0.9	1
Gas, 10^9 m^3	80.5	58.5	0.4	1.2	5.4
Oil and Gas condense, 10^6 ton	13.7	99	0.1	0	0
Crude oil, 10^3 ton	5223.9	87.5	1.1	0.8	6.6
Furnace Fuel domestic use, 10^3 ton	14.8	33.1	13	12.4	4.2
Peat, 10^3 ton	875.7	98.9	0	0.9	0.1
Firewood for heating, 10^3 m^3	2261.3	26.6	0.5	14.5	1.9
1998					
Fuel type	Total in Ukraine	Sector (%)			
		Industry	Construction	Agriculture	Transport
Coal, 10^6 ton	60.8	89.6	0.2	0.5	0.7
Gas, 10^9 m^3	71.1	53.9	0.3	0.7	6.4
Oil and Gas condense, 10^6 ton	13.7	99.0	0.1	0.0	0.0
Crude oil, 10^3 ton	3381.9	88.4	1.2	0.6	4.1
Furnace Fuel domestic use, 10^3 ton	87.8	36.4	12.1	9.3	5.7
Peat, 10^3 ton	527.5	96.3	0.0	0.0	-
Firewood for heating, 10^3 m^3	2484.3	5.2	0.4	3.9	0.6
1999					
Fuel type	Total in Ukraine	Sector (%)			
		Industry	Construction	Agriculture	Transport
Coal, 10^6 ton	63	90.9	0.2	0.3	0.6
Gas, 10^9 m^3	71.5	56	0.2	0.6	6.9
Oil and Gas condense, 10^6 ton	13.3	99.8	0.1	0.0	0.0
Crude oil, 10^3 ton	2124.6	84.3	1.5	0.9	6.0
Furnace Fuel domestic use, 10^3 ton	79.1	40.5	12.2	10	13.6
Peat, 10^3 ton	502.8	96.5	0.0	0.0	0
Firewood for heating, 10^3 m^3	2373.5	4.2	0.3	3.4	0.8
2000					
Fuel type	Total in Ukraine	Sector (%)			
		Industry	Construction	Agriculture	Transport
Coal, 10^6 ton	63.3	92.6	0.2	0.2	0.6
Gas, 10^9 m^3	68.4	57.8	0.2	0.4	6.5
Oil and Gas condense, 10^6 ton	9.4	99.7	0.2	0.0	0.0
Crude oil, 10^3 ton	1222.4	80.3	2.0	1.7	8.3
Furnace Fuel domestic use, 10^3 ton	82.1	41.1	10.5	10.8	2.6
Peat, 10^3 ton	416.9	96.6	0.0	0.0	0.0
Firewood for heating, 10^3 m^3	2572.5	3.6	0.3	2.7	0.9

Source: Country Information.

- solution of the problems related to a stable and reliable supply of fuel and energy resources in order to meet Ukraine's demand;
- decrease in foreign economic dependence of fuel and energy resources;
- wide and large-scale implementation of energy saving technologies;
- expansion of utilization of non-conventional energy sources;
- decrease in harmful effects on the environment of the fuel-energy complex's sectors;
- expansion of the share of extra budgetary sources for programme financing, due to the budgetary deficit and because of the development of market relations;
- development of domestic basis for machinery building to meet the fuel-energy complex's needs.

In accordance with the NEP of Ukraine, it is planned to decrease the import of energy sources by 69 Mt compared to 1990 imports. Till 2010, coal mining has to increase its production to 170 Mt that will ensure and meet the needs in Ukraine for solid fuels. Domestic extraction of oil is expected to increase to 7.5 Mt and that of natural gas to 35.3 billion m^3 by 2010. Currently, the reliability of the Ukraine power supply depends on imported energy. Domestic supply of fuel-energy resources (FERs) covers approximately 40% of the Ukrainian energy needs. The main FERs are imported either from Russia directly or through their territory.

Hence, one of the most important and complicated tasks of the state is the provision of reliable and effective FERs. Implementation of this task requires the development of a real long-term national energy policy for supply of FERs. Decisions are needed in the following areas:

- creation of stable conditions for activities on the fuel and electricity market: legislative and normative base, taxation system, state regulation mechanism and so on;
- overcoming the financial crisis due to non-payment and account exchange removal;
- creation of conditions for investment of domestic fuel-energy complex development, diversification of power supply resources, energy saving and increase of FER efficiency;
- direction on priorities with regard to supply of FERs and provision (assistance) of state mechanism for their realization.

In order to adequately implement the task, it is very important to provide self-financing conditions for developing projects on FERs and not to accept the possibility of foreign credits as investment source. According to the President Order №42/2001 from 27.02.2001, the Ukrainian Energy Strategy has been developed for the period until 2030. The strategy includes programmes for the electricity, coal, nuclear and oil-and-gas industry.

2. ELECTRICITY SECTOR.

2.1. Structure of the Electricity Sector

Electricity generation is the basic branch of industry in any country, within any economic system. Electricity generation is used as a production factor for the other branches of the national economy and in many respects defines competitiveness of energy consuming products and services. A stable and reliable energy system is the basis for national economic and political safety.

The installed electrical capacity is currently 53.8 GW (e) of which 67% is thermal power 24% nuclear power and 9% hydropower. Table 7 lists the major electric power plants. Moreover, the electricity sector comprises 20 000 kilometres of 220-750 kV trunk transmission lines, more than 100 000 kilometres of 35, 110, 154 kV distribution networks and more than 800 000 kilometres of 0.4—10 kV distribution networks. Mostly, thermal power plants capacities were put into operation in the 1960-70s and have actually exhausted its resource. Wear of main equipment is continuously intensive due to use of low quality fuel, operation of the equipment on the fuel and in the modes that are not provided for by design, lack of funds for reconstruction and maintenance of equipment.

TABLE 7. MAJOR POWER PLANTS

Power Plant/Fuel type	Name of station	Number of units times unit electrical capacity pcs*MW	Installed capacity of station MW
Nuclear Power Plants	Zaporozhe NPP	6*1000	6 000
	South-Ukraine NPP	3*1000	3 000
	Rovno NPP	1*1000	1 835
		1*420	
		1*415	
	Khmelnitski NPP	1*1000	1 000
Major Thermal Power Plants	Vuglegirska	3*800	3 600
		4*300	
	Zaporizhye TPP	3*800	3 600
		4*300	
	Kryvorizka	10*282	2 820
	Burshtyn	8*195	2 300
		4*185	
	Zmiiv	4*275	2 150
		6*175	
	Ladyzhyn	6*300	1 800
	Trypilia	6*300	1 800
	Starobesheve	10*175	1 750
	Prydniprovska	4*285	1 740
		4*150	
	Sloviansk	1*800	1 700
		1*100	
		1*720	
		1*80	
	Lugansk	8*175	1 500
		1*100	
	Kurakhove	6*210	1 460
		1*200	
	Zuivska	4*300	1 200
	Dobrotvor	3*100	600
		2*150	
Major Hydroelectric Power Plants	Kyiv HaPP	3*41,5	236
		3*37,0	
	Kyiv HPP	16*18,5	361
		4*16,3	
	Kaniv HPP	24*18,5	444
	Kremenchuk HPP	12*52,0	625
	Dniprodzerzhynsk HPP	8*44,0	352
	Dnieper HPP	6*113,1	1 538
		2*104,5	
		9*72,0	
		1*2,6	
	Kakhovka HPP	6*58,5	351
	Dniester HPP	6*117,0	702

Nuclear power plants have already reached 50% of their designed service life. New capacities have not been put into operation for the latest 10 years (with the exception of unit 6 at Zaporozhe NPP). It can be expected that within the next 10 years two nuclear units will be put into operation. Equipment at the majority of the thermal and hydroelectric plants is obsolete and has a low efficiency. Measures on nuclear power plant safety improvement are required. Thus one half of the installed capacities should be written off, another half could be still operated for 10-20 years if refurbishment and modernization activities would start immediately.

Recently, the prices for fuel that constitute to the main part of electricity generation costs, have grown sharply and reached the world market level. This in the situation where 85 % of the fuel oil and

100 % of the nuclear fuel are imported. The price for coal that is extracted in Ukraine is higher than the price for coal at the markets of neighbouring countries due to its low quality and high cost of extraction. High prices and the need of cash payments for imported fuel with insufficient funds available limit the amount of fuel purchases. The other variable recourses (e.g. labour) are less evident at this background but may become a decisive factor in the future.

Since 1991, electricity generation in Ukraine has been functioning under conditions of political and economic reforms. Reduction of fixed capital and floating stock, consumers inability to pay, excessive social orientation of price and tariff formation policy of the State, are the factors that complicate the market reforms and make adaptation to the work under market conditions more difficult. With the start of reforms in the national economy of Ukraine, the Ministry of Energy developed the principles of reforming the industry and electricity market. The reforms should ensure the integrity of the unified energy system, competition between generating companies, privatization and creating conditions attractive for investments.

It was envisaged to transfer from the expense-based mechanism of price formation to the mixed scheme with a competitive mechanism at the wholesale and retail markets as well as a controlled component for transmission and distribution. Thus, the retail price should have been formed as a sum of the wholesale price that is freely formed by the market, and regulated tariffs for transmission and distribution to the consumer. The regulation of the wholesale and retail price has not been envisaged.

The National Commission on the Energy Issues, set in 1994 by President's Decree № 738 dated 8 December 1994, was reorganized into the National Energy Regulation Commission (NERC) by President Decree № 335/98 dated 21 April 1998. This Commission took under state control all the activities in the energy sector. Recent practice is such that the documents issued by the NERC establish tariffs of power-generating companies, tariffs used by Oblenergos, and retail prices of electricity. Naturally, with such arrangement the profits of market participants are redistributed.

In view of the non-payments for consumed electricity, two markets working in different environments have been formed in Ukraine. They are the electrical energy market itself, where electricity is being sold and purchased, and the market of debts for consumed power. Amount of sales on the first market in 2000 was 58% (recently, it amounted only to 15-20%). The electricity that had been consumed but was not timely paid for constitutes the other portion. This gives rise to the origin of various forms of obligations, e.g. promissory notes. There exist numerous structures that sell such debt obligations and pay the producers with actual resources, including money. Here, only a portion of the value of produced (consumed) electricity is returned.

Such situation gives rise to two prices of electricity and two pricing mechanisms. Obviously, in the absence of normal tools of circulation of promissory notes, lack of transparency of the market of debts for consumed power and absence of any rules of its functioning, such market is less subject to the State influence but at the same time is more controllable by major intermediaries. The electricity sector can be summarized as follows:

- The status of fixed assets in the traditional power sector is critical and requires huge and long-term investments;
- In the short-term run, production of electricity is defined by the status of payments for consumed electricity, i.e. by availability of floating assets required for purchasing variable production factors;
- Under conditions of non-payments, the market of debts for consumed power has emerged in Ukraine. The market of debts for consumed power is alternative with respect to the wholesale market of electricity.

Figure 1 shows the structure of electric power sector and Figure 2 a diagram of the wholesale electricity market. Figure 3 presents a list of the Ukrainian power generating companies and Figure 4 lists the electricity distribution companies.

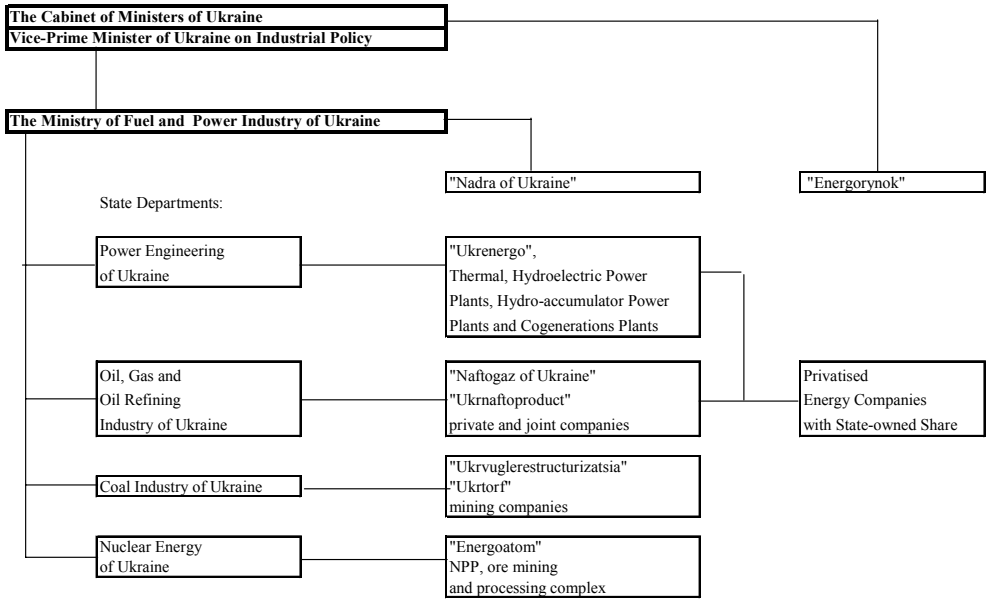
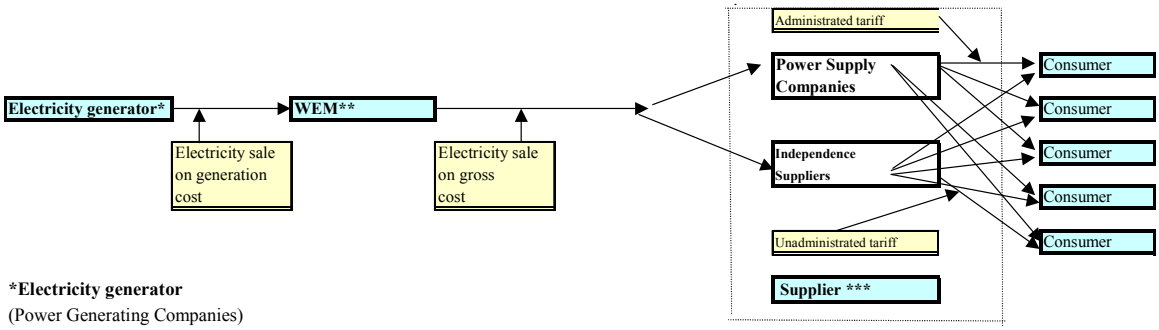


FIG. 1. Structure of the Ukrainian electric power sector (status end of 2000)



***Electricity generator**
(Power Generating Companies)
which gets a licence on
implementation of entrepreneurial
activity on electricity generation

**** WEM- Wholesale Electricity Market**
State Enterprise "Energorynok"
which has a licence on
implementation of entrepreneurial
activity on gross electricity supply

***** Supplier**
(Power Supply Companies and Independence Suppliers)
which had recieved a licence on
activity on gross electricity delivery
with Administared / Unadministared tariff

FIG. 2. The Wholesale Electricity Market (WEM) in Ukraine (status end of 2000)

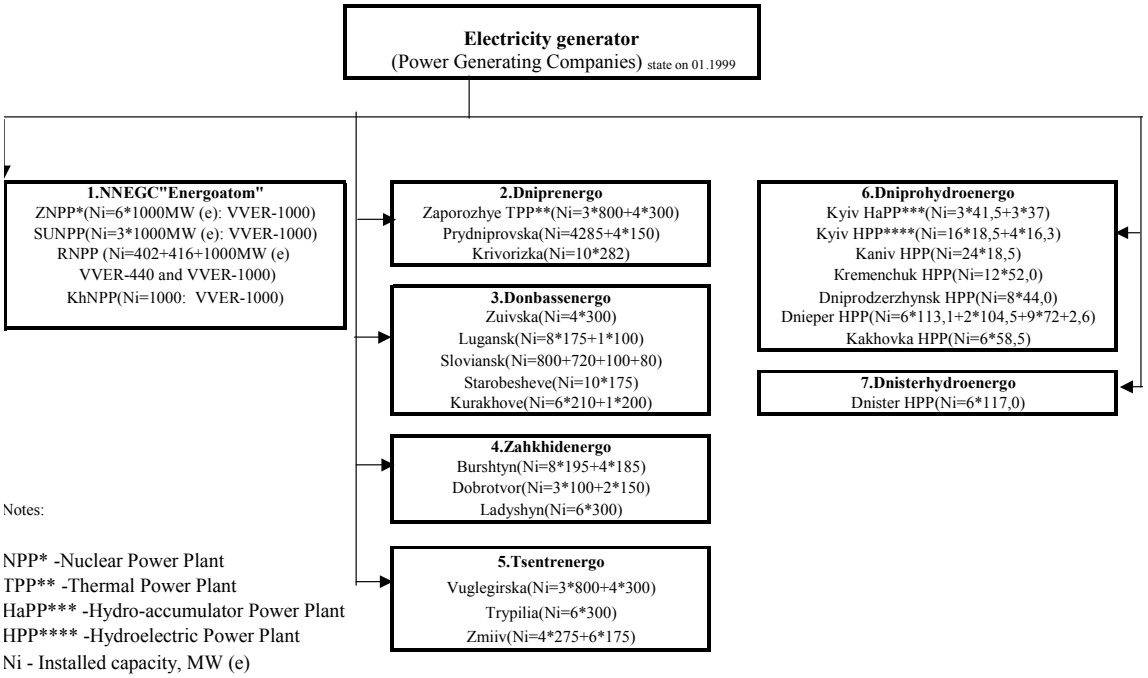


FIG. 3. Structure of Power Generating Companies

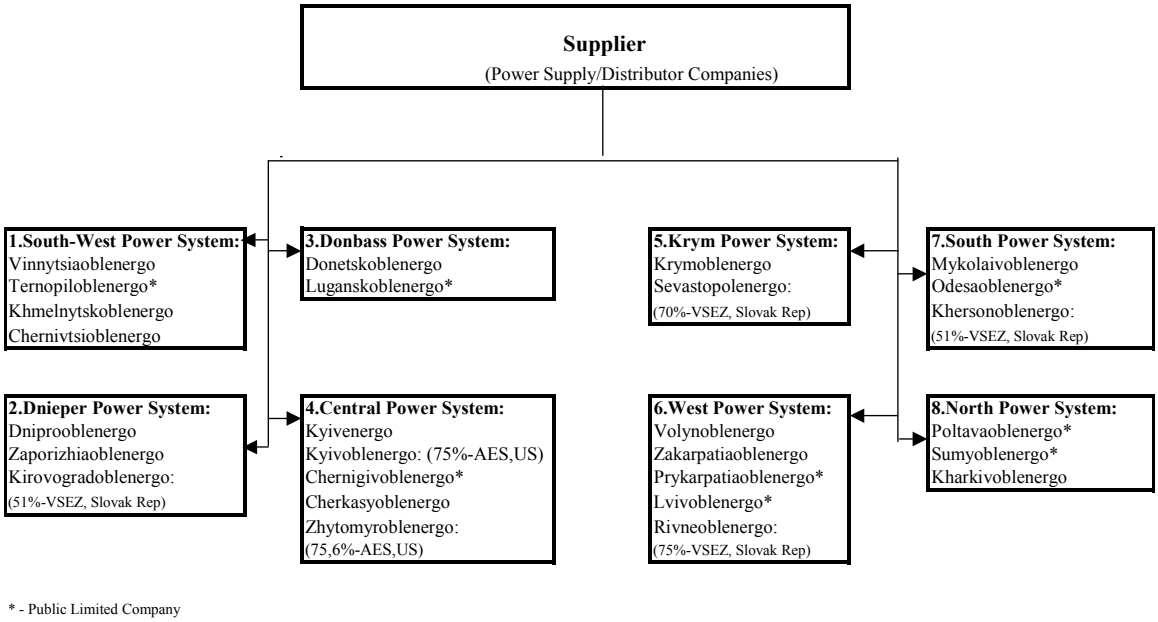


FIG. 4. Structure of Power Supply/Distributor Companies

2.2. Decision Making Process

The Law «On the Electric Power Industry» was accepted on 16 November 1997. It is a very complicated legislative act, which regulates the relations in the electric power industry. The law defines the legal, economical and organizational statute of activities related to electricity. It regulates the contacts, connected with generating, transmission, distribution and use of electricity; energy security provision; competition and protection of consumers and industry employees. It fixes the complex market reform, which already started in the electricity branch on a legal level. The law defines electricity and heat energy as a commodity, lays the foundation of tariff policy and defines the concept of the Wholesale Electricity Market (WEM) of Ukraine.

The Law «On the Electric Power Industry» determines the necessity for developing two draft bills entitled "Main Statements on the WEM Functioning in Ukraine". The above draft submitted by Mr. M. Pavlovsky, People's Deputy, was adopted in the first reading on 5 July 2001. However, its concept requires considerable modifications before the considerations in the Verkhovna Rada will be completed. The President of Ukraine has put a conceptual veto on it and suggested the Parliament to reject it during the second reading. In remarks provided by the President, specifically, it is indicated that the given law has no transitional provisions, and therefore can destroy the current whole sale market' s system, that will lead to electricity tariffs increase, monopolization of the low-cost electricity purchase by individual suppliers and customers, and moreover, can destroy the energy market's clearing account system. In addition to that, some former managers of the fuel and energy complex and utilities supported the law believing that the latter allowed the creation of a competitive environment in the energy market, that, specifically, would improve the efficiency of the electric power sector operation and its investment attractiveness. At present, the state enterprise «Energorynok» remains the only wholesale electricity trader in Ukraine. This enterprise also performs the functions of administrator responsible for the wholesale market assets and settlement systems. This enterprise is directly subordinate to the Cabinet of Ministers. In 2001, the wholesale market's turnover amounted to 15.8 billion UAH. The Verkhovna Rada can lift the President's veto on the law with 300 votes (the total number of people's deputies is 449).

On 22 June 2000, the Verkhovna Rada made changes to the Law «On the Electric Power Industry» with the aim to regulate relations in the WEM, providing energy security and stable operation of the power grid. These items highlight key points in the area of WEM payment adoption order. The offered mechanism increased the payment greatly.

The issues related to privatization cause the greatest difficulties. It's clear that the society is striving to establish finally the order in privatization process of state property, particularly if it concerns the base strategy areas having natural monopolies within their structures. The privatization process in the electric power industry will be conducted with taking into account the Ukrainian President's Decree № 944/99 dated 2 August 1999 "On Some Issues Concerning Privatization of the Electric Power Complex (EPC)'s Facilities". This President' s Decree gives an opportunity to regulate the procedure for participation of strategic investors including foreign ones, in the EPC' s enterprise privatization»

According to the NEP (National Energy Programme), the following main measures and activities on the prospective development of electric power must be undertaken:

i. implementation of energy saving measures;
ii. orientation towards a Ukrainian fossil fuel base (coal): the refurbishment of a fossil fuel balance focused on increasing the share of coal in the electric power production and on decreasing the natural gas and crude oil utilization;
iii. development of the nuclear industry in the future, taking into account the present deficiency in fossil fuel in Ukraine. Ukraine is planning to commission 2 nuclear units with a high priority at Khmeltnitski and Rovno and 2 units with a medium priority at Khmeltnitski;
iv. the commissioning of new hydropower capacities is foreseen at Dnestr and Kanev, taking into account the deficiency of the hydropower plants whose capacity can be changed;
v. a primary task comprises the technical upgrading and rehabilitation of thermal power plants in order to extend their plant life to an additional period of 15 to 20 years and to improve their environmental and economic conditions. Before the year of 2000, the rehabilitation of thermal power plants shall be carried out by means of replacement of components and parts of turbines and boilers. After 2000, upon creating new boiler types and new technologies, it is intended to carry out a comprehensive technical upgrading in which the major equipment will be replaced with a more economical and environmentally friendly one.

In order to provide rehabilitation and technical upgrading of thermal power plants it is required to raise funds. However, the funds raised by means of tariff escalation will not be sufficient, unless other financial sources from outside, including those obtained as a result of establishment of stock-holding companies and privatization of thermal power plants, are provided.

2.3. Main Indicators

Yearend 2000, the gross installed capacity of all electric power plants was 53.8 GW(e), i.e.:

- nuclear power plants 12.8 GW(e) (24%);
- thermal power plants 36.3 GW(e) (67%);
- hydro power plants 4.7 GW(e) (9%).

Table 8 and Figure 5 show the historical electricity production and installed capacity data. Figure 6 shows a comparison of the electricity generation by fuel types in 1996 and 2000 and Table 9 the EEDB energy related ratios.

TABLE 8. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

	1960	1970	1980	1990	1994	1995	1996	1997	1998	1999	2000
Electricity production (TW·h)											
- Total [1]	53.9	137.6	236.0	298.5	202.9	194.0	183.0	178.0	172.8	172.1	171,4
- Thermal	49.9	126.0	208.4	211.7	120.5	113.4	94.6	88.6	81.7	81.7	82,6
- Hydro	4.0	11.6	13.4	10.7	12.3	10.1	8.8	10.0	15.9	14.5	11,5
- Nuclear	0.0	0.0	14.2	76.1	68.85	70.5	79.6	79.4	75.2	75.9	77,3
- Imports	N/A	N/A	-17.5	-28.5	-1.0	-3.0	-2.0	-0.2	-0.7	-3.4	-3,8
- Gross Domestic Consumption	N/A	N/A	218.5	270	201.9	191.0	181.0	177.8	172.1	168.7	167,6
- Distribution Losses	N/A	N/A	19.2	21.9	21.7	18.8	25.0	28.4	30	30.2	31,2
- Final Consumption	N/A	N/A	199.3	248.1	180.2	172.2	156.0	149.4	142.1	138.5	136,4
Capacity of electrical plants (GW(e))											
- Total	11.7	27.9	43.9	55.6	55.2	53.9	54.0	53.9	53.8	53.9	53,8
- Thermal	9.9	25.4	37.4	37.1	37.7	35.4	35.7	36.5	36.3	36.4	36,3
- Hydro	1.8	2.5	4.0	4.71	4.70	4.70	4.70	4.70	4.70	4.70	4,7
- Nuclear	0.0	0.0	2.44	13.8	12.8	13.8	13.6	12.7	12.8	12.8	12,8

[1] Electricity losses are not deducted.

Source: IAEA Energy and Economic Database and Country Information.

The specific character of power production and consumption permits the presence of a high power intensive industry. However, this industry considerably depends on the primary energy sources supplied from Russia (e.g. coal, oil and gas), Poland (coal) and Turkmenistan (gas). Due to the economic difficulties, the considerable decrease in the electric power production, from 298.5 TW·h in 1990 to 171.4 TW·h in 2000, has lead to a redistribution of the consumption structure towards the domestic services industry.

The total electricity production in 2000 was 171.4 TW·h (hydro: 6.7%, nuclear: 45.3%, and thermal: 48%). The maximum electricity production was 298.5 TW·h in 1990, one year before the Soviet Union ceased to exist. The electricity consumption decreased from more that 5,762 kW·h/per capita in 1990 to less than 3,000 in 2000. Electricity export was 2.4 TW·h in 2000 in compared to 43.8 TW·h in 1990. The final consumption was 136.4 TW·h in 2000.

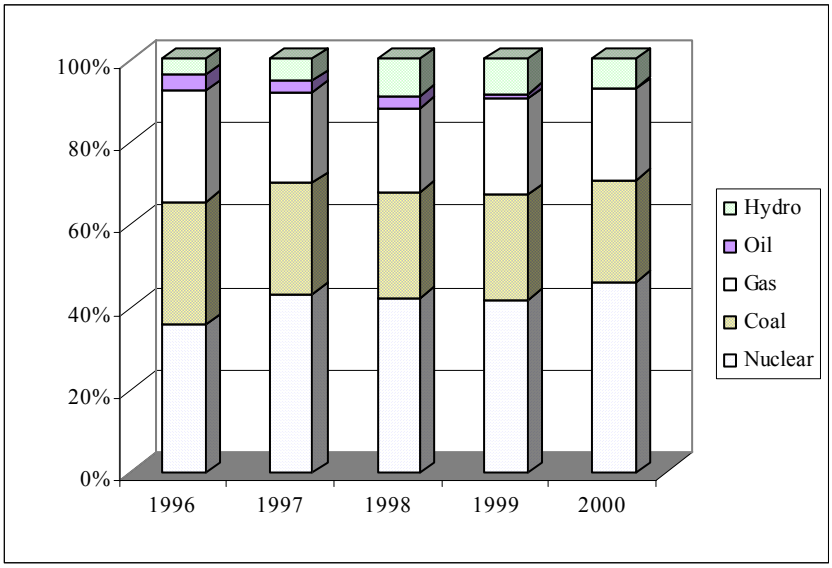


FIG. 5. Electricity Generation by Type of Fuel (%)

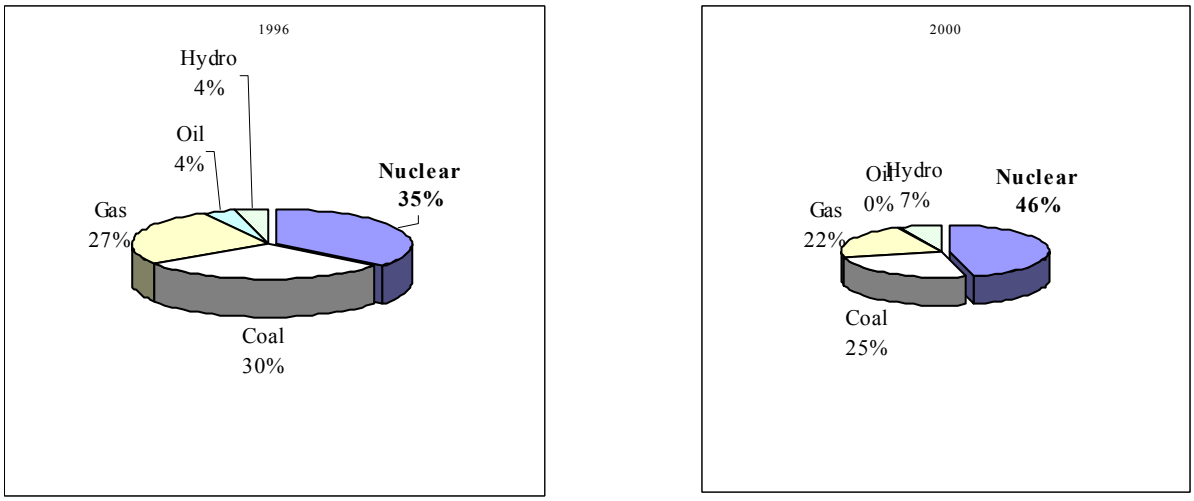


FIG. 6. Comparison of Electricity Generation by fuel type (1996 and 2000)

TABLE 9. ENERGY RELATED RATIOS

	1999	2000
Energy consumption per capita (GJ/capita)	118	115
Electricity per capita (kW·h/capita)	3,031	2,937
Electricity production/Energy production (%)	45	43
Nuclear/Total electricity (%)	44	49
Ratio of external dependency (%) [1]	46	44
Load factor of electricity plants		
- Total (%)	35	34
- Thermal	25	21
- Hydro	43	50
- Nuclear	63	74

[1] Net import / Total energy consumption.

Demand, particularly in the heavy industry, has fallen as a result of the severe economic recession. According to international estimates, it is not expected that the demand regains the 1990-levels before 2010-2015, with a shift away from industrial consumption and an increase in the consumption by the municipal service and population. Top officials in Ukraine do not accept this gloomy scenario. Concern over large-scale energy shortages has been a major argument in the discussions about the status and the future of the Ukrainian fuel-power complex.

The national electricity supplier is the Ministry of Fuel and Power Industry (Mintopenergo). It owns and operates the transmission and distribution system and some 97% of the country's generating capacity. The Ministry is also responsible for the design and construction of power plants. Heat produced by Mintopenergo for district heating distributes by the State Committee of Communal Services.

Mintopenergo is experiencing difficulties in obtaining payments for electricity supplied. The press centre of the Ministry reported that in September 1999 close to 6,649 mln UAH[1] or US $1,445 million remained unpaid (note: consumers, practically, did not pay for 6 months consumption of electricity) and only 18.3% of the electricity produced from January to September 1999 had been paid through banking remittance. Electricity consumption was partly paid through barter. About one quarter of the generated power was not paid. As to the end of September 1999, payable notes of the Ministry (debt of debtors) were 11,229 mln UAH (US $2,441 million). At the same time, the Ministry should pay to creditors 13,743 mln UAH (US $2,987 million). Practically, the Ministry described itself as essentially bankrupt.

Current electricity tariffs do not cover average costs let alone leave a margin for investments, which means that the power industry depends on state funding for renovation and development. Moreover, deductions to the NPPs decommissioning fund, radwaste management and nuclear liability are not included in the electricity tariff. According to the Ministry in 1998, the average tariff of electricity generated by all power plants was 6.82 kopeks/kW·h (about 3.4 US cents). The breakdown of specific generating costs are for TPPs - 3.72, NPPs - 1.61, HPPs - 0.295 and WPPs - 11.25 all in US cents/kW·h. During the last two years, the rules of electricity sales to end consumers and the electricity prices changed many times. At the beginning of September 1999, more then 214 mln UAH (US $46.5 million) salary was not paid to personnel of the power industry.

All problems connected to the acquisition of fuel for power generation is strictly tied to financial resources. Fuel supplies to TPPs are made from both Ukrainian sources and from Russia and Poland (50% domestic and 50% foreign). The situation is aggravated by the fact that in 1998 all reserves of nuclear fuel supplies on a compensation basis (against nuclear warheads returned to Russia) were exhausted. As a result, Ukraine needs to find additionally more than US $200 million to pay Russia for fresh nuclear fuel[2].

The poor financial conditions resulted in shortage of fossil and nuclear fuel and decreasing quality of power plants maintenance. It led, as consequences, to unreliability in electricity supply to all sectors of the economy. There have been problems stabilizing the grid at 50 Hz (during 2000 there were some events with frequency decreasing till 49 Hz) that resulted in periodic disconnection of the Ukraine national grid with its neighbour's grid.

There are 104 thermal power units ranging from 100 MW to 800 MW in capacity of which 90 units are coal-fired. There are six 150 MW units (commissioned in the period 1959 to 1964), forty-three 175 to 210 MW units (commissioned between 1960 and 1975), forty-two 282 to 300 MW units (commissioned between 1963 and 1988), five 250 MW units (commissioned in the 80's) and eight

1 UAH - hrivna, Ukrainian currency

2 shortage of money resulted in absence of fresh fuel for reloading of three units with WWER-1000 reactors at the beginning of October 1999.

720 to 800 MW units (commissioned between 1967 and 1977). More then 95 % of the thermal power units have completed their projected service life of 100,000 hours. A large portion of them (72%) has been in operation for 170,000hours, which exceeds the internationally accepted limits for wear-out and obsolescence. Due to aging of equipment, shortage of high quality fuel and low-level quality of maintenance, specific fuel consumption has considerably increased from 345 g/kW·h in 1990 up to 369 g/kW·h. The house loads also increased from 5.5% in 1990 to 8.5% in 2000. No new capacity was commissioned during 1991-2000. The average load (capacity) factor of the thermal power plants is 28% (Figure 7). This is largely due to the decline in electricity consumption and the non-payment problem in Ukraine.

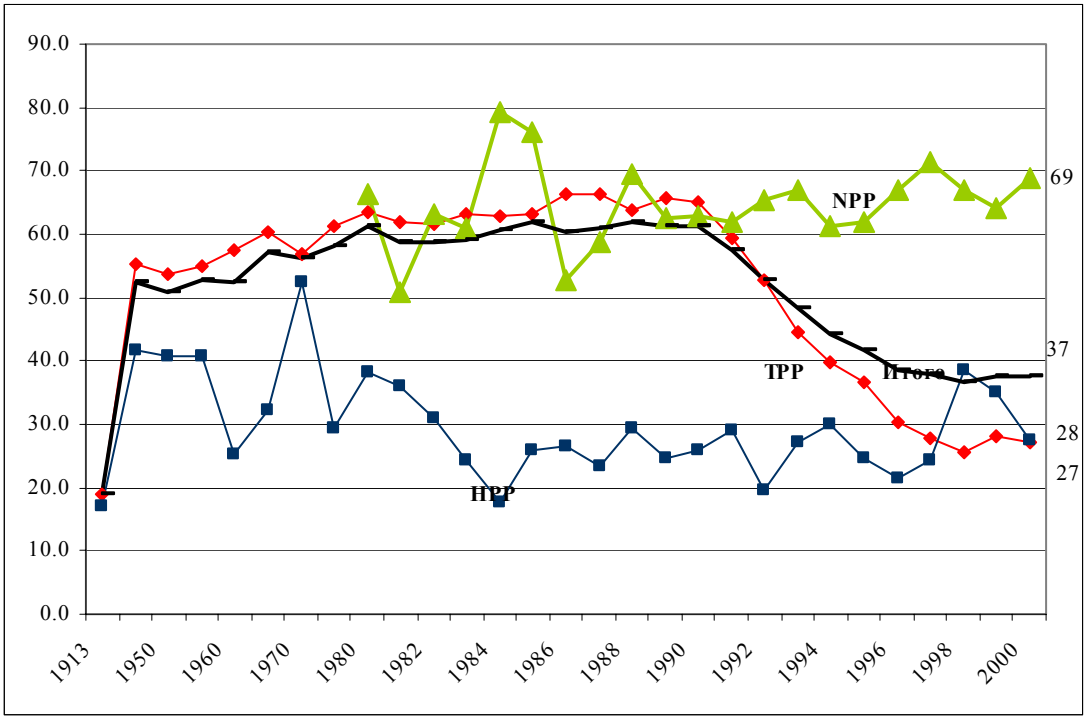


Figure 7. Trend of Load factor

The estimated potential of the Ukrainian hydropower generation is close to 20 TW·h electricity per year. In 1998, almost 80% of this potential was used and was the highest result in the history of the national power industry. Major equipment of the HPPs has operated for about 40 years and needs upgrading. Construction of the Dniester and Tashlyk hydro power complexes has been delayed due to shortage of finance and negative attitude of local authorities to construct the Tashlyk complex that includes a HPP and hydro-accumulator PP[3].

Currently, the Ukraine is in transition from a centralized to a market economy. A number of mistakes has been made and resulted in a very deep economic recession, which resulted in a negative influence on the national power industry. The privatization and deregulation experience in the power industry of Ukraine was also rather negative then positive.

2.4. Impact of Open Electricity Market in the Nuclear Sector

During 1998, the State Property Fund of Ukraine was selling shares of the electricity generating companies by small lots. About 11% of the shares were sold at the stock exchange. Shares also were sold on a competitive basis. About 35% of the shares of the power supplying/distributing companies were sold. However, the experience has proved that the new shareholders were too unaware of the problems faced by the power industry and were not able to initiate any positive innovations. The law prohibits privatization of NPPs. It should be noted, that shares were sold at a very low price and the

3 Tashlyk water storage basin is the cooling pond for SuNPP.

state budget of Ukraine received only about US $90 million (to compare, in the similar situation Hungary received for the budget US $1,700 million). But the main problem was that the new shareholders did not make any adequate investment, for various reasons, to enhance the situation for the power industry. The 6 oblenergos control stock of were sold in April 2001 (Table 10).

TABLE 10. PRIVATIZATION PROCESS

	Name of Oblenergo for selling	Share holding for selling, %	Start price Mln UAH	Sale price Mln UAH	Buyer company name (new shareholder)
1	Kievoblenergo	75	174,032	248,686	AES*
2	Rivneoblenergo	75	100,612	125,697	AES*
3	Zhytomyroblenergo	75.6	95,174	190	VSE**
4	Khersonoblenergo	65	11,4	112,138	VSE**
5	Kirovogradoblenergo	51	87,016	88,234	VSE**
6	Sevastopolenergo	70	35,3	100,960	VSE**
	Total, mln UAH		503,534	865,715	
	Total, mln $		92,7	159	

AES* - Applied Energy Services, Inc., AES Washington Holding B.V. (USA)
VSE**- Vychodoslovenske Energeticke Zavody S.P. (Slovakia)

A formal declaration of the power market had even less success. There were a number of intermediary companies (paying agent) that, having nothing to do with power generation, supply and distribution, got rather high profits from power resale. For example, in January and February 1999, the NNEGC "Energoatom" was paid 2.5% for electricity produced and intermediary companies got 14.3%. In other words, intermediary companies got 5.2 times more "real" money per kW·h compared to those who generated the electricity.

The Wholesale Electricity Market (WEM) is operating now in accordance with the Ukrainian Law on the "Electric Power Industry" issued on 22 June 2000 (No. 1821-III). The WEM' s activity is regulated by:

- WEM regulations;
- agreement concluded by the WEM participants;
- bilateral electricity sale-purchase contracts concluded within the Agreement' s frameworks;
- licenses issued by the National Energy Regulatory Commission of Ukraine for the electricity production, transmission and supply.

Any WEM participant can be subject to those economic activities, which have the license for the corresponding activities and adhere to the WEM participant's Agreement. The main governing bodies of the WEM are the general meetings of WEM participants (members) and the WEM Board. The responsibilities to ensure the functioning of WEM are entrusted to the state enterprise «Energy Market», which, on one side, is subordinate to the Cabinet of Ministers of Ukraine, and, on the other side, represents the executive authorities of the WEM.

The WEM activity is regulated by the state agency - the National Energy Regulatory Commission. At that, the wholesale market' s activity is seriously monitored by the Ministry of Fuel and Energy as an owner of corresponding blocks of shares of generating and regional power supply companies. (All regional companies, so-called "*oblenergo*" are at the same time power transmission and supply companies. They have corresponding licenses for these activities issued by NERC. Regardless the property types, the oblenergos supply electricity only on regulated tariffs.)

The main function of WEM is to ensure the electricity wholesale. The electricity wholesale represents the modern and advanced technology of electricity purchase from generators and its sale to power suppliers in real time within the unified energy system of Ukraine.

Licenses issued by the NERC.

The licenses for electricity generation, transmission and supply are formal documents, which confirm the right of their owners to perform the proper activity upon the conditions of rules and fulfilment of terms established in the above licenses. The license is issued individually for each type of activity:

- for the business activity to be conducted in the field of electricity generation;
- for business activities conducted in the field of bulk electricity transmission and intergovernmental power supply lines;
- for business activities related to electricity transmission by local power supply lines;
- for business activities related to the electricity supply via regulated tariffs;
- for business activities related to the electricity supply via non-regulated tariffs;
- for business activities related to the wholesale electricity supply.

The decision to issue a license is adopted by NERC and documented in a protocol of the meeting after all conditions and requirements imposed by the «Procedure for issuing licenses to the business entities regardless the property's forms for the electricity generation, transmission and supply", are met. The license is granted and valid for unlimited time period.

Pricing mechanism.

The pricing mechanism is currently based on hourly rates of the electricity purchase sale. The electricity prices of fossil power plant utilities are defined based on the price proposal submitted by these companies in accordance with WEM rules. The electricity price of generators that have special working schedules, are established by the NERC (HPP, FPP etc.). In view of prices defined in accordance with the WEM regulations and established by the NERC, the hourly average prices of the electricity are set up for the electric power wholesale to the electricity suppliers.

Based on wholesale electricity prices the electric power suppliers form the retail prices for electric power consumers (except for population). The retail market represents the electric power sale to the electricity suppliers delivering it directly to customers.

Cash collection.

As a rule, the settlements for the electricity in the WEM is performed through bank accounts. The bank assets are transferred through clearing accounts. Funds collected on these bank accounts represent the common properties of all WEM participants (members) and are distributed in accordance with the algorithm approved by the WEM Board and NERC.

The main internal problem of the WEM is the failure of suppliers to provide the electricity via regulated tariffs to fulfill the contract obligations. This became possible because of the transit account' s dependence on of electricity suppliers' administration and due to the lack of legal regulation of these issues.

The non-payments of customers for the electricity supplied and barter operations represent the major external problems of the WEM. This, on one hand, does not provide any possibility for all WEM participants, specifically, for the generators, to perform their functions normally, and on the other hand, this is used for discrediting the WEM model and backbone. As of 01 January 2001 the indebtedness totals 9.8 billion Hryv.

In 2000, the settlements through all payment transactions amounted to 13.7 billion UAH or 85% of the cost of electricity purchased in the WEM. This is 6% higher than the payment level in 1999. The payments provided for electricity purchased through the bank assets reached 5.2 billion UAH that is five times as large than the similar indicator for 1999.

WEM balance.

In 2000, the WEM sold 145 814 million kW·h that is 2.11% less than the similar indicator in 1999. At that, the specific share of NNEGC ENERGOATOM accounted for 49.7% compared to 45.2% in 1999, the share of FPP electricity generators – 39.2% compared to 41.6%; HPP generating companies– 7.9% compared to 9.4%; leasehold power units –1.1% against 0.75%; co-generation plants – 1.7% compared to 3%.

In 2000, the WEM system for payment estimations has been seriously changed. From June 2000, the electricity supply companies have purchased electricity from WEM at the wholesale prices that have been calculated based on the daily kW·h payment calculation. This transition ensures the balance of payments between generators and suppliers and brings the electricity purchase-sale to the conformity to rules of the Ukraine WEM operation.

The Ukraine's WEM system enables the electricity generators along with other suppliers to sell the electricity directly to customers on the basis of bilateral agreements. At that, the sale prices of electricity for customers are contractual prices and are not subject to the state regulation. For instance, the electricity generator – ENERGOATOM is simultaneously an electricity supplier providing electricity via non-regulated tariffs.

For a long time, the Ukrainian NPPs have produced products without selling but just by distributing them. Thus, in 1998 only 7.3% of the total amount of electricity delivered was paid in cash and the rest was paid through various offsets and promissory notes. In 2000, the Ukrainian electric power sector started striving and moving toward receiving only cash payment. However, all payment types for electricity supplied to the energy market made up 87.9% of its cost.

In 1999-2000, the fossil and nuclear power plants have been operating under conditions of lack of conventional and nuclear fuel resulting from non-payments for the electricity supplied. The fact that the Ukraine' s energy system is not able to ensure the electricity generation/consumption balance during maximum daily load, leads to 49.3 Hz grid frequency and unloading of the NPP power units. The lack of cash at NPPs has significantly affected the outage and maintenance duration and quality.

The system of electricity payment by means of various surrogate methods applied for several years (set-off, barters and etc.) led to losses of many millions. The NNEGC should pay a very high price because of the resulted large bill receivables, wage debts and indebtedness at various budget levels.

The situation in the energy market started improving after the Government of Ukraine took several decisions in 2000. First of all, it introduced the practice of cash payment that resulted in substantial improvement of situation with payment for electricity delivered to the state enterprise «Energy Market». The cash collections increased up to 60—70%, which enabled to improve the proceeds to the Company's accounts up to the level of 45—50%. As a result the nuclear industry's personnel wage debts were discharged and the social tension was reduced in work collectives. Earlier, in 1996 one could only dream of this.

However, the current financial status of the Company is still far from being ideal. Until 100% of payment is received for the electricity supplied, the severe problems, such as the stable and timely maintenance and outage campaign at NPP power units, the fresh nuclear fuel supplies and spent fuel withdrawal, and moreover, timely wage payment to the NPP personnel, remain unsolved. The lack of actual earners for settlements with budget and creditors also affects the present situation.

The "emergency situations" implemented in the Energy Market are stipulated by the law and represent tools for assets mobilization in critical areas to ensure the stable and reliable operation of the unified power system. This is the normal mutual crediting mechanism subject to credit repayment in accordance with schedules approved.

The practice of the loan non-repayment or its repayment within the non-approved dates destabilizes the financial activity of the enterprise and leads to significant economic damage and losses. In addition, when implementing «emergency situations» the assets withholding in favour of a needy participant of the market should be made at the expenses of the other market's participants. During the last two years (in 2000–2001) such withholding was realized solely at the ENERGOATOM' s expenses. Unfortunately, the practice of "manual" redistribution of cash assets has been applied more and more frequently. In accordance with the algorithm these cash assets accrued by the ENERGOATOM are transferred, in accordance with some NERC's resolutions, to others power producers. Thus, more than 300 million UAH was redistributed totalling the average monthly amount of cash assets transferred to the Company's accounts. This situation forced the ENERGOATOM to attract significant credit resources, first of all to pay for the fresh nuclear fuel supplies. These problems become more acute specifically when the NPPs prepare for the winter period.

3. NUCLEAR POWER SITUATION

3.1. Historical Development

Nuclear energy in Ukraine started its development in the early 70s with the construction of the first nuclear reactor at Chernobyl. The reactor is an RBMK reactor with a capacity of 1000 MW(e) and commenced operation in 1977. The Ukrainian nuclear energy programme was developed as part of the nuclear energy programme of the former Soviet Union in order to ensure the military defence of the country. A close co-operation was set up between research centres and relevant industries to include all areas needed for the utilization of nuclear energy, such as geology, ore mining and processing industry, metallurgy, chemistry, etc. A significant part of the technical and scientific nuclear complex was based in the Ukraine: 15 power reactors (some of which are under construction, including 10 units of the 3rd generation), - uranium ore mining and processing enterprises, - metallic zirconium and hafnium production centres (used as construction materials in the new reactor types), and - some of the S&R and R&D institutes. The reactors have been built at 5 sites: Chernobyl (ChNPP), Rovno (RNPP), South Ukraine (SUNPP), Zaporozhe (ZapNPP) and Khmeltnitski (KhNPP).

After the accident at the 4th reactor unit at Chernobyl, the Supreme Soviet of Ukraine adopted on 2 August 1990 a moratorium to build new nuclear power units in the Ukraine. The construction work at unit 6 at Zaporozhe was interrupted and the construction of 4 new WWER type reactors at Khmelnitski and Rovno was also halted.

In the second part of 1991, the breakdown of the USSR has deeply affected the structure of the energy complex resulting in the separation of its enterprises and loss of the centralized management system. In that situation, the Cabinet of Minister has made the NPP managers personally responsible for the NPP safe operation. Some changes were introduced into the management structure and into the document needed by NPP for receiving the permission for the operation. All these documents have been submitted to the Regulatory body - GOSATOMNADZOR.

In order to create the State management system, ensuring the safe operation of the nuclear energy, the Ukrainian State Committee on Nuclear Power Utilization has been established (GOSKOMATOM) by the Decree of the Cabinet of Ministers of Ukraine on 16 January 1993.

On 6 May 1997, a Ministry of Energy of Ukraine was established in accordance with a Decree by the President on the basis of the former Ministry of Energy and Electrification as well as on the basis of the State Committee on Nuclear Power Utilization. This new ministry includes the State department for Nuclear Power that was entrusted with the functions of the state authority responsible for nuclear power sector administration.

On 14 April 2000, the Ministry of Fuel and Power Industry of Ukraine (Mintopenergo) was established by the Decree of the President of Ukraine #598/2000 on the basis of the Ministry of Coal Industry of Ukraine; Ministry of Power Industry of Ukraine; State Department of Ukraine on Electric Power Issues; State Department of Ukraine on Oil, Gas and Oil-refining Industry; State Department of Ukraine on Nuclear Power. The main task of Mintopenergo is the state management of the fuel energy complex.

The National Nuclear Energy Generating Company "Energoatom" (NNEGC "Energoatom") has been set up in accordance with the decree of the Government on 16 December 1996 (Figure 8). This Company has been set up with the aim of improving the electricity supply to the national economy and the population, the NPPs operation, the competition ability under market conditions and modifying the structure of nuclear energy management in accordance to the requirements of the acting legislation. In May 1997, NNEGC "Energoatom" joined the World Association of Nuclear Operators-Moscow Centre as an associate member.

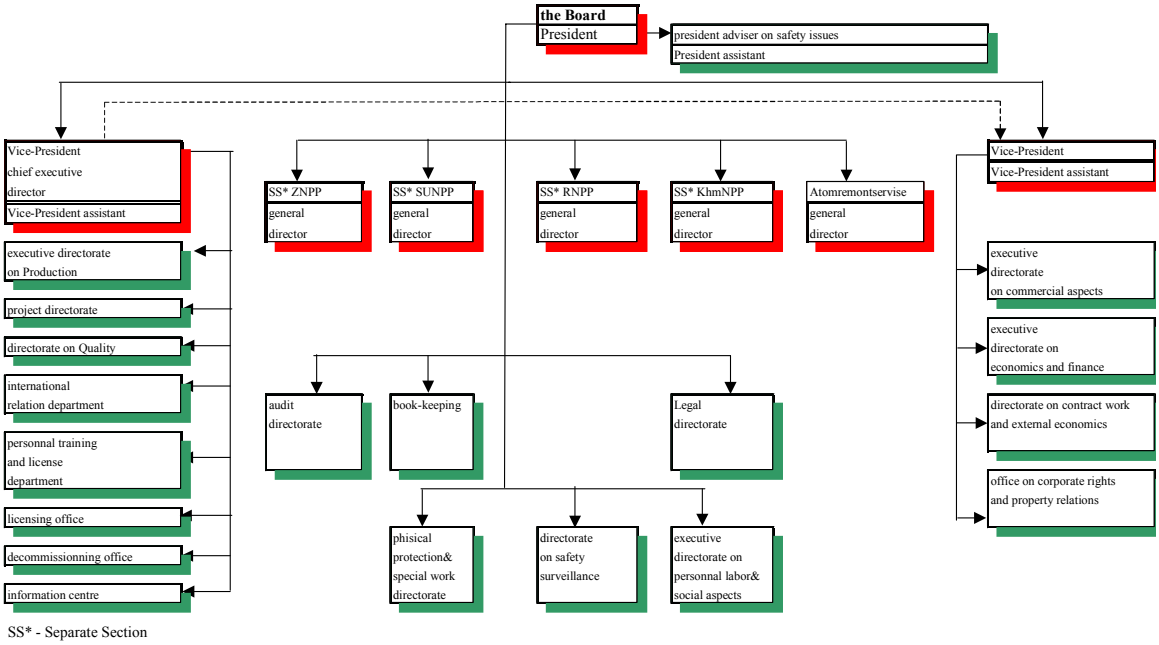


FIG. 8. NNEGC "Energoatom" Directorate Structure.
(status end of 2000)

The year 1996, when the National Nuclear Energy Generating Company ENERGOATOM was established, was very difficult and crucial for the nuclear power industry of Ukraine. The financial and economic situation in the whole nuclear power industry has fully depended on the general status of the national economy that was in the process of liberalization.

The energy carrier prices were released but the electricity price remained fixed. Actually, the energy market has been controlled by so-called independent suppliers, i.e. intermediaries who were able to «cut off» electricity generators from financial flaws. The barter operations have thrived and there was the real risk of energy enterprises acquisition by vertically integrated regional structures and the liquidation of the unified energy system. The current assets of nuclear power plants have been «washed away» at the critical rate.

Under these conditions the Government took the decision concerning integration of the nuclear power plants into one single enterprise - the National Nuclear Energy Generating Company ENERGOATOM. The company included all 5 power plants of Ukraine. This powerful structure with

joint funding became a serious competitor for financing & industrial groups and survived despite the rugged times.

In the present economic environment the results of activities of such a large enterprise like ENERGOATOM, depends on coordinated and efficient work of each sub-structure. Owing to cooperative efforts of all Ukrainian NPPs the Alexandrovska HPEP was commissioned and the dry-cask spent nuclear fuel storage was put into the pilot-industrial operation at Zaporizhzhya NPP. Now the works is going on to complete the KhNPP and RNPP power units as well as the Tashlyk pumped storage and social facilities construction.

In accordance with the Cabinet of Ministers' Decree dated 26 September 2001, the NNEGC ENERGOATOM was included into the list of enterprises that are strategically significant for the economy and security of the country. This important decision enabled ENERGATOM to secure the State's property and interests through improving and upgrading the mechanism intended for protecting interests of individual strategic entities. Moreover, this will prevent any attempt of conducting "hidden /secret/" privatization.

At present, the Nuclear Energy Complex of Ukraine includes the NPPs, the uranium ore mining, processing and enrichment enterprises, the facilities for producing metallic zirconium and hafnium, the R&D Institutes, the maintenance and repair enterprises and the enterprises for NPP completion.

The nuclear power sector represents one of the most important components of the energy complex of Ukraine. The production of electricity by the nuclear power sector remains stable at about 74 TW·h per year. At the same time, the share of electricity generated by the thermal power plants sharply decreased. Thus, the nuclear power sector became one of the most significant factors in overcoming the energy problems in Ukraine. Based on the above mentioned trends, the Parliament of Ukraine adopted a Decree, dated 21 October 1993, that lifted the moratorium on new NPPs construction, that had come into force in 1990 as a result of consequences of the accident at power unit 4 of CHNPP. The above mentioned parliament's decision has promoted the NEP development. The main provision of this programme concerns an urgent need for continuous development of the nuclear energy sector aimed at providing the national economy with electricity of at least 40% of the overall needs.

One direction in the stabilization of the nuclear energy complex situation is the creation of a national nuclear fuel cycle. NEP foresees to create by the year 2010 the nuclear fuel cycle. Pursuant to this programme the "Comprehensive programme of the nuclear fuel cycle creation" was established.

3.2. Status and Trends in Nuclear Power

Ukraine inherited a developed network of NPPs from the former USSR (at the time of independence in 1991, there were 15 units in operation, 5 under construction and one at Chernobyl that in 1986 had been destroyed by the severe accident). In 2000, Ukraine was nines in the world in terms of the number of operational reactors; eights in terms of the electric power output and the total capacity of its NPPs, and fifths in terms of the percentage of electric power generated at its NPPs. At present, the Ukrainian Nuclear Energy consists of the 21 nuclear reactors at 5 nuclear power plants, of which 13 power units are in operation, 4 power units are under construction, and 4 are under decommissioning. The gross installed capacity of the operating plants is 12.8 GW(e), which is about 24% of the total electrical capacity in Ukraine. In 2000, the NPPs produced 45.3% of the total generated electricity. The four reactors under construction have a net capacity of 950 MW(e) each. The problem concerning the completion of two power units (that is: RNPP-4 and KhNPP-2) are under consideration. Table 11 (from 10 February 2001) shows the status of the nuclear power plants and Figure 9 the increase in commissioning.

TABLE 11. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
KHMELNITSKI-1	WWER	950	NNEGC	Operational	PAIP	01-Nov-81	10-Dec-87	31-Dec-87	13-Aug-88	
ROVNO-1	WWER	381	NNEGC	Operational	PAIP	01-Aug-73	17-Dec-80	31-Dec-80	21-Sep-81	
ROVNO-2	WWER	376	NNEGC	Operational	PAIP	01-Oct-73	19-Dec-81	30-Dec-81	30-Jul-82	
ROVNO-3	WWER	950	NNEGC	Operational	PAIP	01-Feb-80	11-Nov-86	21-Dec-86	16-May-87	
SOUTH UKRAINE-1	WWER	950	NNEGC	Operational	PAA	01-Mar-77	09-Dec-82	31-Dec-82	18-Oct-83	
SOUTH UKRAINE-2	WWER	950	NNEGC	Operational	PAA	01-Oct-79	30-Dec-84	06-Jan-85	06-Apr-85	
SOUTH UKRAINE-3	WWER	950	NNEGC	Operational	PAA	01-Feb-85	01-Sep-89	20-Sep-89	29-Dec-89	
ZAPOROZHE-1	WWER	950	NNEGC	Operational	PAIP	01-Apr-80	07-Dec-84	10-Dec-84	25-Dec-85	
ZAPOROZHE-2	WWER	950	NNEGC	Operational	PAIP	01-Jan-81	28-Jun-85	22-Jul-85	15-Feb-86	
ZAPOROZHE-3	WWER	950	NNEGC	Operational	PAIP	01-Apr-82	04-Dec-86	10-Dec-86	05-Mar-87	
ZAPOROZHE-4	WWER	950	NNEGC	Operational	PAIP	01-Apr-83	15-Dec-87	18-Dec-87	14-Apr-88	
ZAPOROZHE-5	WWER	950	NNEGC	Operational	PAIP	01-Nov-85	20-Jul-89	14-Aug-89	27-Oct-89	
ZAPOROZHE-6	WWER	950	NNEGC	Operational	PAIP	01-Jun-86	06-Oct-95	19-Oct-95	16-Sep-96	
KHMELNITSKI-2	WWER	950	NNEGC	Under Construction		01-Feb-85				
KHMELNITSKI-3	WWER	950	NNEGC	Under Construction		01-Mar-86				
KHMELNITSKI-4	WWER	950	NNEGC	Under Construction		01-Feb-87				
ROVNO-4	WWER	950	NNEGC	Under Construction		01-Aug-86				
CHERNOBYL-1	LWGR	725	NNEGC	Shut Down	MNE	01-Mar-70	02-Aug-77	26-Sept-77	27-May-78	30-Nov-96
CHERNOBYL-2	LWGR	925	NNEGC	Shut Down	MNE	01-Feb-73	17-Nov-78	21-Dec-78	28-May-79	30-Nov-91
CHERNOBYL-3	LWGR	925	NNEGC	Shut Down	MNE	01-Mar-76	02-Jun-81	03-Dec-81	08-Jun-82	15-Dec-00
CHERNOBYL-4	LWGR	925	NNEGC	Shut Down	MNE	01-Apr-79	26-Nov-83	22-Dec-83	26-Mar-84	26-Apr-86

Source: IAEA Power Reactor Information System as of 31 December 2000.

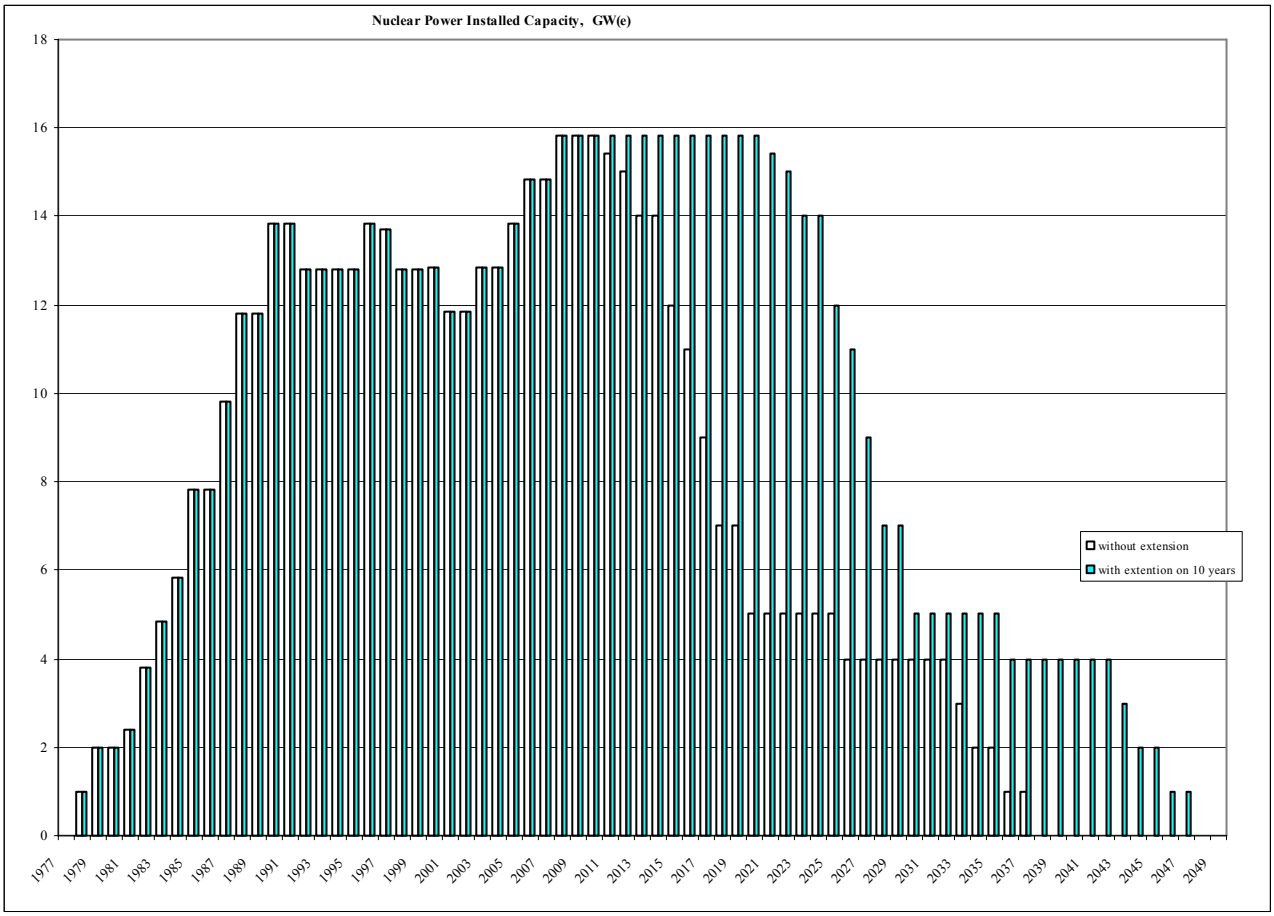


FIG. 9. Commissioning of NPPs in Ukraine

At present, Ukraine has units of three generations, built according to the designs of the 60ties, 70ties and 80ties (see Table 12 for the basic design characteristics):

- 1st generation - RBMK-1000 (ChNPP 1,2);
- 2nd generation - RBMK-1000 (ChNPP 3); WWER-1000 / V-302, V-338 (SUNPP 1,2); WWER-440 / V-213 (RNPP 1,2);
- 3rd generation - WWER-1000 / V-320 (ZNPP 1-6, SUNPP 3, RNPP 3, KhNPP 1).

TABLE 12. BASIC DESIGN CHARACTERISTICS

Item	VVER-440/213	VVER-1000
Reactor type	Water-cooled, water-moderated energy reactor VVER	Water-cooled, water-moderated energy reactor VVER
Number of loops	6	4
Thermal Capacity, MW(t)	1375	3000
Electrical Capacity, MW(e)	2*220	1000
Turbine type	K-220-44	K-1000-60/3000(LMZ) or K-1000-60/1500(KhTzÇ)
Number of fuel elements in assembly	126	317
Coolant temperature at inlet, degree of Centigrade (degree of Fahrenheit)	268 (514)	290 (554)
Coolant temperature at exit from reactor, degree of Centigrade (degree of Fahrenheit)	296.5 (565.7)	322 (612)
Coolant flow rate through reactor, m^3/h	39,200	80,000
SG Steam output, t/h	452	1469

With the commissioning of ZNPP-6 (in October 1995), that site became the largest NPP in Europe and the third in the World. The nuclear power share in national electricity production rose from 25.5% in 1990 to 45.3% in 2000. It was reported that on 6 January 1996, all the nuclear units had been in operation and had supplied 50.5% of the country's electricity.

In 2000, the average load factor of the operating reactors was 68.9% and the individual NPPs have been run with the following load factors: ChNPP: 80.1; SuNPP: 61.4; RovNPP: 70.8; KhmNPP: 71.1 and ZapNPP: 70.0.

Based on the design features, the Ukrainian nuclear power units can be split into the tree following groups:

- power units with WWER-1000 reactors (-320) large series;
- power units with WWER-1000 (-302, -338) small series;
- power units with WWER-440 (-213).

For each power unit of Ukraine the preliminary safety analysis reports (safety substantiation) have been developed at the designing stage. Such a report forms the basis for getting license for power units operation. Safety substantiation includes the analysis of potential safety-important systems (components) failures. It also selects the failures affecting the safe operation of the reactor installation. The safety substantiations also include the list of initiating events and analysis of normal operation violations as well as the design accident analysis. The safety substantiation stipulates the fulfilment of standards and codes being effective at the safety substantiation development date. Safety substantiation justifies and supports operating limits and conditions, safe operation limits and conditions as well as design limits stipulated for design accident. Safety substantiation also includes the expert assessment of influence on the unit operational safety of deviations from the requirements of norms and standards on nuclear and radiation safety that became effective after the completion of construction and commissioning of power units.

For the last three years, NNEGC Energoatom has achieved significant successes in re-assessing the safety of NPP under operation with using and applying new technologies and tools for evaluation and calculations. The strategy of the safety re-assessment of NPPs under operation is focused on combining the periodical assessment at the end of certain period of operation with the in-depth safety assessment using the modern analysis techniques, such as probabilistic safety analysis, beyond -design basis accident analysis, including some transients without scram. At the first stage, the safety analysis is conducted for the reference Unit 1 at Rovno, Unit 1 at SUNPP and Unit 5 at ZNPP that covers all WWER design reactors under operation in Ukraine.

In accordance with the Regulation «Requirements for content of the safety analysis report for NPPs with WWER type reactors under operation in Ukraine» at this stage the safety analysis is limited to the development of:

- extended (supplemented) safety substantiation;
- additional materials on safety analysis;
- design basis accident (DBA) analysis;
- probabilistic safety analysis (PSA), level 1, internal (on-site events).

At the second stage the level 1 probabilistic safety analysis would be additionally developed (external events and low power level) along with the level 2 probabilistic safety analysis (beyond-design basis accident) and the safety analysis report for all units based on the pilot project implementation. The implementation of stage 1 of the assessment will allow to identify the safety level of all type design NPPs under operation that allows the State Nuclear Regulatory Committee to take a decision on NPP operation license issuance for each site operation based on the safety level as well as to set up priorities for further NPP safety improvement.

The additional materials on safety analysis developed for the pilot units, namely: South-Ukraine Unit 1 and Zaporizhzhya Unit 5 as well as additional materials on safety analysis for Rovno Unit 1 will be completed by the end of 2001. Preparation of additional materials on safety analysis for other units (Units 1, 2, 3, 4, 6 of ZNPP; Unit 1 of KhNPP; Units 2 and 3 of SUNPP; Units 2 and 3 of Rovno NPP) will be completed in 2001 - 2002.

The PSAs were implemented for pilot units, namely: Unit 1 of RNPP, Unit 1 of SUNPP, Unit 5 of ZNPP. The PSA for Units 1, 2, 3, 4 and 6 of ZNPP, Units 2 and 3 of Rovno NPP, Units 2 and 3 of SUNPP, Unit 1 of KhNPP will be completed in 2002. Materials of developed PSA for Unit 5 of ZNPP, Unit 1 of Rovno NPP, Unit 1 of SUNPP, Unit 1 of KhNPP have to be subjected to the procedure of independent peer review and State Expertise on nuclear and radiation safety. DBA analysis materials were developed for pilot units: Rovno -1 and SU-1. DBA analysis for Unit 5 of ZNPP will be completed in the first half of 2002. At present, the materials on the beyond design basis accident analysis are under preparation and planned to be completed in 2002 - 2003.

Measures related to the development of safety analysis report are being implemented in accordance with «Summary time-schedule of development of the safety analysis report section for power units with of WWER-440/ -213, WWER-1000 «small series» and WWER-1000/ -320 reactor installations». This schedule was agreed upon with the nuclear regulatory body.

In 2000, based on comprehensive analysis of current safety problems related to the deviations from requirements of effective national norms, standards, rules on safety and from achieved world level of safety and operation regulation, the NNEGC Energoatom developed the «Comprehensive programme on priority measures on upgrading and safety improvements of nuclear power units of Ukraine NPPs». This programme is planned to be implemented in the 3 years period. The document was agreed upon with Regulatory Body and submitted for approval by he Cabinet of Ministers of Ukraine. The «Programme etc.» includes:

- category 3 measures (in accordance with IAEA's classification);
- individual, the most essential category 2 measures (in accordance with IAEA classification);
- measures related to the analysis and substantiation of the safety, which form an integral part of safety analysis report;
- individual measures aimed at avoiding deviations from the effective normative documents or measures that have serious impact on the operation reliability.

The measures included to the Programme, are split into the 3 parts:

- measures for units with WWER-1000 reactor type installations;
- additional measures for power units with WWER-1000/-302, -338 (small series) reactor type installation;
- measures for power units with WWER-440/-213 reactor type installation.

After developing the safety analysis report it is planned to update and adjust the programme, specifically, the nomenclature and measures priority. These measures are postulated in the following documents:

- «Problems of NPP safety with WWER-1000/320 type reactors and their categories» IAEA- EBR-WWER-05;
- «Problems of NPP safety with WWER-440/213 type reactors and their categories» IAEA- EBR-WWER-03;
- «Problems of safety and their prioritisation for NPPs with WWER-1000 (small series) reactors».

This works is conducted with taking into account the contribution of measures to the safety enhancement with considering financial costs for their implementation. Implementation of priority tasks along with activity on support of current safety level ensures acceptable level of NPPs safety in Ukraine. Based on the results obtained while analysing the NPP safety, the following general conclusions can be made:

1. Neither national nor international safety analysis projects have revealed any safety deficiencies requiring to shut down any operating unit;
2. The design safety concept of Ukrainian NPPs equipped with WWER type reactors meet the requirements of the international approaches;
3. Implementation of the developed programme on operating power unit upgrading and improvements of operating practices would allow increasing their safety level.

This supports the confidence that Ukrainian power units under operation are able to work successfully during their service life (30 years). That allows establishing the tasks on measures development aimed at extension of the WWER power units service-life.

During the period from 2013 till 2020, eight VVER-1000 type units and two VVER-440 type units will be shut down. If the decision on the further nuclear power development is not being taken today, the nuclear power will cease its existence in 2020. Thus, taking into account its exceptional importance for the economical and political independence of Ukraine and the sluggishness of the important investments into the nuclear power sector, the first priority task of the Ukrainian National Economy is the decision on the development of the nuclear power industry. From many points of view such as: ecological, economical and strategically, from the view of the provision with the new fresh fuel, the final choice of the 21st century's reactor is extremely important for Ukraine.

The situation, which has become usual in the Nuclear Power Sector on the one hand corresponds to the general tendencies of manufacture stagnation, and on the other has specific features. In the whole, condition of Nuclear Power Sector is possible to characterize as the following:

- Growth of a share of electricity generation by NPS in general energy structure from 26% up to 45.3% for the period 1990-2000 (Figure 8).
- 43% reduction of general electricity production for the same period (Figure 10).

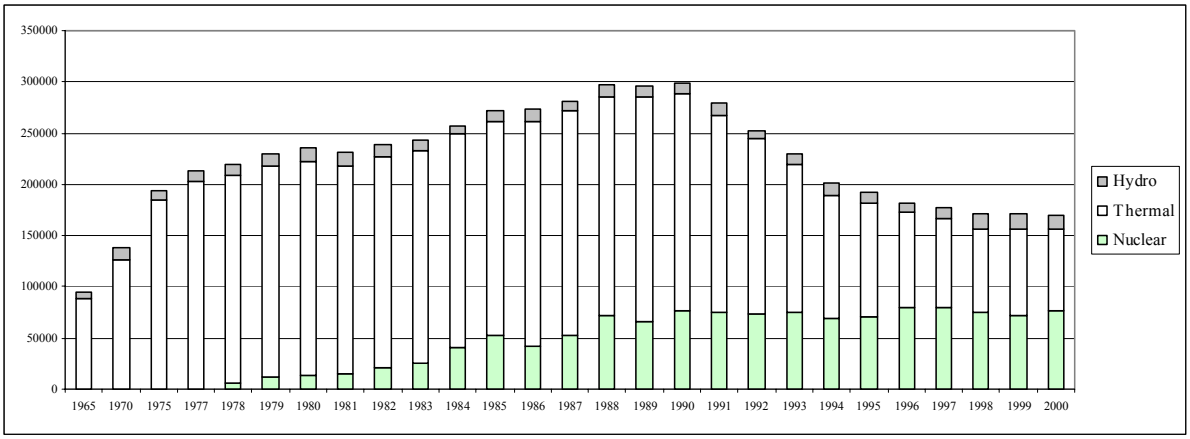


Fig. 10. The electricity production by the Power Plants of Ukraine, GW·h.

The reduction of general electricity production was not connected either with the reduction of NPP installed capacity (Figure 11) or with decrease of operating reliability. Is fact, Capacity Factor

(or Load Factor) even has grown in 1998 in comparison with 1990. Even if to take into account basic mode of NPP operations the above stated testifies to high stability of NPS.

NPPs' stability operating is especially important, because it provides reliable power supply of base branches of a national economy in the current situation with the supply of Thermal Power Plants (TPP) with organic fuel. The sharp jump of the prices up the world level (both for delivered fuel from the nearest foreign countries, and for the fuel extracted in Ukraine) is aggravated by poor quality of black oils (high level of sulphur) and coal (high ash). Besides, the crisis in fuel supplying of TPP coincides with mass ageing of the equipment that, first of all, concerns 200 MW units. All those have caused 61% fall of electricity generation by Thermal Power Plants (Figure 10). In due to the absence of the precise concept by Thermal Power development can be expected, that the reduction of its share in Power Balance will proceed.

It is obvious, that in conditions, where input of new Hydropower capacities and real opportunities of participation of untraditional sources of energy in industrial production of the electricity with few (may be mush less) percents, the NPPs' share in ecologically clean kinds of energy has the steady tendency to growth.

On the other hand, with increase of the NPP share in electricity production, and also due to instability of manufacture on the overwhelming majority of the enterprises there is a necessity of Nuclear Power transition to an adjustable part of the consumption diagram. It, in turn puts increased requirements to reliability and safety.

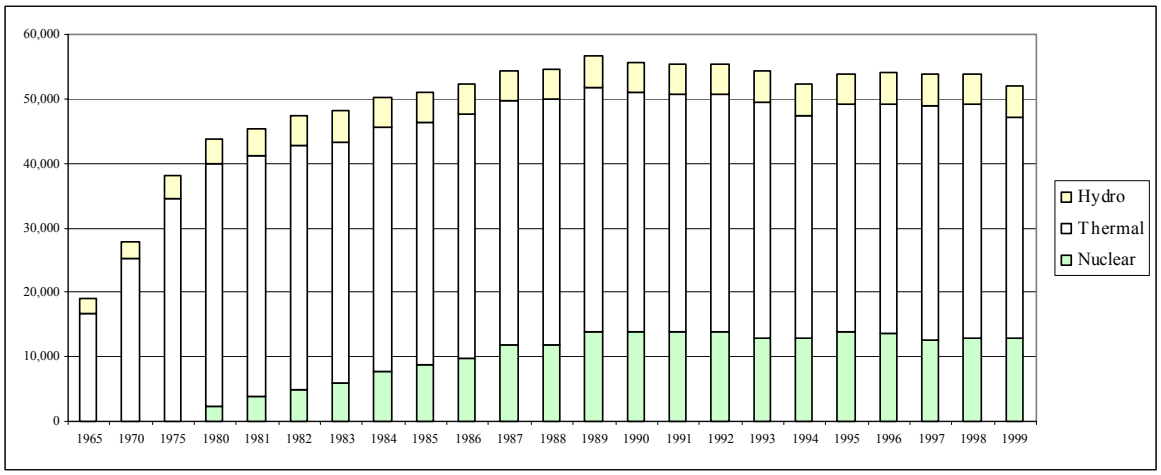


Fig. 11. The installed capacity of the Power Plants of Ukraine, MW.

Zaporozhe NPP

The Zaporozhe NPP now is the most powerful energy supplier in Europe, generating one-fifth of the Ukraine electricity. It makes 40 % of the electrical power produced by the Ukrainian NPPs. Zaporozhe NPP is situated in the south-eastern part of Ukraine on the bank of Kakhovka reservoir in Kamenko-Dneprovsky district, 60 km from Zaporozhe. Zaporozhe NPP is situated not far from Zaporozhe thermal power station which operates on fossil fuels (coal, gas, fuel oil). The construction of the Zaporozhe NPP was commenced in 1979. The plant's site occupies 104.7 hectares. Zaporozhe NPP consists of six units with VVER-1000 units. Each of the 6 power units consists of the WWER-1000 reactor, K-1000-60/1500-2 Turbine, TBB-1000-4 Generator. The service water supply is used with cooling pond and cooling towers. Compensation of losses within the service water system is conducted through the discharge channel of Zaporozhe TPP.

South-Ukraine NPP

The South-Ukraine NPP is located in the south of Ukraine on the river Yuzhny Bug in Nikolayev region. The NPP design foresees creation of the new type of the Utility that would resolve the problems of the complex and rational use of the power, generated by the nuclear power plant, the hydroelectric power plant and also by the pumped storage power station. The construction of the South-Ukraine NPP began in 1976. At present the plant has 3 nuclear power units in operation (Electrical capacity of each unit is 1000 MW). The civil works on hydraulic complex and on Unit 4 have been frozen. Each of power units 1 and 2 consists of the WWER-1000 reactor, K-1000-60/1500 Turbine, TBB-1000-4 Generator; unit 3 consists of the WWER-1000 reactor, K-1000-60/3000 Turbine, TBB-1000-2 Generator. The service water supply (reverse flow) with cooling tower and cooling pond are used. Compensation of losses within the service water system is performed from Yuzhny Bug river.

Khmelnitski NPP

The KhNPP is located in Slavuta area of Khmelnitski region, near the Pripyat's tributary. The construction of KhNPP has been started in 1981. The total design capacity of NPP is 4000 MW. Unit 1 has been put into operation in 1988. Unit 1 includes the WWER-1000 reactor, K-1000-60/3000 Turbine, ТВВ-1000-2УЗ Generator. The service water supply (reverse flow) with a cooling pond are used. Compensation of losses within the service water supply system is performed from Horyn river. As a result of the moratorium, the construction of the other power units was halted. At present in place of 4 nuclear power units stipulated by the design, there is only one power unit in operation. That creates significant difficulties in the operation of the nuclear facilities in Ukraine. After the moratorium was lifted, the work on completion of Unit 2 has been renewed again.

Rovno NPP

The Rovno NPP is located in Rovno region on the bank of the river Styr. The construction of NPPs began in 1973. In 1980 and 1981 the power units with WWER-440 type reactor (second generation's units) were put into operation. In 1986 Unit 3 built according to the unified design, has been connected to the grid. At present Rovno NPP comprises 3 nuclear power units in operation, the total electric capacity of which is 1,818 MW. Power units 1 and 2 include WWER-440 reactors, two turbines K-220-44, 2 generators TBB-220-2; power unit 3 consists of WWER -1000 reactor, K1000-60/3000 turbine, TBB-1000-2 generator. The service water supply (reverse flow) with cooling towers is used. Compensation of losses within the service water supply system is performed from Styr river. The construction of the Unit 4 the estimated capacity of which will be 1000 MW is going on.

Chernobyl NPP

The Chernobyl NPP is located in Polesye region, on the bank of the river Pripyat. The construction of ChNPP began in 1970. From 1977 till 1984 four power units were put into operation. The Units 1 & 2 are the first generation's units and Unit 3 and 4 are the second generation's ones. All power units at ChNPP have only 1 heat transport circuit. Each power unit comprises the light water cooled graphite moderated reactor (Pressurized tube reactor), 8 main circulation pumps, 4 steam drums and two turbines K-500/65-300 with generator TBB-500. The turbines are installed in the turbine building, which is common for all units. Each reactor is housed in a separate building.

After the accident at Unit 4 all power units of ChNPP were shut down. The start-up of the Units 1, 2 and 3 was conducted after the development and implementation of the large complex of top-priority and long-term measures, focused on the upgrading of the safety of NPPs with RBMK type reactors. Unit 1 was shut down at 30 November 1996. In accordance with the «Programme on Termination of ChNPP Unit 1 Operation», the nuclear fuel is being removed from the reactor core. Unit 2 was shutdown in October 1991. Fuel assemblies were unloaded from the reactor and process

equipment was preserved. At that time, the work specified by the «Programme on Termination of ChNPP Unit 2 Operation» is going on.

Pursuant to the Memorandum of Understanding between Governments of «G-7» countries, the European Commission and the Government of Ukraine on the closure of Chernobyl NPP, dated 20 December 1995, and following the commitments undertaken by Ukraine under the Convention of Nuclear Safety, the Cabinet of Ministers of Ukraine approved Resolution № 598 dated March 29, 2000 on «Early Closure of Nuclear Power Unit № 3 Operation and Final Closure of Chernobyl NPP». As a result, the operation of Chernobyl Unit 3 was halted on 15 December 2000. The Resolution by the Cabinet of Minister dated 29 November 2000 №1747 on «Final Shut-down of Chernobyl NPP» approved both the «Comprehensive Programme on Closure of Chernobyl Unit 3 Operation» and «Comprehensive Programme on Chernobyl NPP Decommissioning». Chernobyl NPP developed the «Comprehensive Programme on Chernobyl NPP Decommissioning», which was approved by the Resolution №1747 of the Cabinet of Ministers of Ukraine dated November 29, 2000. The Comprehensive Programme covers two decommissioning stages: termination of operation and mothballing (preservation); further stages are given just conceptually. In accordance with the Comprehensive Programme the annual scope of financing provided from the State Budget for the first five years, is foreseen at the level of 500 million UAH. Based on the «Comprehensive Programme on Chernobyl NPP Decommissioning», the Programmes on shutdown of Chernobyl Units 1, 2 and 3 for the next stage, the State Nuclear Regulatory Committee of Ukraine and Chernobyl NPP started preparing a license for ChNPP decommissioning.

3.3. Current Policy Issues

Main tasks:

- draft a State Programme for Development of Ukraine's Nuclear Power Engineering with account of IAEA and EU requirements, incorporating the Programme of Action for the Extension of NPP Service Life and the Programme of Enhancement of NPP Safety;
- complete the establishment of the State Committee of Ukraine for Nuclear Regulation as an independent regulating body in the field of nuclear power engineering, within one year;
- ensure fulfilment of Ukraine's commitments within the framework of the International Nuclear Safety Convention, including completion of reassessment of safety of all nuclear reactors, preparation of the National report on enhancement of nuclear safety for the Second conference on verification of fulfilment of the Convention requirements (April, 2001);
- equip radiological units of Ukraine's sanitary and epidemiological service with special devices for radiation detection; complete the construction of the second concrete sarcophagus (over the existing one) at the "Shelter" object before 2010; commission a spent nuclear fuel storage facility at the Zaporozhe Nuclear Power Plant in the course of one year;
- commission the first phase of a complex for radioactive waste collection, transportation, disposal and burial in the course of two years;
- enhance control over the storage and burial of dismantled sources of ionising radiation; settle the issue of return of dismantled powerful sources of ionising radiation, manufactured by Russian enterprises, to manufacturers within a year;
- complete the formation of the system of physical protection of nuclear power engineering sites within a year;
- raise the load (capacity) factor of nuclear power plants to the designed level (74.2%), particularly at the expense of reduction of unplanned downtime;
- provide for reconstruction of systems of automated control of technological processes at all Ukrainian NPPs within two years; solution of the issue of development, production and supply of automated control systems for the reactors being built at the Khmelnitski and Rovno Nuclear Power Plants;
- ensure repayment of NPP debts to contractors (over 220 million UAH) for repair work performed, within two years;

- form a set of regulatory-legal acts on: NPP decommissioning (including the Chernobyl NPP); construction of substitute nuclear generating capacities; creation of elements of the domestic nuclear fuel cycle; transformation of the "Shelter" object into an environmentally safe system;
- sign an agreement with the EU on the co-operation in peaceful use of nuclear energy and nuclear components trade.

The very special place among the nuclear installations of Ukraine belongs to Chernobyl power unit 4 («Shelter» Object), destroyed during the severe accident in April 1986. The undertaken emergency operating measures allowed ensuring the current safety of this facility. This was confirmed in a specific report on «Shelter» safety analysis and the prospective estimates of situation development (September 1996), on the basis of which the nuclear regulatory body issued a license for Chernobyl NPP «Shelter» operation to the operating body. Transformation of the «Shelter» object into the ecologically safe system requires significant financial and material resources, utilisation of non-standard innovative science and engineering solutions. Therefore, in the Ukrainian Law «On Ratification of Convention on Nuclear Safety» Verkhovna Rada (the Parliament) of Ukraine warns of the following:

1. Verkhovna Rada of Ukraine adopted a critical decision to ratify the Convention on Nuclear Safety, thus supporting its adherence to the principles of nuclear safety culture and their practical implementation, and in view of that the international community and the IAEA member- countries recognise uniqueness of «Shelter» object located on the territory of Ukraine that is conditioned by the global consequences of Chernobyl disaster. At present, there are no technologies for transforming the «Shelter» object into the ecologically safe system and the complex of necessary measures have not been yet identified to achieve high level of «Shelter» nuclear safety that meets the Convention's requirements. In view of that, Ukraine is unable within the short term to settle on its own this large-scale problem and relies on the IAEA's support as well as that of the international organisations and individual states in resolving scientific and technological problems of the «Shelter» safety. This also will contribute to achievement of the goals of the Nuclear Safety Convention.

2. The provisions of Article 3 of Convention shall not be applied to the «Shelter» object. Pursuant to the above mentioned Ukrainian Laws this Report does not consider individual problems that are related to the «Shelter» object safety. At the same time it should be mentioned that the Shelter Implementation Plan aimed at guaranteed «Shelter» safety assurance was developed by experts of Ukraine and «G-7» countries and approved by respective governments. This Shelter Implementation Plan (SIP) while implemented has to result in and intended for:

- reduction of the risk of building structure collapse;
- minimisation of consequences of potential accident-induced breakdown;
- improvement of the nuclear safety;
- enhancement of the personnel working conditions;
- improvement of the ecological safety;
- development of the strategy for transforming the «Shelter» object into ecologically safe system, including the strategy for fuel-containing material removal.

In accordance with the SIP the developed specific measures aimed at implementing the Action Plan include the parties' commitments on its financing. The above plan covers all aspects of the «Shelter» object safety. To date the first phase of the project implementation has been completed: possible stabilisation measures were identified, the data required for design initiation stage were obtained and integrated.

The works are widely performed to complete and commission two power units with high level of readiness that are equipped with WWER-1000 type reactors, namely Khmelnitski Unit 2 and Rovno Unit 4 (expected terms of their start-up - 2003 and 2005, respectively). Besides completion of two power units (Kh2/R4) construction, last year the funding started and civil works were initiated to

complete the Tashlyk HaPP (consisting of 6 power units rated at 150 MW each with the total capacity of 900 MW). This facility is included to the Industrial Complex of SUNPP.

This enables the ENERGOATOM to participate in regulating frequency within the energy system and contribute to the further strengthening of the Company' s role in the energy market. The first stage of the THaPP construction (two power units with the total capacity of 300 MW) is planned to complete within two years. The THaPP is expected to finally complete in 2006.

After 2010, Ukraine will have to re-new gradually our «reactor fleet». The nuclear power industry is a specific production sector allowing for the long-term process initiated with the unit construction start till its completion. In the former Soviet Union the power units were constructed in 7–10 years, today under current conditions this process will require 15–20 years.

Actually, the appropriate moment already came to define the type and capacity of a future reactor, look for partners for cooperation in the power machine engineering and the raw material mining and processing for the nuclear fuel of modification required. Now the facilities of a new generation are proposed by the USA, France, Canada, Russia and other countries. Ukraine should weight all "*pro and contra*" and make its choice in favour of either reactor type.

3.4. Organization Charts and Scheme of the Nuclear Sector Structure.

At present, the refurbishment of the nuclear energy sector is being carried out in order to:

i. to provide the population and national economy with reliable electric energy supply;
ii. to create the own nuclear fuel cycle and scientific-technical and engineering support of the nuclear energy;
iii. to complete the market reforms in the electric energy systems of Ukraine;
iv. to improve their efficiency during state property refurbishing.

Figure 12 shows the structure of the nuclear sector.

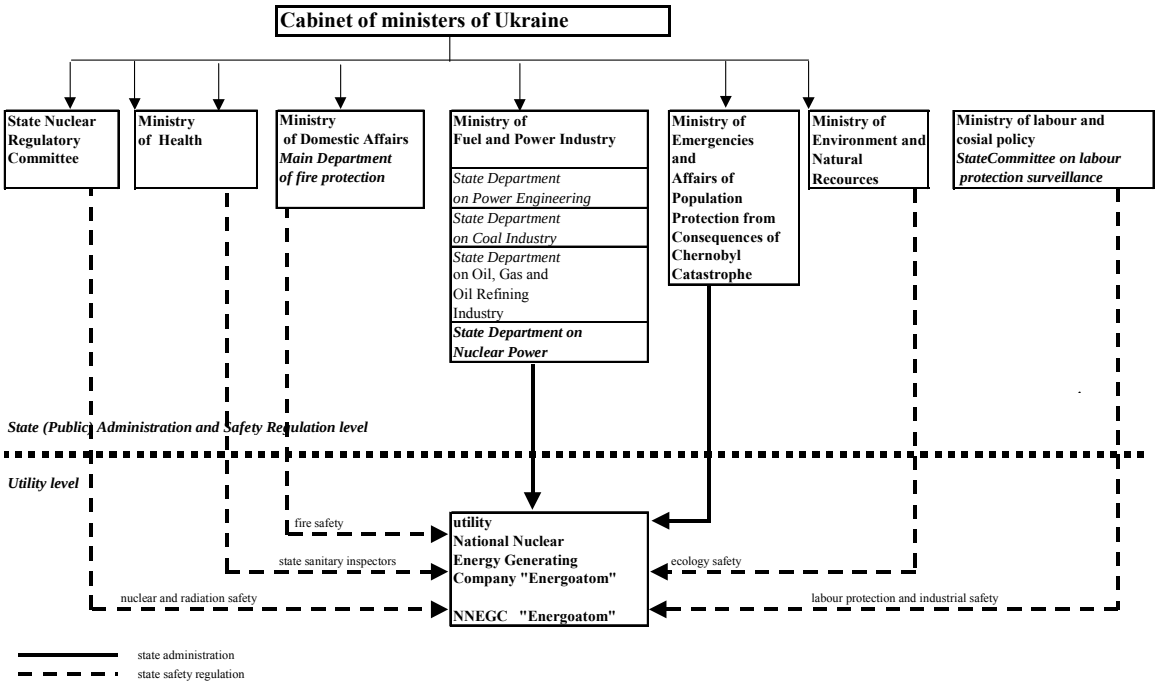


FIG. 12. The nuclear sector structure (status end of 2000)

Organization Chart of the State Nuclear Regulatory Committee of Ukraine

- Chairman
- First Deputy Chairman
- Deputy Chairman
- Deputy Chairman - Chief Nuclear & Radiation Safety Inspector
- Cabinet of the Chairman
- Accountant Office
- Department of Physical Protection and Security
- Department of Planning, Coordination and Development
- Department of Regulations and Legal Matters
- Administrative Department
- Personnel Office
- Department of Safety of Nuclear Facilities
- Department of Safety of Radiation Technologies
- Department of Safety of Waste Management
- Department of Monitoring and Emergence Preparedness
- Main Nuclear and Radiation Safety Inspection Office
    - Department of Inspection Coordination
    - Department of Assessment of Nuclear and Radiation Safety
    - Office of Safeguards

Resident Offices:

- State Inspection at Zaporozhe NPP
- State Inspection at Rovno NPP
- State Inspection at South Ukrainian NPP
- State Inspection at Khmelnitski NPP
- State Inspection at Chernobyl NPP

4. NUCLEAR POWER INDUSTRY

4.1. Supply of NPPs.

Scientific management of NPP development	Scientific centre "Kurchatov Institute" (Russia)
NPP design	“Kievenergoproject” (general designer for RNPP, KhmNPP, ChNPP); “Kharkovenergoproject” (general designer for ZNPP, SUNPP).
Energy equipment development	NIKIET (Development Institute of Power Engineering, Moscow, Russia), OKB GP (Pilot Design Bureau “Gydropress” (Podolsk, Russia), ZKTI (Central Boiler and Turbine Institute, S.-Petersbourgh, Russia).
Equipment production and supply	“Atommash” (Russia), “Izhorsky Plant” (Russia), LMZ PEO “Electrosila” (Leningrad Metallic Plant, S.-Petersbourgh, Russia); Podolsky machine manufacturing plant (Podolsk, Russia), PO “Turboatom” (KhTZ - Kharkov Turbine Plant, Kharkov, Ukraine), PO “Zaporozhtransformator” (Ukraine), Khartron-Enkos (Ukraine), Westron (Ukraine), Machine works on energy equipment and pumps manufacture (Sumy, Ukraine), Arma (Kiev, Ukraine), Metae Plant (Ivano-Frankovsk, Ukraine), Machine works (Kharkov, Ukraine).

4.2. Operation of NPPs

All Ukrainian NPPs are state organizations. On 17 October 1996 the National Nuclear Energy Generating Company "Energoatom" -NNEGC- was established by the Decree of the Cabinet of Ministers to create the state management system and to ensure the safe operation of the Nuclear energy facilities. According to this Decree the rights of the Operating organizations have been channelled to NNEGC.

Analysis of needs of Ukrainian NPPs in staff proved the necessity of establishing the national system of training and developing the network of educational institutions for training specialists for enterprises and organisations of nuclear power and industry. It also allowed setting the ordered quantity for training of fledgling specialists in the higher educational institutions of the Ministry of Science and Education of Ukraine in the period until the year of 2005. The training system functions in co-operation with the organisations, enterprises, state administrative and regulatory bodies, and other systems in order to get advanced training, retraining, upgrading and maintaining of the staff qualification for the purpose of gaining and maintaining knowledge, capabilities and skills required for safe operation of nuclear power plants. The established system shall ensure fulfilment of the following tasks:

- Planning, co-ordination and improvement of the training system;
- Regulation, licensing of and supervision over training;
- Organisation of training and staffing with qualified personnel, provision with material, technical and financial resources, supplying with documentation;
- Personnel training and qualification maintaining.

Based on Articles 7 and 9 of the Law of Ukraine «On Permissive Activities in the Nuclear Energy Field» and Resolution of the Cabinet of Ministers of Ukraine № 1683 of November 8, 2000, a list of jobs of the personnel directly involved in the operation of the reactor installation and subject to licensing was defined. The regulatory body on nuclear safety exercises licensing of training of NPP personnel in compliance with the normative document «Provisions on Licensing of Training of NPP Personnel of Ukraine». This document sets the list of requirements and procedures for assessment of capability of the participants of licensing action to perform it; regulates control procedures of licensing, as well as procedure for record and storage of licensing process related documentation. The Requirements for licensee, training units of operating body are set in the normative document «Licensing Requirements for Training Personnel of Ukrainian NPPs». NNEGC Energoatom has obtained licences for NPP personnel training in respective training centres of Zaporozhe, Khmelnitski, South-Ukraine and Rovno NPPs. NPP Training Centres development is on-going. At present there are 475 employees in training centres, 168 of them are instructors and teachers. Training is carried out in classrooms, laboratories, shops and working places in compliance with the individual training programmes based on the reference programmes. The training employs technical training aids, i.e. base principle simulators, functional and analytical simulators, full-scope simulators, computerised training systems. Full-scope simulators are put in operation at ZNPP 5, RNPP 3, KhNPP 1, SUNPP 1,3 Functional and analytical simulators are commissioned at ChNPP, RNPP, KhNPP and SUNPP. The work on creation of full-scope simulators for WWER 440 is going on.

Today, all Ukrainian NPPs are staffed to full extent with trained and certified personnel. At the same time, comparison of the staff indicator (the number of staff employed per unit of installed capacity of a power plant) at Ukrainian NPPs and foreign ones shows that this indicator of the Ukrainian nuclear installations is much higher. On one hand, it can be explained by the fact, that, in addition to operators who directly carry out and control processes of electricity generation, production personnel includes personnel of the plant services, which maintain, repair, adjust and test equipment and process systems. On the other hand, this fact proves that some significant reserves are available for improvement of NPP organisational structure. Certain activities are carried out in this area at the moment, though traditional approaches and lack of jobs in NPP satellite towns are evident.

To prevent or avoid the impact of the human factor as a NPP performance failure cause due to the lack of correspondence of psycho-physical condition and qualification of the personnel with applicable requirements, the operating body shall use an operating experience feedback system in the course of personnel training at the NPP training centres. The assessment structure of the effectiveness of the training system of Ukrainian NPP personnel, taking into account human factor is as follows:

- Analysis of reports on violations comprising off-normal events due to the human errors;
- Inspections by the nuclear regulatory body of the training centres of NPPs aimed at study of the opportunity of issuing licence for training on specific job positions of the personnel;
- Analysis of reports on accidents due to the gaps in teaching industrial safety.

An indicator of unreadiness of operating personnel is calculated in order to assess technical level of operating personnel preparedness to operate a power unit under various operating modes. The active fallacious actions of the personnel resulting in violation; wrong actions or inaction of the operating personnel during transients at violations in the NPP operation are taken into consideration.
In 1998 the annual number of these active fallacious actions was 15, in 1999 and 2000 - 10. Apparently, the decrease in number of fallacious activities is 30 % and is maintained on the same level as a result of the task-oriented work on operating personnel training. In addition, based on the analysis of the factors (ergonomics, availability and quality of the documentation, working environment, etc.), which had impact on decision-making process and performance of personnel, the following corrective measures (done by the Ukrainian organisation with assistance of the US and German experts) had been implemented in the industry:

- Safety Parameter Display Systems were implemented at the control rooms of the power units, which are intended for improvement of ergonomics of the control room personnel and facilitation of the diagnostics of the power units condition;
- Emergency Symptom Oriented Instructions (Procedures) were implemented, which are aimed at increase of the staff reliability at power unit operation in the course of elimination of the accident condition;

A number of administrative activities having impact on the human factor is underway. They are as follows:

- a person is admitted to the work on nuclear installations and with nuclear materials only following a special examination;
- psychological and physical condition of the personnel is controlled;
- the internal departmental supervision over staffing and training of NPP personnel, improvement of safety culture is exercised;
- authorised persons who directly operate nuclear installation are subject to licensing.

4.3. Fuel Cycle, Spent Fuel and Waste Management Service Supply

The development of the nuclear industry of Ukraine is going on under the following programmes:

- Comprehensive programme for nuclear fuel cycle establishment;
- Programme concerning integration of Ukrainian zirconium production into the nuclear fuel for the WWER-1000 reactors;
- Programme dealing with the spent fuel management. Main tasks in the area of the Ukrainian NPPs' spent fuel management for the period till 2010. This programme concerns establishment of on-site (near-site) storage for long-term (up to 5 years) "dry" storage of spent nuclear fuel at all NPPs site of Ukraine, moreover organization of spent nuclear fuel containers manufacture in Ukraine, establishment of central storage for long-term "dry" storage of the spent nuclear fuel. The problem of the reliable and safe radwaste storage also has to be solved;

- The programme of equipment manufacture and technology mastering for the NPPs of Ukraine.

For the normal functioning and development of the nuclear industry, it is necessary to supply it with nuclear fuel. This problem became a long time ago apparent and subsequently a comprehensive programme for the nuclear fuel cycle (NFC) creation in Ukraine was developed. However, it didn't materialize. Meanwhile, the conditions for organization domestic nuclear fuel production in the Ukraine are quite good.

Figure 13 shows the structure of the possible nuclear fuel cycle. The only problem will be the enrichment of Uranium. Realization of the scheme would facilitate the fuel supply and is expected to be profitable for Ukraine.

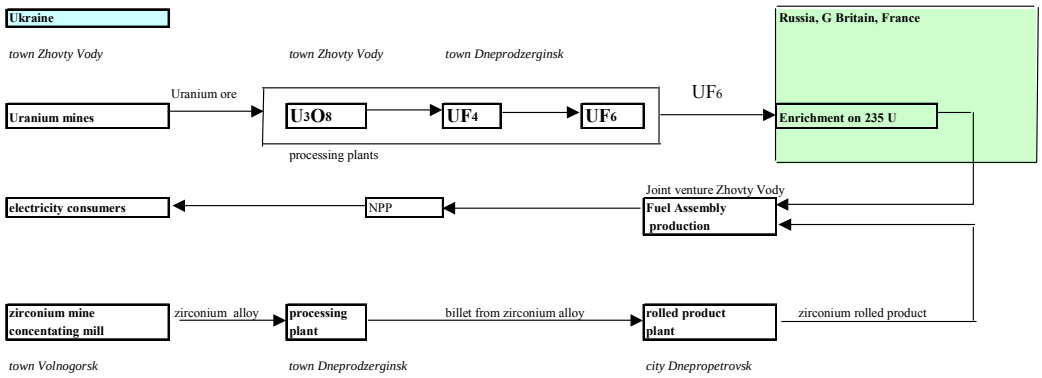


FIG. 13. Structure of the Fuel Cycle

The uranium ore mining and uranium concentrate production in Ukraine is performed by the Vostochny Uranium Ore Mining and Processing Enterprise (VostGOK). The main product of the enterprise is natural uranium concentrate. The commercial and industrial activity of the VostGOK on the natural uranium mining and processing is aimed at implementing the «Comprehensive Programme of Nuclear Fuel Cycle Creation in Ukraine». The programme on the development of the nuclear energy's raw material sources allows for covering the NPPs demand for uranium and is focused on two main areas: maintaining of the existing production capacities and increasing of the output up to the level of the nuclear energy demand for natural uranium.

To settle the spent nuclear fuel and radioactive waste management problems, the Cabinet of Ministers adopted Decree №542 dated 5 April 1999, according to which a new «Comprehensive Programme on Radwaste Management» was established. Following the Order No. 7, issued by the Minister of Fuel and Energy on 13 January 2000, the «Comprehensive Programme of Management of NPP Spent Nuclear Fuel» was established. In accordance with the adopted decisions and with the financial assistance of the Nuclear Safety Account (jointly established by the «G-7», the European Commission and some other countries) a storage facility of spent nuclear fuel is being constructed on the Chernobyl site. The design of the storage facility allows for safe storage of 25 000 spent fuel assemblies and additionally, 3 000 used absorbers in a dry-type storage facility. After commissioning a new storage, the existing one will be decommissioned. Activities on the first stage of spent nuclear fuel storage were completed at ZNPP based on the method of «dry» storage in reinforced concrete casks. The Nuclear Regulatory Committee completed assessment of the Storage Safety Analysis Report and granted the license to the Operating Body-Utility.

4.4. Research and Development Activities

After the USSR break down the considerable part of the scientific and technical support of the nuclear power remained in Russia. Without such basis the Ukrainian nuclear power is not able to exist and it must not. In Ukraine there is a sufficiently powerful scientific basis, but it was insufficiently

specialized on the problems of the nuclear power field. NNEGC “Energoatom” supports continued relations with respective Russian counterparts, and, first of all, with organizations of the main designer (SDB “Gydropress” and NIKIET), VNIIAES and with Russian scientific centre “Kurchatov Institute”. At the same time, Ukraine is conducting activities aimed at creation of the national infrastructure of scientific and technology support of the NPP safe operation. In 1997, the Institute for NPPs operation support was established. Its main functions and tasks are as follows:

- collection, analysis and summarizing of NPPs operational experience, development of corrective measures;
- creation and population of data bank concerning equipment’s and flow diagrams’ failures;
- Assessment and re-assessment of the safety of power units in operation and under construction, participation in the preparation of safety analysis reports;
- participation in the development of the modernization programmes of units in operation for the purpose to improve the efficiency and safety of their operation;
- execution of functions of the nuclear power sector’s expert organization in the field of scientific and technical support of NPPs operation.

The institute was established on a joint-stockholding basis and includes several organizations that have certain work experience in the area of nuclear power utilization. Significant assistance to the institute development, its personnel’ professional skill upgrading as well as for strengthening of procedure and technical basis, is provided by the US national laboratories an engineering companies under the financial support provided by the US Government.

Scientific activities are carried out by the Ukrainian Institute for Nuclear Research. The main direction of in the institute is the development of work connected with scientific and technical support for the safe operation of the nuclear power plants. The direction of the work is to:

- elaborate neutron-physical calculations of core operation regimes in water-water power reactors for Ukrainian nuclear power plants;
- evaluate the multiplication factors, neutron spectra and neutron flux density space distribution in the "Ukryttya" Shelter;
- study the effect of fast neutron fluence on water-water power reactor vessels;
- develop and ground the technical aspects for the programmes of nuclear reactor decommissioning;
- develop the methods for evaluation of fire hazard at the facilities with the increased radiation risk.

Ukrainian INIS Centre (International Nuclear Information System) functions at INR. This system contains information on more than 2 million publications in nuclear science and technologies.

Unfortunately, a number of scientific support’s components do not meet the current requirements. Ukraine should create a sector scientific support covering various aspects such as: availability, diagnostics, calculation codes, water chemistry, technology for the spent fuel and radwaste management, equipment certification, decommissioning issues and etc. Now there is such an opportunity, that is the creation of scientific support of the nuclear power sector on the basis of the Kharkov Scientific centre - “Physics & Technological Institute”.

In Ukraine, there are specific installations, such as the "Shelter" and the Zone and there are problems in connection to NPP decommissioning. For this purpose, it is suggested to expand the Shelter. Establishing the Programme on Nuclear Power development in Ukraine the Cabinet of Ministers proceeded from the assumption that Ukraine, which is taking the path of the road of market economy creation, needs the deep social and economic reorganizations and transformations, the effectiveness of the energy policy. At the same time it should take into account the power resources balance, the competitiveness of the different energy sources, the ecological, political, social and economic consequences of the different ways of the country's power development. Today all these facts are assuming the special significance.

4.5. International Co-operation in the Field of Nuclear Power Development and Implementation

International co-operation intended for the provision of nuclear safety and safety culture improvement at the Ukrainian NPPs, development and implementation of QA programmes, development and improvement of scientific and technical support, solution of Chernobyl problems, etc. is one of the principal areas of the NNEGC «Energoatom»'s activity. The USA, the United Kingdom, France, Germany, Spain, Canada and other countries are the partners of Ukraine in the field of nuclear power. Since 1992 the European Community has been rendering technical assistance within TACIS programme to improve safety of the Ukrainian NPP's. Representatives of French, German and Spanish companies act as consultants at ZNPP, RNPP, KhNPP and SUNPP. Implementation of the projects under the Soviet Design Reactors International Nuclear Safety Programme is one of the major areas of co-operation with Japan, the UK, France and the USA as well as with international organizations such as IAEA, WANO, EC, etc., which provide assistance in the field of personnel training and qualification upgrading and in the field of experience exchange.

VARTA - the Intention Protocol on the co-operation with GOSKOMATOM has been signed on 15 March 1994 for a storage battery supply.

SIEMENS - an agreement on the supply of a cask for radwaste accumulation, storage and transportation has been signed on 21 April 1995.

WESTINGHOUSE ELECTRIC - co-operation in advanced technology supply and I&C systems.

EDF - the permanent group is working within the TACIS framework at Rovno NPP.

CEGELEC - the development of new modifications "Zentralog" for I&C; the preparation of the project on Zaporozhe NPP physical protection.

DUKE ENGINEERING - the contract on the construction of a dry storage cask at Zaporozhe NPP has been signed.

COGEMA - negotiations on joint uranium ore mining.

USA DOE – supports the following activities at KhmNPP, RNPP, SUNPP and ZNPP:

KhNPP

Scope and Status of Activities

At the KhmNPP, DOE's efforts have focused mainly on establishing the Khmeltnitski Training Centre, a fully equipped training facility at which operators from other Ukrainian reactors can be trained in the Systematic Approach to Training methodology (1993-1998). A full-scope simulator to enhance the effectiveness of operator training also was provided as part of this effort. Job-specific and general safety-related courses were developed for use at the Khmeltnitski Training Centre and at other Ukrainian nuclear plants (1993-1998). Other major projects focus on developing improved operating procedures and practices (1996-2004) and providing a safety parameter display system (1996-1999). Other projects support in-depth safety assessments (1998-2003) and provision of non-destructive examination equipment (1997-1998).

Accomplishments:

Management and Operational Safety

- A full-scope simulator was installed at the plant in December 1997; the simulator is now in use for training plant operators.
- Basic equipment was provided for the development and support of the Khmelnitski Training Centre. This equipment included computers, scanners, printers, photocopiers, fax machines, office furniture, whiteboards, overhead projectors, projector screens, and various consumables and office supplies.

- A fully equipped nuclear power plant-training centre was established at the plant. To date, more than 2,000 personnel have taken courses at the training centre.
- Operator exchanges that trained plant personnel to develop improved operating safety procedures and practices were completed.
- Training specialists from the Khmelnitski Training Centre, working with U.S. specialists, developed and conducted eight planned job-specific maintenance and operating courses and four planned general courses on nuclear safety-related topics.
- To complement the eight job-specific maintenance and operation training courses, course-specific equipment was provided to the plant. This equipment included soldering stations, a refuelling simulator with video simulation capabilities, water chemistry equipment, and AutoCAD workstations.
- The mechanical maintenance, motor-operated valve repair course was developed at the Khmelnitski Training Center and transferred for use at the Balakovo Training Centre.
- Plant managers attended workshops to familiarize themselves with the elements of the Ukraine national standard for quality assurance. Administrative and management changes were started to implement the standard at Khmeltnitski.
- Computer equipment was installed to support development and pilot implementation of the Ukraine Reliability Database at Khmelnitski.

Engineering and Technology Upgrades

- A safety parameter display system was installed, tested, and placed in operation at the plant.
- Two advanced ultrasonic flaw detectors were delivered to the plant.

Plant Safety Evaluations

- An in-depth safety assessment for Unit 1 was initiated, and data collection and system design documentation tasks were begun. Computer equipment for the in-depth safety assessment work was installed at the plant.
- Technical transfer training was provided in the areas of thermal-hydraulic analysis, containment analysis, radiological inventory, and probabilistic risk assessment.
- Safety computer codes were transferred to the Ukrainian project staff: RELAP5 (thermal-hydraulic), CONTAIN (containment), MELCOR (containment), ORIGEN (radiological inventory), and SAPHIRE (probability).

RNPP

Scope and Status of Activities

At Rovno nuclear power plant, DOE projects include developing emergency operating instructions (1993-1998), improving operator training (1997-2002), and performing in-depth safety assessments (1997-2005).

Accomplishments:

Management and Operational Safety

- Emergency operating instructions that promote safety through improved accident mitigation strategies for WWER-440/213 units were developed. Analysis for validating these instructions is under way.
- Operator exchanges that trained plant personnel to develop improved operating safety procedures and practices were completed.
- The Preliminary Design Specification (PDS), Interim Design Specification (IDS) and control panels for the Rovno Unit 3 full-scope simulator were completed. The project is scheduled for completion during 2001. Key components (e.g., computer platform, control panel, input-output control devices) were delivered for the WWER-1000 full-scope simulator at Unit 3.
- Work is under way to develop a full-scope simulator for Rovno Unit 2. A team of Ukrainian specialists is working with U.S. vendor GSE Power Systems to develop this simulator, which is scheduled for completion in 2002.
- The transfer of the Systematic Approach to Training methodology and materials developed at the Khmelnitski Training Centre to the Rovno plant continues. Pilot training courses for the

Instrumentation and Control Technician, Unit Shift Supervisor, and Control Room Reactor Operator positions were developed and implemented.
- To complement the pilot training course on instrumentation and control for pressure transmitters, pressure calibration course-specific equipment was provided to the plant. Basic equipment, including a computer with network capabilities, a printer, and associated consumables, was provided for the development and support of training.
- Three Rovno staff members were trained to conduct internal quality assurance audits. Plant managers attended workshops reviewing plant and Energoatom activities to implement the Ukraine national standard for quality assurance at nuclear facilities.
- An audit was completed of nuclear fuel handling at Rovno.

Engineering and Technology Upgrades
- Six advanced ultrasonic flaw detectors were delivered to the plant.
- A safety parameter display system was installed in Unit 3. Pilot plant operation was initiated in early 2000.

Plant Safety Evaluations
- Computer equipment for the in-depth safety assessment work was installed at the plant.
- The in-depth safety assessment for Unit 1 was initiated. Contracts were awarded for planning, development of project guidelines, an internal-event probabilistic risk assessment, and a deterministic risk assessment.
- Technical transfer training was provided in the areas of thermal-hydraulic analysis, containment analysis, radiological inventory, and probabilistic risk assessment.
- Safety computer codes were transferred to the Ukrainian project staff: RELAP5 (thermal-hydraulic), CONTAIN (containment), MELCOR (containment), ORIGEN (radiological inventory), and SAPHIRE (probability).
- Documentation of previous probabilistic risk assessment work was completed. Data collection, system documentation, a baseline thermo hydraulics model, fault-tree models, and event-tree models were completed.
- Design basis accident analysis and probabilistic risk assessment Level 1 analysis began. These analyses are past the 50 percent completion level.
- Data collection began for internal hazards (fire and flood) and external hazards (fire, flood, seismic, and other).

SUNPP

Scope and Status of Activities

DOE projects at South Ukraine nuclear power plant have supported development of full-scope simulators to enhance operator training (1995-2001). In addition, in-depth safety assessments are under way (1995-2000), and safety parameter display systems are being provided (1996-2001).

Accomplishments:

Management and Operational Safety
- A full-scope simulator for Unit 1 is being developed in Ukraine. The interim design specifications for this simulator were completed. The control panels were installed and acceptance testing has started. The project is scheduled for completion during 2001.
- Operator exchanges that trained plant personnel to develop improved operating safety procedures and practices were completed.
- The transfer of the Systematic Approach to Training methodology and materials developed at the Khmelnotski Training Centre to the South Ukraine plant was completed. Pilot training courses for the Instrumentation and Control Technician Unit Shift Supervisor and Control Room Reactor Operator positions were developed and implemented.
- To complement the pilot training course on instrumentation and control for soldering, soldering equipment was purchased for the plant. Basic equipment, including a computer with network capabilities, a printer, and associated consumables, was provided for the development and support of training.

- A full-scope simulator for Unit 3 was completed in May 2000.
- A South Ukraine staff member was trained to conduct internal quality assurance audits. Plant managers attended workshops reviewing plant and Energoatom activities to implement the Ukraine national standard for quality assurance at nuclear facilities.
- An audit of environmental radiation monitoring and related laboratory activities was completed.
- South Ukraine staff was trained on the development of Westinghouse-based EOIs.

Engineering and Technology Upgrades

- Six advanced ultrasonic flaw detectors were delivered to the plant.
- Safety parameter display systems were installed, tested, and are now in operation at Units 1 and 2. The system at Unit 3 was installed. Testing will be completed before the end of 2000.

Plant Safety Evaluations

- The in-depth safety assessment for Unit 1 is in progress. Probabilistic risk assessment project guidelines were completed for system descriptions, nuclear steam supply system database, component reliability database, abnormal events database, containment database, preliminary thermal-hydraulic models, internal-and external-event probabilistic risk assessment, deterministic safety assessment, and containment assessment. The data collection, system description documentation, and baseline thermo hydraulics model were completed in 1998.
- The Level 1 probabilistic risk assessment for internal events of South Ukraine Unit 1 was completed in 1999. In April 2000, this probabilistic risk assessment was reviewed by an IPSART Mission of the International Atomic Energy Agency. The findings of this review were generally positive. An independent peer review of the probabilistic risk assessment by an Ukrainian technical organization is in progress.
- Work on the design basis accident analysis for Unit 1 is in progress. All the analytical models for the analysis of accident progression and the determination of containment response under accident conditions have been developed. The design basis accident sequences are being analyzed and about 70% of the overall effort has been completed.
- The first part of the external hazards (both man-made and natural phenomena) assessment and the internal hazards (fire and flooding) assessment for Unit 1 was completed in June 2000. This involved data and information collection, screening of hazards, and, where possible, the preliminary assessment of vulnerabilities and risk. The tasks needed to complete the internal/external hazards assessments were delineated and prioritized.

ZNPP

Scope and Status of Activities

DOE efforts at Zaporozhe nuclear power plant focus on improving the safety of day-to-day operations at the plant, upgrading critical plant safety systems, and ensuring adequate storage facilities for spent nuclear fuel. Projects include activities to improve operator training (1994-2003), development of improved operating procedures and practices (1993-1997), provision of fire-fighting and fire-prevention material and equipment (1993-2003), performance of in-depth safety assessments (1996-2005), and provision of a dry storage system for spent nuclear fuel (1994-2000).

Accomplishments:

Management and Operational Safety

- Emergency operating instructions that promote safety through improved accident mitigation strategies were developed. Analysis for validating these instructions is under way.
- All 16 management and operational control guidelines for preparing operational control procedures that promote safety through improved operating practices were developed; plant-specific procedures were implemented at the plant.
- The operator exchange programme, which trained plant personnel to develop improved operating safety procedures and practices, was completed.
- A configuration management programme for keeping the plant's design basis current and accurate was initiated at the plant.

- A full-scope simulator upgrade for Unit 5 was completed in June 1999.
- Transfer of simulator maintenance tools was completed.
- The transfer of the Systematic Approach to Training methodology and materials developed at the Khmelnotski Training Center to the Zaporozhe plant was completed. Pilot training courses for the Chemical Operators and Water Chemistry Technicians Unit Shift Supervisor, and Control Room Reactor Operator positions were developed and implemented.
- Simulator instructor training was initiated at the plant. Simulator instructor training was provided to simulator instructors from the Zaporozhe and Kozloduy plants using the Zaporozhe simulator.
- Basic equipment was provided for the development and support of training. This equipment included a computer with network capabilities, a printer, and associated consumables.
- Guidelines for plant procedures for quality assessments, document control and records management were developed and implemented during 2000. Fifteen Zaporozhe staff members were trained to conduct internal quality assurance audits. Zaporozhe managers attended workshops to familiarize themselves with plant and Energoatom activities to implement the Ukraine national standard for quality assurance at nuclear facilities.
- Procedures were developed for pilot implementation of an event analysis, reporting and lessons learned system. Training of personnel and development of a database were completed. Pilot implementation will be completed in 2000.
- A simulator SPDS unit was completed and fully integrated with the Zaporozhe 5 full-scope simulator.

Engineering and Technology Upgrades

- Fire-resistant penetration sealant materials, fire detectors, sprinkler heads, and firefighting equipment were delivered to the plant. The fire-detection system, sprinkler system, and penetration sealant material will be installed in 2000.
- Technology for manufacturing fire doors, previously transferred to the Ukrainian company Askenn Concern, was used by Askenn to provide 125 fire doors to the plant. These doors have been installed.
- Safety parameter display systems were installed, tested, and are now in operation at Units 3 and 5. The systems for Units 2 and 4 were installed. Testing of these systems will be completed in 2000. The hardware for Units 1 and 6 was ordered, and these systems are scheduled to become operational in the spring of 2001. During the summer of 2001, a multiunit surveillance capability will be added to the plant. This will permit the plant shift supervisor and technical support center to observe the operation of all six units at the site.
- Advanced equipment to inspect steam-generator tubing was provided to the plant. This equipment is to be used at all Ukrainian nuclear power plants.
- Twelve advanced ultrasonic flaw detectors were delivered to the plant.

Plant Safety Evaluations

- The in-depth safety assessment for Unit 5 is in progress. Guidelines were prepared for the quality assurance, probabilistic risk assessment, deterministic safety assessment, and containment assessment. System description documentation, documentation of past safety assessments, data collection for both probabilistic and deterministic analysis, and a baseline thermohydraulics model were completed in early 2000.
- Basic training in probabilistic risk assessment methodology was provided to plant personnel. Computer equipment to be used in the assessment was installed at the plant.
- The analyses on the Level 1 probabilistic risk assessment for internal events were completed in September 2000 and a draft report was issued. External review of this report is now in progress. To permit the analysis of asymmetric flow transients in the core region, work has started on the modification of the baseline thermal hydraulic model.

Fuel Cycle Safety

- A project to provide three spent fuel dry-storage casks, a cask transporter, ancillary equipment, and associated services and training to the plant is nearly complete. The cask transporter, all cask hardware, and ancillary equipment were delivered. Technology was

transferred for fabrication of the concrete casks and the plant constructed three casks. The first cask is scheduled to be loaded with spent fuel in 2000.

- The plant received the official construction license from the Ministry of Environmental Protection and Nuclear Safety for onsite fabrication of the dry spent fuel storage system.
- Operating procedures for the dry-cask storage system at the plant were completed.

5. REGULATORY FRAMEWORK

During the period of 1992-1995, the activities in the nuclear energy field and radiation protection have been based on the safety rules and regulations of the former Soviet Union. They have been put into force by the Decree of GOSATONMNADZOR of Ukraine on 04 January 1995. The Rules and Regulations that are now in force in Ukraine do not meet the international requirements and standards and also not the social-economic relations in Ukraine. The extreme necessity to set up new legislation in Ukraine regulating the nuclear energy utilization and radiation safety became apparent. At present, in this area some important laws, regulations and decrees have been adopted by the Government of Ukraine. The System of the Regulatory, the Main Safety standards and the radwaste management standard; the QA standards are under development now.

5.1. Safety Authority and Licensing Process

The President of Ukraine, upon submission of the Cabinet of Ministers of Ukraine, made a decision to establish the State Nuclear Regulatory Committee as a central executive authority with the special status on the basis of the Department of Nuclear Regulation and Main State Inspectorate of the Ministry of Environment Protection and Natural Resources. In compliance with Decree # 1303 of the President of Ukraine «On State Nuclear and Radiation Safety Regulation» dated 5 December 2000, the newly established authority is entrusted with the following functions:

- set criteria, requirements and conditions of safety in nuclear energy utilisation;
- issue permits and licenses for carrying our activities in this field;
- exercise state supervision over compliance with the legislation, norms, regulations and standards on nuclear and radiation safety;
- exercise other functions of national regulatory body of nuclear and radiation safety as defined in the Convention on Nuclear Safety and Joint Convention on the Spent Fuel Management and on the Safety of Radioactive Waste Management.

The tasks, functions and mandates of the regulatory authority are defined in details in the Statute on the State Nuclear Regulatory Committee of Ukraine, which was approved by the Decree №155 of the President of Ukraine dated March 6, 2001. In addition to the above said, this Statute entrusts the State Nuclear Regulatory Committee (hereafter Regulatory body) with the function of the central authority and contact point which is responsible for physical protection of nuclear material in compliance with the Convention on Physical Protection of Nuclear Material, and with the functions of the competent authority and contact point in charge of transmission and receipt of notifications in case of nuclear accident in accordance with the Convention on Early Notification of a Nuclear Accident. It is also responsible for organisation and performance of researches in the field of nuclear and radiation safety assurance, and for co-ordination of activities of the executive authorities as regards their performance of nuclear and radiation safety regulation. The Statute provides for the mandates required for execution of the regulatory activity, in particular: the right to access the territory of facilities and to obtain necessary information, mandates to apply financial sanctions and to limit or stop activities involving violations of safety conditions, mandates dealing with the orders to carry out activities required for maintaining the safety level, right to hear the reports of the officials and to pass the materials to law-enforcement authorities.

The President of Ukraine following the submission by the Prime Minister of Ukraine appoints by his decrees the Chairman of the regulatory body and his deputies. Activity of the regulatory body is

financed out of the state budget funds. The structure of the State Nuclear Regulatory Committee of Ukraine is given in chapter 3.4.

A system of technical support organisations for the nuclear safety regulatory body was established in Ukraine. It includes the following organisations:

- State Scientific and Technical Centre of Nuclear and Radiation Safety, an independent scientific and technical and expert organisation which provides support for the regulatory body activities;
- Affiliates of the State Scientific and Technical Centre of Nuclear and Radiation Safety in Kharkiv, Odesa and Slavutich, which perform the functions of specific scientific and technical support to the regulatory body according to their specialisation.

Today, it is planned to expand Slavutich affiliate and to provide jobs for the specialists of Chernobyl NPP dismissed due to the closure of the plant. In its work the State Nuclear Regulatory Committee of Ukraine is guided by the principles of quality assurance, using a number of documents (procedure, plans, programs), which are the components of the quality assurance system.

Clear separation between the functions of the regulatory body and those of other body or organisation concerned with the promotion or utilisation of nuclear energy is ensured in Ukraine. In its activity the regulatory body is independent of any central bodies of the executive authority responsible for the nuclear energy utilisation. This provision is secured by Article 23 of the Law of Ukraine «On Nuclear Energy Utilisation and Radiation Safety». NNEGC Energoatom as a licence holder bears full responsibility for the radiological protection and safety of nuclear installations irrespective of the activity and responsibility of suppliers or state nuclear and radiation safety regulatory bodies. In line with responsibilities laid by the Ukrainian law on the operating body, NNEGC Energoatom shall:

- assure nuclear and radiation safety;
- develop and take measures on safety improvement of nuclear installations. For instance, based on the previous analysis and assessment of the safety level of nuclear power plants the long-term measures for upgrading and safety improvement of Ukraine's nuclear power plants were developed:
- provide for radiological protection of personnel, public and environment. The new radiation safety norms with stricter requirements were put in effect in 1998. The operating body has developed and is implementing the programme on bringing its activity in conformity with these requirements. The reference levels of external personal exposure, exposure dose limits of the public in the areas of NPP locations were revised and reduced. More stringent reference levels resulting from average actually achieved values for 5 years for each reference parameter were introduced based the results of calculations of admissible levels of radioactive releases and effluents;
- inform in proper time and in full scope of the violations in the nuclear installation operation. Dispatcher's and public relations services have established the system of early notification about violations in NPP operation of the central and local authorities, regulatory and administrative bodies, which, in turn, notify thereof the respective international organisations. The information on violations and changes in operation of NPPs is provided for news agencies and web-site of NNEGC Energoatom on a daily basis. Twice a month Energoatom issues press-releases on economic, financial situation and changes in operation;
- provide financial coverage of the liability for nuclear damage in the amount and on the conditions defined by the Ukrainian law. Financial coverage of the liability for nuclear damage is provided by means of insurance;
- set requirements for personnel's qualification depending on their responsibility for safe operation of nuclear installation. The training and qualification maintenance system for all staff, and, in first turn, or operating personnel, was established and functions in the company.

Today, NNEGC Energoatom holds licences by the regulatory body for activities as follows:

- construction of nuclear installations - 2 licences (Unit 4 of Rovno NPP, Unit 2 of Khmelnitski NPP);
- operation of the «Shelter» Object;
- design of nuclear facility (spent fuel storage facility at Chernobyl NPP).

A system of annual temporary licences for power unit operation (one licence per each unit) issued by the regulatory body is and will be effective until the applicable system of the permissive activity is put in compliance with the Law of Ukraine «On Permissive Activities in the Nuclear Energy Field». This system is put into force by the resolution of the regulatory body until licensing issues are settled at the legislative level.

5.2. Main National Laws and Regulations

The provision of legislation for adequate functioning of the power system became insensibly the main condition for the establishment of the market reform in Ukraine. It marks the process of new State building. Life based on instructions, directions and orders is replaced by life based on law. The number of issues, which are not regulated by law of direct action, decreases insensibly and the nuclear power sector isn't an exception.

From 1992 to 1994 the activities in the Nuclear power area and radiation protection were based on the laws and regulations on the Safety in the Nuclear Power field of the former Soviet Union. These laws have been implemented in Ukraine accordingly to the Decree N I issued by the Regulatory Authorities of Ukraine on 4 January 1992.

One of the most important way to ensure the safety in nuclear power utilization is the legal framework or legislation. In 50s in the former Soviet Union the nuclear legislation started its development. However, the developed laws represented mostly the corporate normative acts that did not cover in full all issues concerning rights, obligations and responsibilities of actors participating in the nuclear power utilization sector. In addition, the administration of the nuclear power utilization sector was fully under the control by the Union's authorities. The legislation of the republic concerning the issues above mentioned has been practically absent despite the situation in Ukraine that had 5 nuclear power plants in operation and several ionizing radiation sources utilized on its territory. The Chernobyl catastrophe pushed forward the development of legislation in the area of nuclear power utilization. Therefore, after the independence of Ukraine had been proclaimed, first laws have appeared in this field, such as: "About the status and social protection of citizens that suffered from the Chernobyl catastrophe" (dated 19.12.1991) è "About the legal regime on the radioactively contaminated territory" (dated 27.02.1991).

On the 25th of January 1995 the Verkhovna Rada of Ukraine approved the Concept of the State regulation of safety and nuclear sector administration in Ukraine. That put the basis for the state control over the safe utilization of nuclear energy as well as fundamental principles of nuclear power utilization that should support the nuclear legislation. These are the following principles:

- priority of the human being protection;
- prohibition to execute all types of activities in the area of nuclear power utilization without appropriate license;
- separation of functions of the state administration and state regulation of the safe nuclear power utilization;
- state supervision in the field of nuclear power utilization.

On 8 February 1995, the Verkhovna Rada adopted the law "On the Nuclear Power Utilization and the Radiation Safety". It is the basic, fundamental law of the Nuclear Legislation System. It defines the priority of the people's safety and environment, the rights and the duties of citizens in the area of the Nuclear Power utilization. This law regulates and controls the activity related to the

operation of the nuclear facilities and ionizing radiation, and defines the legal basis of the international obligations of Ukraine in the Nuclear Energy field. The basic nuclear third party liability rules are set out in this basic law.

The main provisions of the law are:

- The basic principles of the Government policy in the field of the Nuclear power utilization and Radiation Safety.
- The rights and the obligations in the field of the Nuclear Power utilization and Radiation Safety.
- The regulation of the Nuclear power Utilization's Safety by Government.
- The legal status of the judicial and physical persons who are engaged in the work in the Nuclear Power Utilization and Radiation Safety area.
- The placing and construction, commissioning and decommission of the nuclear facilities and sites reserved for the nuclear waste management.
- The Specific Safety rules for the territories where there are the nuclear facilities and sites, reserved for the nuclear waste management.
- Specific conditions for the safety regulation of the crafts, aircraft's, spaceships with the nuclear installation or the ionizing radiation sources.
- Nuclear Waste Management.
- The transportation of the ionizing radiation sources.
- Physical protection of the nuclear materials and nuclear facilities.
- The Prevention of the utilization of the nuclear materials, equipment and technology with the military purposes.
- The Indemnification for the nuclear damages.
- The liability for the legislation violation in the Nuclear Power Utilization and Radiation Safety field.
- Export/import of the nuclear installations, equipment technologies nuclear materials and ionizing radiation sources, specific non-nuclear materials and services in the Nuclear Power Utilization area.
- International Co-operation of Ukraine in the field of the Nuclear Power Utilization.

Other important laws and Government's Decrees related to the utilization of nuclear power and radiation safety are:

- The Law on Civil defence.
  It defines the following basic tasks of the State Authorities: the prevention of the emergency; the reduction of the, damages and losses after the accident; the early notification of the population about the emergency. This law creates the system of the analysis and control; the system of early notification and communication; the special system for the oversight, control and monitoring of the radioactive contamination. This law constantly supports their readiness, preparedness for the systems' stable functioning in cases of emergency.

- The Law on Environment Protection.
  Article 54. It demands to develop and to take some measures aimed to the prevention of the accidents and liquidation of their consequences. These functions, obligations have been charged on the owner of the dangerous nuclear facility and the operating organization.

- Law on " Protection of the atmospheric air".
  Defines the standardization as well as measures aimed at the atmospheric air protection.

- Law on "Ensuring of sanitary and epidemic welfare of population".
  Article 23. Ensuring of radiation safety. Article 30. Prevention of extremely dangerous infectious diseases, mass intoxication, and radiation damages of population.

- Law on “Ecological expertise”.
  Defines the forms and procedure for conducting the ecological expertise as well as the state regulation and administration in the ecological expertise area.

- Law on “Uranium ore mining and processing”.
  Regulates the peculiarities of legal relations during uranium ore mining and processing as well as during its product utilization as a raw material to get the nuclear material. This law also defines specific features of uranium facilities operation, their personnel, population and environment protection against the impact of ionizing radiation sources as well as specificity of social protection of the uranium facility personnel and population due to the ionizing radiation impact.

- Law on “Radwaste management”.
  The law is aimed at ensuring the protection of people and environment against the harmful impact of the radwaste now and in the future.

- The Decree of the Cabinet of Ministers of Ukraine on the Creation of the State Committee on Nuclear Power Utilization - GOSKOMATOM, issued on January 16, 1993.
  According to this Decree GOSKOMATOM is responsible for the Creation of the State System for the management and the operation of the Nuclear Power facilities in Ukraine.

- The Decree of the Cabinet of Ministers of Ukraine on the Creation of "State Emergency Response Center" on the basis of the "SPEZATOM" liquidated by the same decree (July 16, 1993).
  This center should ensure the permanent preparedness for the quick and effective measures in case of the accidents at the Nuclear Power facilities, radiation accident in the industry. This Center should work accordingly to the Ukraine's international obligations that are meeting the requirements of I the International Atomic Energy Agency (IAEA) to create the National System for the liquidation of the nuclear 'dent and catastrophes' consequences.

- The Cabinet of Ministers' Decree on the Creation of the Permanent Government Commission on the Ecological Safety and Emergency issued on August 10, 1993.

  This commission should quickly resolve the problems that are related to the realization of the Ukrainian citizens' rights to protect their life and their health from the consequences of the accidents, catastrophes, ecological and moral damages. This decree is focused on the co-ordination and control of all complex of works at the Government level.

- The President's Decree on the measures for the physical protection of the nuclear materials and facilities (December 28, 1993).
  The decree will permit to create the physical protection system that meets the international requirements.

- Provisional Interdepartmental rules of the acceptance of the completed NPPs power units for the operation, approved on June 22, 1994.
  This document establishes the procedures of the acceptance of the completed NPPs for the operation, the acceptance of their separate units and separate buildings at the NPP territory.

- The Cabinet of Ministers' Decree on the Measures for the stabilization of the NPP Work and Operation, and for the solution of the first priority tasks in the Nuclear Power development (October 3, 1994).
  The Decree defines the special tasks of the Operating organization: GOSKOMATOM and GOSATOMNADZOR in the further execution of the scientific-technical expertise and safety evaluation of the NPP units in operation or under construction.

- The President's Decree on the Creation of the Ministry of the Environment Protection and Radiation Safety of Ukraine (On the basis of the Ministry of the Environmental Protection and the Ukrainian State Committee for Nuclear and Radiation Safety, which were liquidated by the same Decree of December 15, 1994).

  This Decree was aimed toward the improvement of the environmental protection and radiation safety system.

- Decree by the Cabinet of Ministers of Ukraine concerning "Establishment of the National Nuclear Energy Generating Company "Energoatom" dated October 17, 1996.

  With the purpose of improving electric power supply to the national economy and population, completion of market reforms in the electric power sector and upgrading the efficiency of NPPs operation under the electricity market implementation conditions.

- Decree by the President of Ukraine concerning "the Ministry of Ukraine for Emergency situations and protection of population against the Chernobyl accident's consequences" (On the basis of the Ministry of Ukraine for Protection of Population against the Chernobyl NPP accident's consequences and Civil Defense Headquarters of Ukraine) dated October 28, 1996.

  With the purpose to improve the administration of the civil defence in Ukraine, the protection of the population and territories against emergencies and to implement the measures on ChNPP accident's consequences liquidation.

- Decree by the President of Ukraine concerning "Establishment of the Ministry of Power Industry of Ukraine" (On the basis of the Ministry of Energy and Electrification and the State Committee on Nuclear Power Utilization) dated May 06, 1997.

  With the purpose to improve the structure of administration of the energy -industrial complex to increase its efficiency under the conditions of the national economy reforming.

- Decree by the Cabinet of Ministers of Ukraine concerning "Improvement of the systems of payments for the electric and thermal power supplied" dated May 21, 1997.

  With the purpose to ensure timely payments for the electric and thermal power supplied, to stabilize the financial situation of the electric power sector, to provide the stable electric power supply to the social production and to overcome the payment crisis.

- Law on "Person protection from ionizing radiation", March 1996.

  The law is aimed on provision of person life, health and property protection from negative influence of ionizing radiation, caused by practical activity, in case of radiation accidents and during prediction and saving measurements execution.

- Law on "General principles on following operation ChNPP and transformation of blasted ChNPP#4 to ecology safety system" December 1998.

  It is directed to legal relationship regulation during following operation and pre-term ChNPP decommissioning; transformation of blasted ChNPP#4 to ecology safety system; ChNPP staff social protection; taxation feature of enterprise activity subjects.

- Law on "Permission activity in the Nuclear Power Utilization sphere" December 1999.

  The Law was accepted in the first reading. It's designated the legal, organizational and economical essential principles of permission activity in the sphere of Nuclear Power Utilization, also the general states of the social relations regulation. The permission system in the sphere of Nuclear Power Utilization is directed on National Security Interest protection, non-admission on allowable norm exceeding for person irradiation and environment pollution and also on requirement fulfillment for non-proliferation of Nuclear Weapons.

- The President's Decree "On changes in the structure of executive authority central organs" dated December 15, 1999.

- Creation of the Ministry of Ecology and Natural resources – Minecoresource (on the base of the State Administration of Nuclear Regulation .

- The Cabinet of Ministers' Decree "List on activities connected with provision of Physical Protection of Nuclear Installations and Materials, which are under obligatory licensing" dated July 12, 2000.

- The Cabinet of Ministers' Decree "List on posts and professions for staff on Nuclear Installations Operation, the training for them is under obligatory licensing. List on posts for staff, who perform directly the Nuclear Installation Control and who's activity can perform only on the licensee base" dated August 8, 2000.

- The Cabinet of Ministers' Decree "Some issues on State regulation for ionizing source using activity" dated November 16, 2000. Here are the documents, which were prepared by Nuclear Regulation Department: "List of Ionizing Source the activity for their using releases from licensing" and "The State Registration Order of Ionizing Source"

- The Cabinet of Ministers' Decree "the Licensing Order of some activity kind in the sphere of Nuclear Power Utilization" dated December 12, 2000.

The process of improving and setting up new regulations, standards and rules for nuclear and radiation safety continues. Among normative-legal acts on nuclear and radiation safety, the "General Safety Regulations" (НП 306.1.02/1.034-2000 replaced the "General Safety Regulations: OPB-88") should be noted. This document is the first step in replacing the "soviet" regulations and rules by national documents, which are based on national legislation and take into account recommendations by the international organizations and experience of the Ukrainian NPPs.

Thus, Ukraine for comparatively short period of time was able to create its own nuclear legislation that was formed as the independent sector or branch of the national legislation. The fundamental provisions of this sector were reflected in the Constitution of Ukraine in accordance to which the State is responsible for the liquidation of Chernobyl accident's consequences and preservation of genetic fund of the Ukrainian people. However, the nuclear legislation has some deficiencies. Not all the public relations are covered by the normative acts. There are some problems with nuclear damage indemnity or nuclear liability.

In spite of the shortage of the financing for the creation of the legal basis of the nuclear and radiation safety, Ukraine had created the State Structure for the Management and Regulation in the area of the Nuclear Power Utilization and Radiation Safety.

5.3. International, Multilateral and Bilateral Agreements

International assistance to the Ukrainian Regulatory Body started in 1992. A large number of efforts were directed to staff training, analysis project of legislative and normative acts in nuclear and radiation safety, transfer of safety assessment methodology for scientific support of regulative activities.

Ukraine was one of IAEA founders and has been taking an active part in IAEA working since foundation time – 1957. The main direction of IAEA co-operation: favour to non-proliferation of nuclear weapons through guarantee regime, participation in technical co-operation programme, participation in yearly sessions of IAEA General Conference.

The European Commission participates in the implementation of the safety improvement strategy of Ukraine in the framework of the TACIS programme. Ukraine is the party to international conventions in the field of nuclear and radiation safety and a number of multilateral and bilateral international agreements.

AGREEMENTS WITH THE IAEA

• Amendments to Articles VI and XIV of the Agency statute	Not ratified	
• Agreement on privileges and immunities	Entry into force:	5 October 1966
• NPT related safeguards agreement INFCIRC/153	Entry into force:	22 January 1998
• Additional Protocol	Signed:	15 August 2000
• Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	21 September 1990

MAIN TREATIES OR AGREEMENTS

• NPT	Entry into force:	5 December 1994
• Conventional on the physical protection of nuclear material	Entry into force:	5 August 1993
• Convention on early notification of a nuclear accident	Entry into force:	26 February 1987
• Convention on assistance in the case of nuclear accident or radiological emergency	Entry into force:	26 February 1987
• Vienna convention on civil liability for nuclear damage	Entry into force:	20 December 1996
• Paris convention on civil liability for nuclear damage		Not applicable
• Joint protocol	Entry into force:	24 June 2000
• Protocol to amend Vienna convention on civil liability for nuclear damage	Signed on:	29 September 1997
• Convention on supplementary compensation for nuclear damage	Signed on:	29 September 1997
• Convention on nuclear safety	Entry into force:	7 July 1998
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Ratified on:	24 July 2000

OTHER RELEVANT INTERNATIONAL TREATIES OR UNDERTAKINGS

- Improved procedures for designation of safeguards inspectors — Not requested
- Zangger Committee — Non Member
- Acceptance of NUSS Codes — No replay
- Nuclear Suppliers Group — Member
- Nuclear export guidelines — Not adopted

BILATERAL AGREEMENTS

- A bilateral agreement with the US government has been concluded, providing a State Guarantee (Indemnity Statement).
- Co-operation with FRG is based on an agreement between German and Ukrainian Government on issues, which represent mutual interest in view of nuclear-technical safety and radiation protection. Since 1992, the Federal Ministry of Environmental Protection and Nuclear Reactors Safety (BMU) has been organizing and financing the realization of bilateral programme on technical assistance to Ukraine.
- Co-operation with Spain is performed according an agreement on co-operation between the Ukrainian Ministry of Ecology (UME) and the Spanish Council on Nuclear Safety, signed on 1 October 1997 in Vienna.
- Co-operation with Italia is executed according an agreement on technical information exchange and co-operation in the area of nuclear safety and radiation protection between the Italian National Agency on Environment Protection (ANPA) and UME (March 23,1998, Rome).
- Co-operation with Sweden has been executed since 1992 on the base of common programmes and protocols. Since 1999, on the base of 2 agreements between the Government of Sweden and the Cabinet of Ministers of Ukraine (CMU) on notification of a nuclear accident, information exchange and nuclear safety co-operation.
- Co-operation with Switzerland is executed on the base of agreement between the Swiss Federal Inspectorate on Nuclear Safety and the Ukrainian State Committee on Nuclear and Radiation Safety and renewed in 2000 by an agreement between the Federal Inspectorate and Minecoresource.
- Co-operation with Bulgaria is executed on the base of an agreement on co-operation in the area of state regulation and safety surveillance between the Bulgarian State Committee on the Use of Atomic Energy Utilization for Peaceful Purposes and Minecoresource.
- Co-operation with Hungary is executed on the base of an agreement on notification of a nuclear accident, information exchange and co-operation in the Nuclear Safety area between the Governments of Hungary and Ukraine.
- Co-operation with the USA is executed on the base of a memorandum between the US Nuclear Regulation Committee and the State Administration on Nuclear Regulation of Ukraine (28 January 2000, Washington).
- Co-operation with Canada is executed on the base of an administrative agreement between the Commission on Nuclear Safety of Canada (CNSC) and UME and meeting protocols.
- The agreement on notification of a nuclear accident and information exchange on nuclear installations was signed between the Government of Turkey and CMU in 2000.

REFERENCES

[1] National Economy of Ukraine in 1985-2000. (In Russian, Reference books). State Committee on Statistics, Kiev.
[2] Economic report of the President of Ukraine in the Supreme Soviet, (1994) (in Russian).
[3] The National Energy Programme of Ukraine for the period till 2010 (NEP).
[4] The comprehensive programme of the nuclear fuel cycle creation in Ukraine, GOSKOMATOM, (1995).
[5] The Wholesale Energy Market of Ukraine, Minenergo of Ukraine, (1995).
[6] Nuclear Legislation. Collection on normative-legal acts (on 1 January 1999). Kiev, 1999 Regulations of Ukraine (Reference books).
[7] IAEA Energy and Economic Data Base (EEDB).
[8] IAEA Power Reactor Information System (PRIS).
[9] International Conference "Energy Security of Europe. Look into the XXI Century", 22-25 May, 2001. Kiev.
[10] International Conference "Experience of reforming energy markets", June 13-14, 2001. Kyiv
[11] US DOE, Office of International Nuclear Safety and Co-operation, Program Reports, Soviet-Designed NPP Profiles, Ukraine, http://insp.pnl.gov.
[12] Data & Statistics, The World Bank, www.worldbank.org/data.

ABBREVIATIONS

NEP	National Energy Programme of Ukraine for the period till 2010
FER	Fuel-energy resources
NPP	Nuclear Power Plant
TPP	Thermal (Fossil) Power Plant
HPP	Hydroelectric Power Plant
HaPP	Hydro-accumulator Power Plant
UES	Unified Energy System
NERC (Russian - NKRE)	National Energy Regulation Commission
UK	United Kingdom
WEM	Wholesale Electricity Market of Ukraine
UAH	Hrivna, Ukrainian currency
Mintopenergo	Ministry of Fuel and Power Industry
NNEGC "Energoatom"	National Nuclear Energy Generating Company (utility) "Energoatom"
ChNPP	Chernobyl Nuclear Power Plant
RNPP	Rovno Nuclear Power Plant
KhNPP	Khmelnitski Nuclear Power Plant
SUNPP	South Ukraine Nuclear Power Plant
ZNPP	Zaporozhe Nuclear Power Plant
VNIIAES (Russian abbr.)	All-Russian Research Institute for NPP Operation (Moscow, Russia)
NIKIET (Russian abbr.)	R&D Institute of Power Engineering (Moscow, Russia)
OKB GP	Pilot Design Bureau "Gydropress" (Podolsk, Russia)
KhTZ	Kharkov Turbine Plant
TP	Temporary Permissions
VostGOK	Vostochny Uranium Ore Mining and Processing Enterprise
oblenergo	At the same time Power Transmission and Supply companies
NFC	Nuclear Fuel Cycle
NPS	Nuclear Power Sector

Appendix

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

NATIONAL NUCLEAR ENERGY AUTHORITIES

Ministry of Fuel and Power (Mintopenergo) Kiev, Khreshchatyk St. 30 Minister – Mr. Gaiduk	Tel: 8 (044) 221-4394 Fax: 8 (044) 224-4021 http://www.me-press.kiev.ua
State Committee of Nuclear Regulation Kiev, Arsenalnaya 9/11 Chairman – Mr. V. Grishchenko	Tel: 8 (044) 254-33-64 http://www.snrcu.gov

OTHER NUCLEAR ORGANIZATIONS

Utility NNEGC «Energoatom» Executive President – Mr. J.Nedashkovsky 01011, 9/11 Arsenalna Str, Kyiv, Ukraine	Tel: 8 (044) 294-48-70 Fax: 8 (044) 294-48-70 http://www.energoatom.com.ua
ZNPP Director – Mr. V. Pyshny 71500, Energodar, Zaporizhzhya region, Ukraine	Tel: 8 (06139) -32451 Fax: 8 (06139) -31912 http://www.nppzap.zaporizhzhe.ua
SUNPP Director – Mr. B. Bilyk 55000, Yuzhno-Ukrainsk, Mykolayiv region, Ukraine	Tel: 8 (05136) -24988 Fax: 8 (044) 227-2661
RNPP Director – Mr. V. Korovkin 34400, Kuznetsovsk, Rovno region, Ukraine	Tel: 8 (03636) -22360 Fax: 8 (03636) -22314
KhNPP Director – Mr. B. Sophiyuk 30100, Neteshin, Khmeltnitski region, Ukraine	Tel: 8 (03848) -33350 Fax: 8 (03848) -33360
State Particularized Enterprise ChNPP Director – Mr. V. Tolstonogov 07100, Slavutich, Kyiv region, Ukraine	Tel: (38 044) 234-11-66 Fax: 8 (279) -25670 Fax: 8 (279) -26359
State Emergency Technical Center Prypyat	Tel: 8 (044) 225-53-24
VOSTGOK" the ore Mining and Processing Plant Zhovty Vody, Dniepropetrovsk region	Tel: 8(056-52) -9-35-58
PO "Pridnieprovsky Chemistry Plant" Dneprodzerginsk	Fax/Tel: 8(056-92) -3-00-43
R&D Institute "Energoproject" Kiev	Tel: 8 (044) 274-10-12 Fax: 8 (044) 274-60-61

R&D Institute “Energoproject” Kharkov	Fax: 8 (057) 2-22-50-29
Maintenance Enterprise “Lvovenergoremont” Lvov	Fax: 8 (032 2) 42-23-94
Institute of Nuclear Research Kiev	Tel: 8 (044) 265-23-49
Scientific Centre “Physics-Technical Institute” Kharkov	Tel: 8 (0572) 35-37-95 Fax: 8 (0572) 35-16-88
Ministry of Environment and Natural Resources of Ukraine	http://www.menr.gov.ua
Ministry of Emergencies of Ukraine	http://acc.ic-chernobyl.kiev.ua
International Chornobyl Centre for Nuclear Safety, Radioactive Waste and Radioecology	Phone/Fax: 8 (044) 294-4379 Phone/Fax: 8 (04479) 2-3016
International Nuclear Safety Centres (INSCs)	http://www.insc.gov.ua
Ukrainian Nuclear Society (UkrNS)	Tel: 8 (0482) 60-41-60 http://www.ukrns.odessa.net