HUNGARY

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1. ENERGY, ECONOMIC AND ELECTRICITY INFORMATION

1.1. General Overview

Hungary is a landlocked central European country. It has borders with Austria, Slovakia, Ukraine, Romania, Yugoslavia, Croatia and Slovenia. It is strategically located astride main land routes between Western Europe and the Balkan peninsula as well as between Ukraine and the Mediterranean basin. Most of Hungary is a fertile, tolling plain lying east of the Danube River and drained by the Danube and Tisza rivers. In the extreme Northwest is the Little Hungarian Plain. South of that area is Lake Balaton (648 km^2). Hungary covers an area of 93,032 square kilometres.

Hungary is a Republic. The National Assembly, consisting of 386 members elected to four-year terms, is the legislative body. The National Assembly elects the President. At present, the representatives of six political parties are the members of the National Assembly. The last election was in May 1998, the next one will be in 2002.

Hungary has a continental climate with Mediterranean and Atlantic influences with humid winters and warm summers. The average temperature in January is 2ºC (28ºF) and in July 23ºC (73ºF).

In 2000, there lived about 10 million people in the country, in fact, as much as during the mid-sixties, and the population density is 108 inhabitants per square kilometre. The long-term population curve - reflecting losses of war periods and of the 1956 crisis - was increasing up to 1980, and then it showed a downward trend. The rate of population decrease has been accelerating. The population decreased in every region of Hungary in particular in Budapest (Table 1).

TABLE 1. POPULATION INFORMATION

	1970	1980	1990	2000	2001	2002	Growth rate (%/yr 1990 To 2002
Population (millions)	10.3	10.7	10.4	10.0	10.0	9.9	-0.4
Population density (inhabitants/km²)	111.1	115.1	111.4	107.6	107.1	106.7	

Predicted population growth rate (%) 2002 to 2010	-4.4
Area (1000 km²)	93.0
Urban population in 2002 as percent of total	65.1

Source: IAEA Energy and Economic Database.

1.1.1. Economic Indicators

Hungary is still in the midst of a difficult transition from a centralized to a market economy. Its economic reforms during the communist era gave a head start on this process, particularly in terms of attracting foreign investors. Although, the privatization process has lagged. Overall, about half of Gross Domestic Product (GDP) now originates in the private sector.

In international terms, Hungary has a relatively limited economic potential with a sensitive

[1] The profile has been updated by the Secretariat, mainly by replacing the statistical information in the Tables with EEDB and arranging contents according to the revised table of contents.

foreign economy. Based on its GDP, Hungary is ranked as a relatively small unit in the world economy; greatly dependent on international developments as well as on external development conditions. The Hungarian economy has undergone a dramatic transformation since 1995 and as a result the gross domestic product per employed person shows continuous improvement in the course of the past four years. The economy began to pick up in 1997. In 1998, the economic growth was even higher than expected: the Gross Domestic Product (GDP) increased by 5 percent compared with 1997. There was a dynamic growth in export and industrial production, 12.6 %, and 28.9% respectively while unemployment rate slightly decreased (7.8 % in 1998). In 1998, the level of labour productivity exceeded 12% that of 1997. The improvement of the equilibrium of the economy was due to the decrease of inflation (about 14%) and the increase of internal consumption has slowed down, as well. This was the second year that economic revival was not accompanied by worsening of the external financial equilibrium. In 1999, the GDP at market prices increased by 4.5 % to 48,400 million US$ (Table 2). This compares favourably with other eastern European countries, but is significantly lower than other European countries at similar levels of development such as Greece and Portugal.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1980	1990	2000	2001	2002	Growth rate (%/yr 1990 To 2002
GDP (millions of current US$)	23,987	35,775	46,337	48,653	53,129	3.4
GDP (millions of constant 1990 US$)	31,946	35,775	39,008	40,839	42,228	1
GDP per capita (current US$/capita)	2,240	3,452	4,628	4,881	5,354	3.7

Source: IAEA Energy and Economic Database.

1.1.2. Energy Situation

Hungary has various energy resources, but mainly coal and lignite (Table 3). Coal mining has been in a critical situation for a long time. Difficult geological conditions, poor heating value and low quality of Hungarian lignites, together with the current low prices of the other energy sources, have resulted in a declining annual production. In recent years, Hungary produced about 20-22 million tonnes of coal, including 5-6 million tonnes of poor quality lignite. Hungary is a producer of crude oil. The present production of approximately 2 million tons/year covers less than a quarter of the national demand and is decreasing. About 6 billion m^3/year of natural gases are produced in Hungary, covering roughly half of the total demand. Gas production is also decreasing. The mining of uranium began in Hungary in the 1950s. Under a special arrangement, the total production was exported to the former USSR and hence did not play a role in the national energy balance. Hungary has 100 m tons of economically recoverable known reserves of hard coal, with total reserves in situ amounting to 714 m tons. Reserves of lower-rank coal are much larger. However, the low average calorific value, the high sulphur contents, and the high production costs limit both the extent of recovery and the specific fields of utilization. Many mines are uneconomical and need considerable investment to exploit deeper seams. Oil reserves are put at 58m tons. Gas reserves are estimated to be about 113 billion m^3. Hungary's only uranium ore mine, located in the south of the country, was the primary source of Hungarian nuclear power plant. As production costs are above world prices, the mine closed down in 1997.

The share of domestic energy resources in energy production in 1993 was 24% for nuclear, 31% for coal, 16% for oil and 29% for gas. The basic energy statistics are given in Table 4. The share of the final energy consumption by sector in 1993 was 38.2% in industry, 34.8% in household and 26.9% in others.

Domestic production of fuels decreased by about 6% between 1995-97. In 1997, 55% of fuels was of import origin. Within the fuels, the share of natural gas has been increasing from about 30 % in the early nineties to 36% in 1997. The share of crude oil and crude oil products increased up to the mid-nineties (35-36%) then it started to decrease and it was 33% in 1997. Consumption of all kinds of coal and other solid fuels gradually declined (from 20% to 15 % in 1997). The role of nuclear energy did not change considerably in recent years, it covered 12% of the total energy consumption. Imported electric energy provides 2% of the fuels.

TABLE 3. ESTIMATED ENERGY RESERVES

	Estimated energy reserves in (Exajoule)					
	Solid	**Liquid**	**Gas**	**Uranium** (1)	**Hydro** (2)	**Total**
Total amount in place	7.72	0.34	0.78	8.03	0.67	17.53

(1) This total represents essentially recoverable reserves.
(2) For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 2002) by a factor of 10.
Source: IAEA Energy and Economic Database.

In 1998, Hungary produced about 14.6 million tonnes of coal, including 7.6 million tonnes of poor quality lignite. Hungary is a producer of crude oil. The production in 1998 was 1.26 million tons/year covers 16% of the national demand and is decreasing. In 1998, about 3.87 billion m^3/year of natural gases are produced in Hungary, covering roughly a quarter of the total demand. Gas production is also decreasing.

TABLE 4. ENERGY STATISTICS[(*)]

							Average annual growth rate (%)	
	1970	**1980**	**1990**	**2000**	**2001**	**2002**	**1970 To 1990**	**1990 To 2002**
Energy consumption								
- Total (1)	0.94	1.29	1.20	1.14	1.12	1.11	1.22	-0.59
- Solids (2)	0.52	0.40	0.24	0.22	0.21	0.18	-3.78	-2.32
- Liquids	0.26	0.45	0.35	0.30	0.29	0.30	1.57	-1.29
- Gases	0.13	0.36	0.37	0.45	0.46	0.47	5.52	1.92
- Primary electricity (3)	0.03	0.07	0.23	0.17	0.15	0.16	10.18	-2.84
Energy production								
- Total	0.64	0.67	0.58	0.53	0.51	0.48	-0.51	-1.56
- Solids	0.43	0.31	0.19	0.19	0.18	0.18	-3.99	-0.44
- Liquids	0.09	0.12	0.10	0.09	0.08	0.08	0.70	-2.25
- Gases	0.12	0.24	0.16	0.12	0.11	0.10	1.40	-4.22
- Primary electricity (3)			0.13	0.14	0.14	0.12	28.41	-0.07
Net import (Import - Export)								
- Total	0.27	0.56	0.54	0.59	0.57	0.31	3.51	-4.43
- Solids	0.09	0.09	0.04	0.03	0.03	0.03	-3.81	-3.87
- Liquids	0.17	0.33	0.28	0.22	0.23	0.22	2.54	-1.88
- Gases	0.01	0.14	0.22	0.34	0.31	0.06	19.07	-9.79

(1) Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.
(2) Solid fuels include coal, lignite and commercial wood.
(3) Primary electricity = Hydro + Geothermal + Nuclear + Wind.
(*) Energy values are in Exajoule except where indicated.
Source: IAEA Energy and Economic Database.

1.2. Energy Policy

The main strategic goals of the Hungarian energy policy, as of 1994, are:

i) exemption of the unilateral import-dependency of the country;
ii) restraint of the environmental damages of energetics;
iii) helping of thrift and more efficient consuming;
iv) extension of social-acceptance system;
v) flexible system-development;
vi) creating of the development sources (capital investment).

The major Hungarian energy policy directives approved by the Parliament are the following:

- maintaining and increasing energy supply stability;
- increasing energy efficiency and the role of energy conservation thereby improving the competitiveness of the Hungarian economy;
- establishing a market conforming organizational, economic and legal background;
- enforcing environmental protection aspects;
- promoting European integration in the energy sector.

Since its approval in 1993, certain parts of the directives and strategic objectives have already been implemented and others are currently under way. Just to point out some of the most important results one should mention the increase of storage capacity for oil, the construction of a new gas transmission pipeline between Austria and Hungary, the plan for building secondary reserve capacity in connection with our joining the electric energy system of Western Europe (UCPTE). New relationships have set the ground for establishing the conditions for integration. Hungary joined the OECD in 1996. It advances the efforts and provides additional means of helping the Hungarian economy.

Based on the new government programme the Ministry of Economic Affairs has started to elaborate a document entitled "Basic Principles of State Energy Policy and a New Business Model". This document maintains the main objectives of the 1993 resolution but reflects on the new ownership situation after the privatization, the EU liberalization directives, and EU accession in the near future, and sets out practical approaches to accomplish the required adaptation, including responsibilities and deadlines. Associated with the application process for membership of the EU, Hungary has addressed most of the issues in the energy chapter of the EC questionnaire

1.3. The Electricity System

1.3.1. Structure of the Electricity Sector

The Hungarian national utility, the Hungarian Power Company Ltd. (MVM Rt.), is owned by State Asset Management Ltd. (AV Rt.) (99,82%) and by local municipalities 0,18%. The AV Rt. is responsible for the long-term strategic asset administration, maintenance of the state majority (50%+1 vote) and implementation of the national asset policy guidelines (value based sale of shares). The MVM Rt. is responsible for wholesale trading, imports/exports, the basic network, system dispatching and system development. There are four different company groups in the ownership structure belonging to MVM Rt., AV Rt. and the local municipalities:

- Power Plant Ltd;
- Power Plant Ltd with coal mines;
- Distribution LTD's;
- National Grid Operating Company.

The national grid is a part of the former Comecon power system, with 750 kV and 400 kV international interconnection lines with neighbouring countries. Hungary has only limited island operation with Austria, which is synchronized with the Western European grid of the Union for Co-ordination Production and Transport of Electric Energy (UCPTE)

During 1999, the Hungarian government would be making a decision on the privatization of the electricity sector which implies that the above mentioned will be subject to changes in the near future. During the nineties a major privatization has taken place in the Hungarian electric energy sector as well. The majority shares of the six power electric power distribution companies and six gas distribution companies as well as two power generating companies have been sold to foreign strategic investors. The privatization of five coal fired power generating companies has been decided while no final decision has been taken on the privatization of the Hungarian Power Companies Ltd. (MVM Rt.), the owner of the national long distance grid with the maintenance company (OVIT Rt.) and of the Paks NPP.

To comply with the EU Directive 96192 for the internal market of electricity, the Hungarian electricity market needs to undergo some more structural change if effective competition is to be introduced. The legal environment should also be changed. As a first step the Act on Electricity of 1994 should be amended by the mid of 2000.

1.3.2. Decision Making Process

Based on the demand forecasts and system development plan prepared by MVM any possible modifications made to it by the Hungarian Energy Office (MEH), the Minister of Economy submits a power plant establishment plan to the Government and to Parliament every two years. Should there be applicants who propose power plants in accordance with this plan the MEH can grant a preliminary license for power plant establishment. If there are no suitable applications, MVM issues a tender in close operation with MEH and the Minister. The winner of the bidding process is to be determined on a competitive basis in order to ensure the new capacity is soured at least cost. According to the legislation in force, the approval of the Government or the Parliament is needed for the establishment of power plants above 200 MW capacity. Between 200 and 600 MW capacity, it is the right of the Government to give the approval, while above 600 MW capacity, the Parliament has to approve it. Nuclear power plants should be approved by the Parliament independently of their capacity.

1.3.3. Main Indicators

At the end of 2000, the total installed capacity was 7,020 MW(e) of which 74% fossil fired, 25% nuclear and 0.7% hydro. The nuclear share in total electric power generation was 36%, fossil 64% and hydro 0.4%. Of total electricity consumption, about 2% was imported and 1.5% provided by autoproducers. Table 5 shows the historical electricity production and installed capacity data and Table 6 the energy related ratios.

2. NUCLEAR POWER SITUATION

2.1. Historical Development and current nuclear power organizational structure

2.1.1. Overview

The first Hungarian reactor was built for research purposes at Csilleberc on the outskirts of Budapest in 1959. The reactor, of soviet origin and refurbished by Hungarian experts after 30 years of operation, was put into operation again by the Nuclear Energy Research Institute in 1993. In 1966, it was decided to construct a larger nuclear power plant in Hungary. The decision taken concerned two

WWER-440 type, 230 model, reactors. The construction work started in 1968, but was interrupted in 1970 because, at that time, the oil-fired stations were considered to be more economic. The actual construction work started after the oil crisis in 1975. The final decision included four second generation reactors, i.e. WWERs-440/213, instead of the two 230 model reactors, all to be part of one nuclear power plant. The plant is located about 5 km south of the town Paks, on the right bank of the river Danube. Since 1987, these four reactors have been generating electricity to the Hungarian electric energy system. The installed capacity of the reactors was 4 times 440 MW(e). As a result of modifications, the electrical output was increased by 20 MW(e) at the same nominal capacity of the reactors. At present, the total gross capacity per unit is 460 MW(e), hence the total power of the plant is 1,840 MW(e).

TABLE 5. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

							Average annual growth rate (%)	
	1970	**1980**	**1990**	**2000**	**2001**	**2002**	**1970 To 1990**	**1990 To 2002**
Electricity production (TW.h)								
- Total (1)	14.54	23.88	28.41	35.19	35.25	34.24	3.41	1.57
- Thermal	14.45	23.76	15.34	20.83	20.95	21.29	0.30	2.77
- Hydro	0.09	0.11	0.18	0.18	0.17	0.17	3.58	-0.51
- Nuclear			12.89	14.18	14.13	12.79		-0.07
- Geothermal								
Capacity of electrical plants (GWe)								
- Total	2.48	4.98	6.60	8.21	8.59	9.10	5.02	2.71
- Thermal	2.46	4.93	4.80	6.41	6.79	7.29	3.41	3.55
- Hydro	0.02	0.05	0.05	0.05	0.05	0.05	4.47	
- Nuclear			1.76	1.76	1.76	1.76		
- Geothermal								
- Wind								

(1) Electricity losses are not deducted.
Source: IAEA Energy and Economic Database.

TABLE 6. ENERGY RELATED RATIOS

	1970	**1980**	**1990**	**2000**	**2001**	**2002**
Energy consumption per capita (GJ/capita)	91	120	115	113	113	112
Electricity per capita (kW.h/capita)	1,598	2,736	3,569	3,605	3,801	3,985
Electricity production/Energy production (%)	22	34	48	64	67	69
Nuclear/Total electricity (%)			45	40	40	37
Ratio of external dependency (%) (1)	29	44	45	52	50	28
Load factor of electricity plants						
- Total (%)	67	55	49	49	47	43
- Thermal	67	55	36	37	35	33
- Hydro	50	28	42	42	41	40
- Nuclear			84	92	92	83

(1) Net import / Total energy consumption.
Source: IAEA Energy and Economic Database.

In 1986, a preliminary decision was made by the government to continue the nuclear power programme by extending the Paks site with two further Soviet PWRs, of 1,000 MW(e) each. Under a very different economic environment, the project was cancelled in 1989. Reasons for this cancellation were amongst others, a lower demand growth forecast and problems in providing the funds for such a large project.

2.1.2. Current Organizational Chart(s)

The structure of the Hungarian nuclear energy sector is shown in Figure 1.

The Hungarian Atomic Energy Commission (HAEC) is responsible for policy making in nuclear energy, R&D in nuclear safety, international relations (such as IAEA), bilateral and multilateral agreements, public information, nuclear safety inspectorate, nuclear export/import, safeguards, accountancy of radioactive materials and co-ordination of regulatory activities. The main responsibilities of the Hungarian Energy Office are the following:

i) licensing of the electric power production, supply and distribution;
ii) quality control of the services and the satisfaction of the consumer needs;
iii) consumer protection.

The office sets the electric energy prices and tariffs to be paid by the different consumers.

The Hungarian Power Companies Ltd. (MVM Rt.) is responsible for the overall electricity production. The Power Engineering and Contracting Co. (EROTERV) is the Hungarian construction and engineering company most involved in nuclear power development in Hungary.

The Power Engineering and Contractor Co. (ETV-EROTERV Co., Budapest) works on the field of design, construction, commissioning and operating management of nuclear facilities. Its activities include waste management (treatment, storage and disposal).

The Institute for Electrical Power Research (VEIKI) performs all kind of research related to the electric power production. It includes both the conventional and nuclear energy production. The Institute performs also safety analyses of nuclear power plants, PSA and severe accidents, noise analysis, etc.

The Institute of Isotopes is responsible for the production of radioisotope sources for industrial, medical and research purposes. The Institute for Isotope and Surface Chemistry (MTA IKI) of the Hungarian Academy of Sciences performs a wide variety of research related to the use of radioactive materials and nuclear techniques, among them a research and development programme for nuclear safeguards. They provide the expert support and the laboratory backgrounds for the HAEA.

The Central Research Institute for Physics (KFKI) operates a 10 MW(e) reactor and a critical assembly for research purposes and is performing R&D in the field of nuclear measurement and process control technology.

The Atomic Energy Research Institute (KFK AEKI, Budapest) of the Hungarian Academy of Sciences operates the 1 0 MW Budapest Research Reactor. It is active in several fields of nuclear technology such as reactor physics, thermal-hydraulics, health physics, simulator techniques, reactor chemistry.

The Institute of Nuclear Research (ATOMKI, Debrecen) of the Hungarian Academy of Sciences operates a 20 MV cyclotron and a 5 MV Van de Graaff accelerator, and is active on several fields of nuclear physics and nuclear techniques.

The Technical University of Budapest is operating a nuclear training reactor.

The Frederic Joliot-Curie National Research Institute for Radiobiology and Radiohygiene provides expert advice and technical assistance to the Ministry of Public Welfare.

Institute for Radiobiology and Radiohygiene (OSSKI, Budapest) performs a wide spectrum of research including the biological effects of radiation and radioisotopes, radiohygiene (operational and environmental), sterilization, detoxification etc.

The Ministry of Public Welfare is taking a role in the licensing procedure and is the agency responsible for health protection rules in relation to nuclear power plant operations. The State Public Health and Medical Officer Service is responsible for the collection, treatment, and storage of solid and liquid radioactive wastes.

The Ministry for the Environmental and Regional Policy is responsible for establishing air and water quality standards, limits in radioactive releases from nuclear facilities, as well as for controlling the releases at the facilities to the environment.

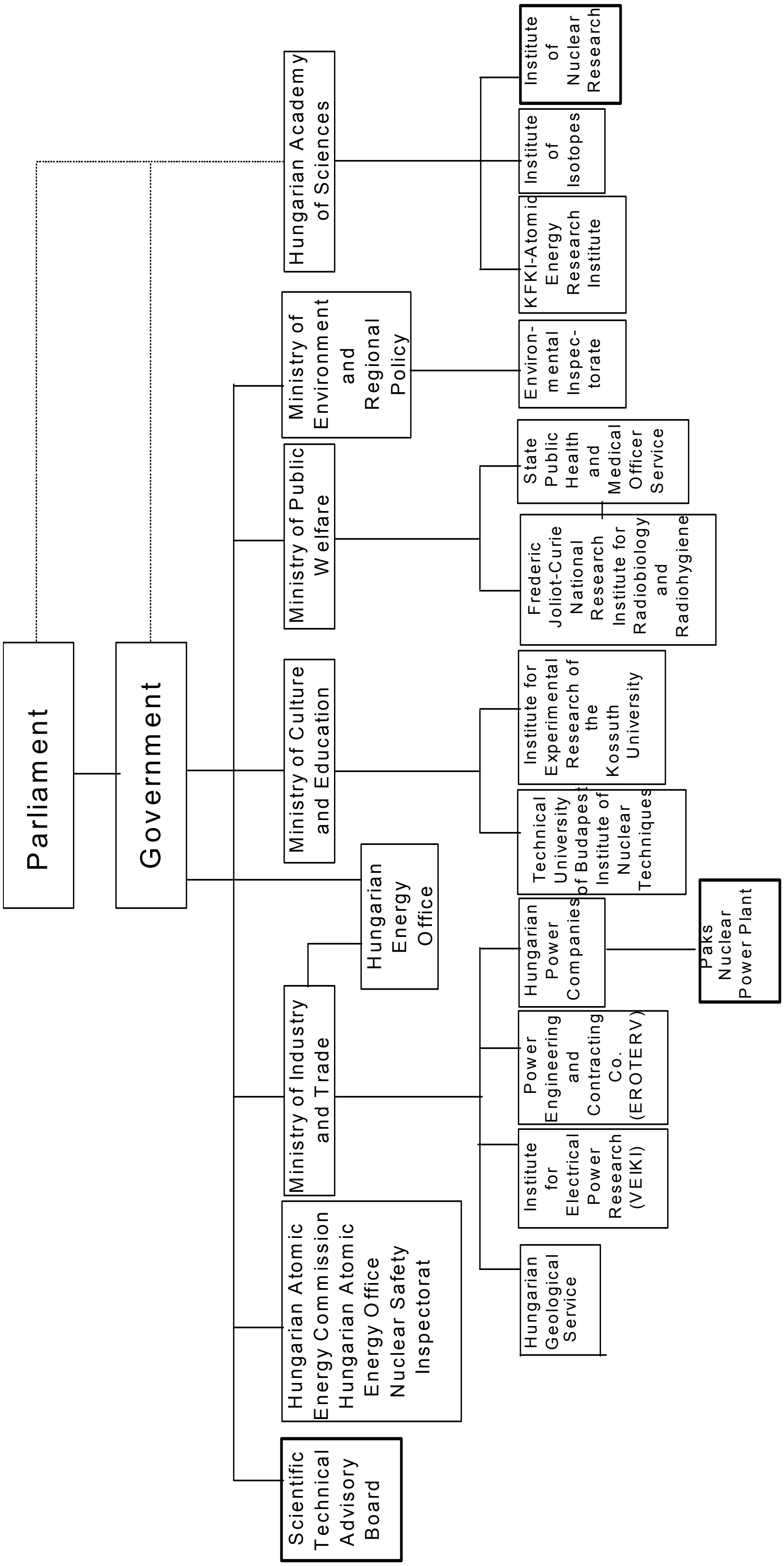

Fig. 1. Organizational Chart of the Hungarian Nuclear Energy Sector

2.2. Nuclear Power Plants: Status and Operations

As mentioned above there is only one nuclear power plant in operation with four WWER reactors. Both the technical as well as the economic experience with the Paks plant have been so far very satisfactory. The plant runs in base load and sells electricity to MVM under a long-term contract. Paks NPP continued to operate reliably throughout the year. The average load factor has remained fairly constant for several years and is above the international average. Table 7 shows the status of the nuclear reactors. The nuclear electricity generation was about 14.72 TW·h in 2000 and the nuclear electricity share in electricity generation was 42.2%.

TABLE 7. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Net Capacity	Operator	Status	Reactor Supplier
PAKS-1	WWER	437	PAKS RT.	Operational	AEE
PAKS-2	WWER	441	PAKS RT.	Operational	AEE
PAKS-3	WWER	433	PAKS RT.	Operational	AEE
PAKS-4	WWER	444	PAKS RT.	Operational	AEE

Station	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
PAKS-1	01-Aug-74	14-Dec-82	28-Dec-82	10-Aug-83	
PAKS-2	01-Aug-74	26-Aug-84	06-Sept-84	14-Nov-84	
PAKS-3	01-Oct-79	15-Sept-86	28-Sept-86	01-Dec-86	
PAKS-4	01-Oct-79	09-Aug-87	16-Aug-87	01-Nov-87	

Source: IAEA Power Reactor Information System as of 31 December 2002.

2.3. Supply of NPPs

There are no NPP suppliers in the country, the main components of the Paks NPP were made abroad. (i.e. in Russia and Czech Republic). The main constructor was AEE (Atomenergoexport) and the main architect ERBE -EROTERV (Hungary).

The main component suppliers are:

– reactor system AEE/SSSR
– reactor vessel Skoda
– fuel AEE
– steam raising AEE
– turbine AEE
– generator GANZ

The manufacture of many components of the Russian-designed WWERs was done in the former COMECON countries under a multilateral agreement.

2.4. Operation of NPPs

The Paks NPP is owned by the Hungarian Power Companies Ltd (50%), State Asset Management Ltd. (49%) and local municipalities (1%). Operation and maintenance is performed by Paks Nuclear Power Ltd. (PARt). In the past, the operator's training was done in Greifswald and in Novovoronezh, but nowadays Paks NPP has a full-scope simulator at the on-site training centre.

The four units of Paks NPP are equipped with all engineered safety systems, similar to the Western PWRs of the same vintage, including confinement of special pressure suppression system. Due to the conservative design, there are several safety merits of these reactors, which have been proved by the outstanding operational records of the plant. The four units achieved a load factor ranging from 80.4% and 94.1% in 2000. The nuclear electricity generation was 14.72 TW·h in 2000 and the nuclear electricity share in electricity generation was 42.2%.

2.5. Fuel Cycle and Waste Management

2.5.1. Fuel Cycle

Hungary has 20,000 metric tons of exploitable uranium resources and 10,000 metric tons of additional reserves. There are three areas in Hungary where uranium occurrences are known, but only one region in Mecsek Mountains has been exploited. Hungary was mining uranium ore, which was processed to yellowcake at Mecsek and then shipped to Russia. Fuel cycle services were guaranteed by the former USSR when Hungary purchased Soviet reactors including the fabrication of fuel assemblies, the shipping of the fabricated fuel assemblies to Hungary, and the return of spent fuel to the former USSR. Hungary does not have other fuel cycle capabilities such as fuel conversion, enrichment, and fabrication.

There are no reprocessing capabilities in Hungary, and no plans to develop any. Hungarian spent fuel has been reprocessed in Russia and the recovered plutonium does not have to be returned to Hungary. Hungary has at present no plans for recycling plutonium as fuel.

A new fuel management strategy was initiated in 1993 and completed in 1995. The strategy includes the creation of the conditions for purchasing nuclear fuel from second supplier and the preparatory work for the use of a new type of Russian fuel assembly with profiled enrichment to allow changeover to 4 year's fuel cycle. The first Russian produced profiled fuel, with a mean enrichment of 3.82%, was loaded into reactor 3 during 2000.

2.5.2. Spent Fuel

The Hungarian policy on spent fuel storage is to store the spent fuel in the pools at the Paks reactor site for 5 years and then transport the spent fuel to the former USSR under an existing agreement. In spring 1992, the Russian parliament passed an environmental law forbidding the import of foreign spent fuel. However, Paks was able to send a few spent fuel shipments up until February 1995.

The Hungarian Atomic Energy Commission issued a license on 4 February 1995 to the Hungarian Power Companies Ltd. for the construction of a spent fuel interim dry storage facility at the Paks site. The Paks NPP management has already chosen GEC Alsthom's modular dry storage technology. In an agreement last year with the Paks local government, Paks NPP guaranteed that no spent fuel would be placed in the dry storage facility as long as the Russians accepted the spent fuel. The dry storage facility is designed to hold fuel for 50 years and should be commissioned in 1996.

According to the Hungarian-Soviet Inter-Governmental Agreement on Co-operation in the Construction of the Paks Nuclear Power Plant, concluded on 28 December 1966, and the Protocol concluded on 1 April 1994 attached to such Agreement, the Soviet and/or Russian party undertakes to accept spent fuel elements from the Paks nuclear power plant in such a manner that the radioactive waste materials and other by-products arising from the treatment of such fuel is not returned to Hungary. Until 1992 return of the spent fuel elements was conducted without problems, under conditions which were very favourable for Hungary, but which nevertheless deviated from normal international practice. Following the collapse of the Soviet Union however, this method of returning waste became less and less reliable. For this reason and in the interests of ensuring operation of the power plant, it became necessary to find an interim solution (50 years) for the storage of spent fuel units.

The Interim Storage Facility for Spent Fuel constructed at the Paks nuclear power plant is a modular system dry-storage facility designed by the English company GEC Alsthom. The advantage of the modular system is that the modules can be built at different times and handled separately from one another. The first section of the facility consisting of three modules was put into operation in 1997 and has a capacity of 1350 fuel element units. This section was approximately 90% full by the end of 1998.

Expansion of the interim storage facility is now underway, in accordance with the increased requirements, and the expanded facility will have capacity for storage of another 1800 units. The investment is being carried out over a two-year period (1998-1999) and will be put into operation in 2000.

2.5.3. Waste Management

Hungary producers radioactive waste from the Paks nuclear reactors - (non-disposable in the existing off-site repository) and from medical and industrial nuclear activities (disposable in the existing off-site repository). The strategy on LLW/ILW disposal in Hungary is that these wastes will be buried in cemented form in steel drums in a shallow-ground disposal site, maintained for 600 years. Since 1986, ILW/LLW from the Paks nuclear power station has been stored at Paks, due to public opposition to its continued burial at the existing disposal site at Puspokszilagy. Public opposition also prevented disposal of Paks-generated ILW/LLW at the alternative site at Ofalu. Until this situation is resolved, ILW/LLW generated at Paks is cemented and stored on-site at Paks.

In the past activities related to the disposal of radioactive waste were conducted within the framework of the State budget for waste not originating from the power generation industry, while the Paksi Atomer6mG Rt. was responsible financing the disposal of waste from the nuclear power plant. As of 1 January 1998 the Atomic Energy Act established the Central Nuclear Financial Fund based on the payments of parties using nuclear energy. The goal of this Fund is to attend to the storage of radioactive waste, interim storage and final disposal of spent fuel, and to finance the decommissioning (dismantling) of nuclear facilities.

Pursuant to the Act on Atomic Energy, a body designated by the Government shall be responsible for attending to the duties related to the treatment of radioactive waste and the decommissioning of nuclear facilities. Based on the authorization of the Government, the HAEA has established the Public Agency for Radioactive Waste Management (PURAM) for this purpose.

In accordance with the relevant Government Decree and Resolution, the Public Agency for Radioactive Waste Management attends to the planning, construction and treatment duties associated with the storage and disposal of radioactive waste and spent fuel elements. It is also responsible for activities related to the decommissioning of nuclear facilities, as well as for the operation of the Püspökszilágy Disposal Site (PDS) and the Interim Storage Facility for Spent Fuel (ISFS) located at the Paks nuclear power plant. Its duties include preparation of the annual, intermediate and long-range plans for the Central Nuclear Financial Fund.

In accordance with international expectations activities are underway at various levels in Hungary in the field of the safe treatment and disposal of radioactive waste and spent fuel in the frame of a national programme started already in 1993. The focus of this programme is the selection of a site for the storage of low and intermediate-level radioactive waste.

2.6. Research and Development

The Technical Support Organizations (TS0s) of the nuclear safety authority are the KFKI Atomic Energy Research Institute (AEKI) and the Nuclear Power Division of the VEIKI Institute for Electric Power Research Co. (VEIKI). The research activities of both institutes are strongly related to nuclear safety problems. While they serve as TSO for the authority they are solving various principal and actual problems for the Paks NPP, too.

The experimental activities of AEKI were oriented partly towards thermohydraulic measurements on the PMK-2 integral facility (simulation of primary to secondary leak via the collector cover, natural circulation in shut-down conditions) and partly towards severe accident modelling at the CODEX facility (air ingress phenomena). The thermohydraulic phenomena are interesting from the point of view of WER-type reactors, while the air ingress process is of general interest. These experiments were carried out in various PHARE projects and a part of them was financed by the National Commission for Technological Development.

An extensive code simulation study of diluted boron slug formation and its reactivity consequences was finished, pointing out the very low probability of this type of accidents at the Paks NPP. The project participants were AEA Technology, AEKI and VEIKI. In other PHARE projects VEIKI and the Western partners dealt with severe accident consequences. AEKI completed the development of the KIKO3D and ATHLET codes for coupled neutronic and thermohydraulical safety analysis calculations.

The Hungarian Atomic Energy Authority continued the financing of various R & D projects. VEIKI performed a detailed precursor analysis based on Paks NPP data and developed a risk supervisory system. AEKI continued the development of the software basis for the emergency response centre CERTA.

Finally, it is worth to mention the very promising co-operation between the Haiden Reactor Project, Paks NPP Co. and AEKI aiming at the development of a Critical Safety Function Monitoring System. This system will be used in connection with the new symptom oriented E0Ps. The project is carried out as a part of the plant computer reconstruction, but the co-operation itself is organized under the umbrella of OECD NEA.

The research institutes intend to participate in the 5th EU Framework Programme. They received a lot of invitation to various consortia, but it is too early to evaluate the potential Hungarian participation in the EURATOM projects.

2.7. International Co-operation and Initiatives

A four-year safety project with a 7 million US$ budget has just started at the Paks NPP. The project is partly funded by the US Government and the PHARE assistance programme of the European Commission, with the IAEA providing technical assistance. The project will establish a maintenance training centre, introduce international training techniques and help to enhance safety at the plant.

An operator reliability experiment project is carried out with participants from the Institute for Electrical Power Research (VEIKI), EPRI and Paks NPP. The project is supported by the US Government.

Hungary maintains wide ranging relations with various international and national nuclear organizations, professional bodies, institutes, nuclear power plants abroad, companies involved in the design, manufacture and implementation of nuclear facilities and research institutes.

The Hungarian Atomic Energy Authority (Authority) is authorized counterpart of International Atomic Energy Agency (IAEA) and of the OECD Nuclear Energy Agency (NEA) and co-ordinates the Hungarian participation in their activity.

The Authority has signed mutual information exchange agreements with the counterpart organization of Canada, France, Romania, United Kingdom and the United States of America. It maintains close professional relations with the authorities of other countries operating WWER reactors and with the authorities of Belgium and Spain. Hungary has benefited from the technical co-operation programmes of the IAEA and from several projects of the European Union's PHARE programme. As a result of the international assistance two major facilities have been established in recent years: the Maintenance Training Centre of the Paks NPP and the CERTA Centre of the Authority for emergency response, training and analysis. Both projects received assistance from the IAEA and from the PHARE programme as well.

The Authority takes an active part in the work of the "CONCERT" group and in the Forum of the authorities of countries operating WWER reactors.

The Paks NPP is member of the World Association of Nuclear Power Plant Operators (WANO), the WWER-440 operator’s club, the WWER user’s group, the International Nuclear Safety Programme (the so called Lisbon Initiative), NUMEX (Nuclear Maintenance Experience Exchange) and NMAC (Nuclear Maintenance Applications Centre).

These relations serve to interchange knowledge and experience and are the main guarantee of maintaining and increasing nuclear safety.

The fact that Hungarian experts are held internationally in high esteem is demonstrated by their taking active role in several committees, with many of them being board members of international organizations or invited as experts.

3. NATIONAL LAWS AND REGULATIONS

3.1. Safety Authority and the Licensing Process

The Hungarian Atomic Energy Commission (HAEC) is an organization on the level of ministries lead by a minister without portfolio. The HAEC became independent from the Ministry of Industry and Trade in 1990. Formerly, regulation and production functions were both under the same Ministry authority. HAEC manages most of the nuclear aspects, which are related to international relations, preparation for legislation, internal relations, nuclear regulatory and licensing activities.

The Nuclear Safety Inspectorate (NSI) and the Nuclear Safety Supreme Inspectorate (NSSI), i.e., the authorities of the first and second level respectively, work under HAEC. The license holder can appeal to NSSI against any decision of NSI.

A general development of regulation and licensing procedures is in progress. The Atomic Energy Act and the Guides of Nuclear Regulations (GNR) give only general principles to licensing procedures (at present these reports on nuclear regulation are being updated). The detailed licensing procedures will be described in the Quality Assurance Manual (QAM). QAM is being developed at present and will contain the operating rules and other activities of HAEC.

There are two types of licensing procedures. Nuclear safety licenses are required for nuclear facilities for the following phases: selection of the site, construction, commissioning, operation, modification and decommissioning of the facility. Nuclear safety licenses for nuclear equipment and devices are required for their fabrication, import, installation, commissioning and operation, modification or reconstruction, reparation and removal.

The licensing of a nuclear facility is performed step by step. It means that the whole process of licensing consists of subsequent licensing procedures according to the mentioned phases. The sequence of phases is fixed and the licensing procedure of a phase may not be started before completing the previous one. The licensing procedures are similar for different nuclear facilities, but every type of nuclear facility requires a set of special directives.

The Act on Atomic Energy defines the role of the Hungarian Atomic Energy Commission (hereafter referred to as Commission) and the Hungarian Atomic Energy Authority (hereafter referred to as Authority). The Commission consists of senior representatives of the ministries and governmental organs having regulatory responsibilities in the use of atomic energy. The Commission itself does not have regulatory function or operative tasks, its main function is co-ordination and supervising. The President of the Commission is appointed by the Prime Minister. For the time being the President is the Minister of Economy, who performs this task on behalf of the Government, independently of his ministerial responsibilities.

The Hungarian Atomic Energy Authority is the nuclear safety regulatory body of the country and the main counterpart for IAEA. The Hungarian Atomic Energy Authority is an authority and, as such, it co-ordinates or performs the particular regulatory tasks necessary to ensure the safe application of nuclear energy. It is an independent administrative body operating through its Nuclear Safety Directorate, under the supervision of the Government. The Authority's scope of responsibility covers not only nuclear safety licensing of nuclear facilities and of their systems, structures and components, but also safety assessment and review of Licensee's reports as well as inspection including enforcement actions, like withdrawing operational licence and it may impose penalties on the licensee.

In addition, the Authority operates the nuclear safeguards system. It is responsible also for recording and supervision of radioactive material, licenses the package and transport of radioactive substances as well as gives licence for nuclear export-import activities. The General Nuclear Directorate of the Authority is responsible for these activities.

As far as general radiation protection is concerned, the Act on Atomic Energy allocates regulatory, official and professional administrative tasks to several ministries. The regulation of radiation protection directly affecting humans beings is the duty of the Ministry of Health, the technical side of radiation protection in nuclear facilities is the task of the Hungarian Atomic Energy Authority. The issue of releases and thus protection of the environment concerns the Ministry for Environmental Protection, while tasks related to the radioactivity of the soil and the vegetation belong to the scope of responsibilities of the Ministry of Agriculture and Regional Development. The new regulation of radiation protection is under preparation, it will be based on ICRP 60.

3.2. Main National Laws and Regulations in Nuclear Power

3.2.1. List of the essential legal laws and decrees regulating nuclear power in Hungary

- Decree of the Ministry of Heavy Industry 5/1979. (III.31) on Technical Safety Questions of the Nuclear Power Station.

  The Annex of Decree contains the following:

  - Technical safety regulation of the nuclear power plant;
  - Quality proving regulation of the nuclear power plant;
  - Technical safety regulation of the pressure vessels of the nuclear power reactors;
  - Stability calculating regulation of the pressure vessels of the nuclear power reactors;
  - Welding regulation of the structures of the nuclear power plant;
  - Control regulation of the welding of the structures of the nuclear power plant;
  - Electric and technical safety regulations of the nuclear power plant;
  - Regulation of handling radioactive wastes arising in the nuclear power plant.

- The Act on Nuclear Energy, Law No. 1/1980, and its associated Executive Order was passed by the Parliament in 1980 and established the legal basis for nuclear energy and the nuclear fuel cycle and confirmed previous laws. The nuclear regulatory tasks are carried out under the Ministry of Industry (formerly the Ministry of Heavy Industry) Decree 5/1979, which deals primarily with the safety aspects of nuclear plants and delegates nuclear regulatory authority to the state Supervisory of Energetics and Energy Safety.

  The Act on Nuclear Energy provides that:

  - Nuclear energy is to be used in a manner prescribed by law;
  - Nuclear energy applications are subject to regular State surveillance;
  - License is required for construction, commissioning, operation, alternation, and decommissioning of nuclear power plants;
  - The licensing authority is required to enforce the provision of the Act on Nuclear Energy;
  - The Act also defines that compensation payments for nuclear accident damage shall be the responsibility of the State and voids any other legal provisions, which exclude or limit liability.

- Law Decree No. 15 of 1987 amended the Act I.
- Governmental Decree 104/1990 (XII.15.) on the tasks and competency of the Hungarian Atomic Energy Commission and Hungarian Atomic Energy Office. The nuclear regulatory and licensing activity came to the authority of the Hungarian Atomic Energy Commission.
- Decree of Minister without Department 1/1990. (XII.25.) on fixing the fees of official procedures concerning nuclear facilities
- Decree of Minister without Department in 1993 on the Safety Technical Regulation of the nuclear facilities. It updated the decree from 1979 extending nuclear regulations to the whole nuclear technology that is to zero power and research reactors and other nuclear facilities too.

3.2.2. The mechanisms in place for financing decommissioning and waste disposal

No nuclear facilities in Hungary have reached the stage of decommissioning and no policy has been decided on this topic yet. Waste management and disposal activities are mainly regulated by the Act I. 1/1980 as amended by the Decrees of Legal Force (DLF) No.1987. Act I. 1/1980 states the responsibilities of the various ministries involved in the regulatory and licensing processes for nuclear facilities. The Departmental Order No. 7/1988, issued by the Ministry of Public Welfare, contains some stipulations concerning the radiation protection requirements for the final disposal of radioactive wastes. Some other aspects, such as the shielding and packing of radioactive materials, transportation are also recovered by Departmental Orders. In 1990, the Hungarian Atomic Energy Commission was charged with the responsibility for evaluating and proposing a more comprehensive basis for nuclear legislation. This process may lead to a revised law. This law incorporate provisions and will address such issues as financing, long-term responsibilities for waste management, siting procedures, etc. The creation of a fund for financing the future costs of radioactive waste management is foreseen.

The legal regime applicable to nuclear activities in Hungary was previously set down in the Atomic Energy Act of 1980. Political, economic and social changes that took place in Hungary urged the promulgation of a new Act on Atomic Energy to reform the regulating framework. Following several years of preparatory work, the Hungarian Parliament approved the new Act on Atomic Energy in December 1996 [(Act No. CXVI. of 1996 on nuclear energy), which entered into force on 1 June 19971. The aim of the Act is not only to modernize Hungarian nuclear law, but also to harmonize Hungarian national law with ional treaties to which Hungary is a party. The main characteristics of the Atomic Act (1996) and the changes compared to previous regulations are as follows:

- exclusive state ownership of nuclear installations and radioactive substances was terminated;
- the authority for facility-level licensing of nuclear installations was entrusted to the HAEA;
- declaration of the priority of nuclear safety;
- definition and allocation of the tasks of ministries, national authorities and bodies of competence in licensing and supervising procedures;
- prescription of the organizational and financial independence of the Authority;
- utilization of human resources, education and research and development;
- it defines the responsibility of the Licensee for all damage caused by the use of nuclear energy, and the sum of indemnity in accordance with those undertaken by Hungary in the context of the Vienna Convention;
- it entitles the Authority to impose fines should rules be broken;
- prescribes the establishment of a Central Nuclear Financial Fund for financing the final disposal of radioactive waste, the interim storage and final disposal of irradiated fuel elements and the decommissioning of nuclear installations;
- establishes new principles on informing the public;
- gives requirements of a new concept regarding emergency preparedness and accident prevention.

To implement the requirements of the Act, many executive orders are necessary among them 8 governmental orders and 12 ministerial decrees are already in force and are still in preparation. As a result, a new and comprehensive regulatory framework has been developed and entered into force in Hungary.

One of the most important governmental orders is No.10811997(V1.25.) that contains the tasks and responsibilities of the nuclear safety authority and, as an Appendix, it contains mandatory safety standards in five volumes as follows:

1. Regulatory procedures for NPPs;
2. Quality assurance requirements for NPPs;
3. General requirements for the design of NPPs;
4. Operational safety requirements of NPPs;
5. Nuclear safety requirements for small reactors.

The Director General of the Authority has been entitled to issue guides concerning the actual implementation of the safety requirements. 33 Guides have been issued so far and further 27 are expected to come into force by the end of 1999.

4. CURRENT ISSUES AND DEVELOPMENTS ON NUCLEAR POWER

4.1. Energy Policy

There has not been made any decision on new power plant construction for base load mode operation, so no provisions have been made to start a new nuclear power project in the near future. On a long-term basis, nuclear power and, to a limited extend, domestic coal are the only alternatives for electricity supply. As a former communist-controlled country, the public involvement in nuclear power development has been minimal, i.e. there is not much experience with public acceptance. Hungary is studying the experience of various western utilities. However, it is clear that Hungary must develop its own policy, tailored to the needs of the Hungarian society, but using western experience and support. The Paks NPP should take an active role according to the established traditions in other fields such as judgement of the nuclear industry, the degree of the public acceptance; general safety upgrading efforts and implementation of new nuclear power plants.

The future of nuclear power in Hungary remains open. There is no referendum, Government or Parliament decision against nuclear power. In fact, the Paks Power Plant Co. sees a future for nuclear power in Hungary and submitted a bid in MVM's capacity tendering round in 1998. The bid proposed three alternatives for a new nuclear power plant of around 700 MW to come into operation by 2006. The alternatives were a Westinghouse pressurized water reactor (AP-600), a Canadian Candu-6 reactor, and a WWER-640 supplied by Atomstroexport of Russia with Siemens participation. None of the three bids were accepted by MVM. This was partly due to that fact that they were all submitted after the 9 October 1998 deadline.

Following a comprehensive technical and economical review in 2000, a decision has now been taken to extend the operating licence for the four Paks units. The review concluded that there is no technical barrier or safety limit that may restrict the operation of the Paks nuclear power plant for up to 50 years. A preparatory project was launched in October 2001, with a view to drafting and introducing a comprehensive lifetime management programme, and to preparing the necessary licensing documents for the lifetime extension by year 2007. This comes on top of existing plans for an 8% increase in total electrical output.

4.2 Privatisation and deregulation

General description of open market issues and its influence in the nuclear sector reorganization

Mention de-regulation, competition, privatisation mergers and acquisitions affected or may affect the electricity and nuclear sector. It could include a discussion on regulatory and legislative framework in the context of privatisation and de-regulation.

REFERENCES

[1] Data & Statistics/The World Bank, www.worldbank.org/data.

[2] IAEA Energy and Economic Data Base (EEDB).

[3] IAEA Power Reactor Information System (PRIS).

Appendix 1

INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

AGREEMENTS WITH THE IAEA

• Agreement on privileges and immunities	Entry into force:	14 July 1967
• NPT related agreement INFCIRC/174	Entry into force:	30 March 1972
• Additional Protocol	Entry into force:	4 April 2000
• Agreement concerning provision of a dose assurance service by IAEA to irradiation facilities in its Member States	Entry into force:	4 November 1985
• Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	12 June 1989

MAIN INTERNATIONAL TREATIES

• NPT	Entry into force:	27 May 1969
• Convention on physical protection of nuclear material	Entry into force:	8 February 1987
• Convention on early notification of a nuclear accident	Entry into force:	10 April 1987
• Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	10 April 1987
• Vienna convention on civil liability for nuclear damage	Entry into force:	28 October 1989
• Paris convention on third party liability in the field of nuclear energy	Not applicable	
• Joint protocol relating to the application of the Vienna and Paris conventions	Entry into force:	27 April 1992
• Protocol to amend the Vienna convention on civil liability for nuclear damage	Signature:	29 September 1997
• Convention on supplementary compensation for nuclear damage	Not signed	
• Convention on nuclear safety	Entry into force:	24 October 1996

- Joint convention on the safety of spent fuel management and on the safety of radioactive waste management — Entry into force: 18 June 2001

OTHER RELEVANT INTERNATIONAL TREATIES

- Treaty banning nuclear weapon testing in the atmosphere, in outer space and under water — Entry into force: 5 August 1963

- Treaty of the prohibition of the emplacement of nuclear weapons and other weapons of mass destruction on the seabed and the ocean floor and in the subsoil thereof — Entry into force: 13 August 1971

- ZANGGER Committee — Member

- Improved procedures for designation of safeguards inspectors — Accepted: 9 May 1988

- Nuclear Export Guidelines — Adopted

- Acceptance of NUSS Codes — Accepted

- Nuclear Suppliers Group — Member

- Standard agreements concerning technical assistance to Hungary — Parties:
  - United Nations Organization
  - International Labour Organization
  - Food and Agriculture Organization of the UN
  - International Civil Aviation Organization
  - World Health Organization
  - International Telecommunications Union
  - International Atomic Energy Agency

BILATERAL AGREEMENTS

- Agreement for Co-operation in the Peaceful Uses of Nuclear Energy
  Parties: Hungary/Canada — Entry into force: 27 November 1987

- Agreement on the regulation of matters of mutual interest related to the nuclear facilities
  Parties: Hungary/Austria — Entry into force: 25 August 1987

- Agreement on the regulation of matters of mutual interest related to exchange of information and co-operation in the field of nuclear safety and radiation protection Parties: Hungary/Germany — Entry into force: 7 February 1991
- Agreement on exchange of information and co-operation in the field of nuclear safety and radiation protection Parties: Hungary/Czech Republic — Entry into force: 15 May 1991
- Agreement on exchange of information and co-operation in the field of nuclear safety and radiation protection Parties: Hungary/Slovak Republic — Entry into force: 15 May 1991
- Agreement for Co-operation in the Peaceful Uses of Nuclear Energy Parties: Hungary/USA — Entry into force: 13 February 1992
- Agreement for the early exchange of information in the event of a radiological emergency Parties: Hungary/Slovenia — Entry into force: 15 February 1996
- Agreement on early notification of nuclear accidents Parties: Hungary/Romania — Entry into force: 24 February 1998
- Agreement on early notification of nuclear accidents, on exchange of information and co-operation in the field of nuclear safety and radiation protection Parties: Hungary/Ukraine — Entry into force: 25 February 1999
- Agreement for the early exchange of information in the event of a radiological emergency Parties: Hungary/Croatia — Signature: 11 June 1999

Appendix 2.

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

NATIONAL ATOMIC ENERGY AUTHORITY

Hungarian Atomic Energy Authority P.O. Box 676 H-1539 Budapest 114 Hungary	http://www.haea.gov.hu/english/index.html
General Nuclear Directorate	Tel: (361) 355 97 64 Fax: (361) 375 74 02
Nuclear Safety Directorate	Tel: (361) 355 05 28 Fax: (361) 355 15 91
Nuclear Emergency Preparedness GC (NEP)	http://www.bik.hu/english/Index.htm

NUCLEAR RESEARCH INSTITUTES

Atomic Energy Research Institute of the Hungarian Academy of Sciences KFKI AEKI P.O. Box 49 1525 Budapest	Tel: (361) 395-9220 Fax: (361) 395-9293 http://www.kfki.hu/~aekihp/
Institute for Isotope and Surface Chemistry of the Hungarian Academy of Sciences P.O. Box 77 1525 Budapest	Tel: (361) 395-9220 Fax: (361) 395-9274 http://www.iki.kfki.hu/
Campus Research Institutes - Budapest (KFKI)	http://www.kfki.hu/
Institute of Nuclear Research – Debrecen of the Hungarian Academy of Sciences	http://www.atomki.hu/
Institute for Electrical Power Research VEIKI P.O.Box 801251 Budapest	Tel: (361) 457-8220 Fax: (361) 457-8253
"Fodor József" National Public Health Centre, "Frederic Joliot-Curie" National Research Institute for Radiobiology and Radiohygiene P.O.Box 101, 1775 Budapest	Tel: (361) 229-1944 Fax: (361) 229-1931 http://www.osski.hu/

OTHER NUCLEAR ORGANIZATIONS

Paks Nuclear Power Plant P.O. Box 71 7031 Paks	Tel: (3675) 311222 Fax: (3675)

ETV-EROTERV-RT P.O. Box 111 1450 Budapest	 Tel: (361) 215-6810 Fax: (361) 218-5585
Hungarian Academy of Sciences	http://www.mta.hu/
Hungarian Nuclear Society	http://www.kfki.hu/~hnucsoc/
Roland Eötvös Physical Society	http://www.kfki.hu/~elfthp/
RMKI Department of Plasma Physics	http://www.rmki.kfki.hu/plasma

UNIVERSITIES

Eötvös Loránd University of Sciences	http://www.elte.hu/
Technical University of Budapest Institute of Nuclear Techniques Muegyetem Rkp. 9 1521 Budapest	 Tel: (361) 463-2523 Fax: (361) 463-1954 http://www.bme.hu/

OTHER ORGANIZATIONS

National Széchényi Library (National Library of Hungary)	 http://www.oszk.hu/
National Technical Information Centre and Library	http://www.omikk.hu/omikk/cimlap.htm