ROMANIA

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1. GENERAL INFORMATION

1.1. General Overview

Romania is a unitary republic in southeastern of Central Europe, in the northern part of the Balkan Peninsula, halfway between the Atlantic Ocean and the Ural Mountains, being placed at a distance ranging between 1050 km (south) and 2800 km against the continent extremities. Romanian territory is unfolding on around 4.5 degrees latitude and 9.5 degrees longitude, being placed at the crossing of the parallel 45° N with the meridian 25° E (at 17 km north of town Fagaras). The country is bordered by Hungary (west), Serbia (south-west), Bulgaria (south), Ukraine (north), Moldavia (north-east) and the Black Sea (east), along 245 km of coastline. The country covers an area of 238,391 square kilometres and is the continent's 13th largest country in area.

Romania's topography is dominated by the great arch of the Carpathian Mountains, which enter northern Romania via Ukraine and take a curving course, first southeastward and then westward across the central part of the country. The Carpathians then turn south again and cross the lower course of the Danube River, which forms Romania's southern boundary with Serbia and Bulgaria. The southern and eastern portions of Romania consist of fertile plains that are drained by the Danube and its tributaries. The Carpathians in Romania may be divided into the Eastern Carpathians, the Southern Carpathians (or the Transylvanian Alps), and the Western Carpathians. The highest point in Romania is the peak Moldoveanu (2,544 m) in the Southern Carpathians. Main features of relief units are:

- proportionality (31% mountains, 36% Sub-Carpathians, hills and plateaux, 33% plains, meadows and Danube Delta).
- concentric display, in amphitheatre (The three ranges, the major levels, with an average elevation of 800 m, form a semicircle, open to the west through structural depressions ("gates"), that shelters the tableland of the Transylvanian Basin in the central part of the country. On the outer fringe of the Carpathians' great arc are the Sub-Carpathians, reaching elevations between 400 and 1,000 m. The eastern and southern plains occupy one-third of the country's total area and formed the populated cores of historic Moldavia and Walachia, respectively.

Stretching for approximately 480 km from north to south and about 680 km at its widest extent from west to east, it contains no desert, no too high mountains, or other difficult environments that limit the extent of human occupancy. Romania's climate is intermediate between temperate and continental types, with lower oceanic influences from the west, Mediterranean ones from southwest and stronger continental-excessive ones from the north-east. Average annual temperatures range latitudinal from 11°C in the south to 7 °C in the north and altitudinal with values of -2.5° C in the mountain areas (Omu Peak - Bucegi Massif) and 11.6°C in the southern plain (Zimnicea town - Teleorman county); average yearly rainfall decreases in intensity from west to east, with ranges from 400 mm in the south-east to 1,400 mm in the Carpathian Mountains. Romanian running waters are radially displayed, most of them having the springs in the Carpathians. Their main collector is the Danube River, which crosses the country in the south on 1075 km length (about 40 % of the entire course) and flows into the Black Sea through a large delta. Its basin area is 33,250 km^2, excluding the tributaries, which form the first-degree basins. In the mountains areas there are numerous glacial lakes and recently, anthropic lakes which turn into account the rivers hydro-energetic potential.

The vegetation is determined by the relief and by pedo-climatic elements, being displayed in floors. Mountain areas are covered by coniferous forests (especially spruce fir), mixture forests (beech, fir-tree, spruce fir) and beech forests. Higher peaks are covered by alpine lawns and bushes of dwarf pine, juniper, bilberry etc. In the hills and plateaux, there are broad-leaved forests, prevailing beech, common oak or durmast oak; the main forest species often met on low hills and high plains are Quercus cerris and Quercus frainetto. Forests cover about one-fourth of the land. The typical steppe and silvosteppe vegetation, which covered the areas of low humidity in Dobrogea Plateau, Romanian

Plain, Moldova Plateau and Western Plain, has been mostly replaced by agricultural crops.

The territory of the country is devised in 41 counties, with 265 towns (of which 93 municipalities) and 2,686 communes (consisting of 13,092 villages), and Bucharest Municipality. The population of Romania, as following the last Census of population, March 2002, was of 21,698,181 inhabitants - with a density of about 91 people per km^2. These preliminary data show a decreasing by 1 million persons from the previous census, ten years ago. Only 7 cities have a population of over 300,000 and 16 cities have a population of over 100,000. Bucharest, the capital city, has about 2.9 million inhabitants. Table 1 shows the historical statistics concerning population information.

TABLE 1. POPULATION INFORMATION

											Growth rate (%)
	1960	1970	1980	1990	1996	1997	1998	1999	2000	2001*	1980 to 2000
Population (millions)	18.4	20.2	22.2	23.2	22.6	22.5	22.4	22.4	22.3	21.7	- 6.5
Population density (inhabitants/km²)	77.5	85.3	93.5	97.7	95.1	94.8	94.6	94.6	94.3	91	- 3.2
Urban population as percent of total	33	36.9	45.8	54.3	54.9	55	55.1	55.9	54.6	52.7	1.15
Area (1000 km²) 238.4											

Source: IAEA Energy and Economic Database; Data & Statistics/the World Bank; National Commission for Statistics (CNS), Romanian Statistical Yearbook 2001; Institute of Geography Bucharest; UN Statistics Division.
* Census of population and dwellings, March 18-27, 2002.

1.2. Economic Indicators

Table 2 shows the historical GDP data.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1980	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Growth rate (%) 1990 to 2001
GDP [1]	34,272	38,244	28,851	19,579	26,361	30,073	35,686	35,508	34,904	38,158	31,293	35,493	39,750	-0.03
GDP [2]	35,767	38,244	33,305	28,720	29,007	30,025	32,097	33,363	N/A	N/A	28,689	29,262	30,324	-
GDP [3] per capita	1,544	1,648	1,245	848	1,148	1,316	1,570	1,569	1,550	1,697	1,647	1,677	1,766	7.1
GDP by sector (%):														
-Agriculture	N/A	20	18	18	21	20	21	20	20	15	16	13	15	-5.0
-Industry	N/A	50	45	44	42	46	43	44	45	36	31	36	34	-16.0
-Services	N/A	30	37	38	37	34	37	36	36	48	53	51	51	21

[1] Millions of current US$.
[2] Millions of constant 1990 US$.
[3] Current US$ per capita.
Source: IAEA Energy and Economic Data Base; CNS Romanian Statistical Yearbook 2001; Data & Statistics/the World Bank; PriceWaterhouse Coopers, FiFoOst, Romanian Commercial Bank.

1.3. Energy Situation

Among the various main useful minerals we can mention: crude oil, with old exploitation traditions; natural gas; coal, especially cocking pit coal, lignite and brown coal; ferrous and non-ferrous ores, gold, silver and bauxite ore deposits; great reserves of salt as well as numerous non-metalliferrous resources. Table 3 shows the energy reserves, and Table 4 the historical energy statistics.

1.4. Energy Policy

Brief description of current energy policy in terms of independence of the sector, use of domestic resources, market driven, influence of climate change, impact of Kyoto in the energy policy, etc. Discussion on the country energy resources and its impact in the energy policy.

Since 2001, Romania's macroeconomic environment and business climate have improved. Social and political factors are related today to the trend of transition from fossil energy resources, expendable by definition, to new reliable sources and to a sustainable development, in order to prevent a crisis. The country is facing today the factors above and the Government is trying to cope with difficult economic circumstances. The economic context is characterized by deregulation and competition, supported by the industry that is now under a full restructuring with concerning an increased demand of energy and more clear requirements for a clean and safe environment.

Table 5 illustrates the energy independence degree, as ratio between primary energy production and quantity available.

There are not yet estimations referring to climate change. The consequences of global warming in Romania include in particular changes in the severity and frequency of extreme weather events (temperatures in winter and summer, storms, flooding etc.).

The impact of the Kyoto Protocol in the current energy policy has no a large significance due to the very large decrease by almost 50% of emissions of carbon dioxide during the 1990s. It is to be pointed out that there are efforts to mitigate emissions and to suitably modernize the industry but the emissions decay is mainly as a result of the severe economic recession by the end of XXth century.

2. ELECTRICITY SECTOR

With a Romanian electricity history that goes back to 1862 when electric lighting was for the first time used in Bucharest. An electric power plant fitted with steam boilers and Brush dynamos supplying direct current through a 2 kV line (underground cable) was commissioned in the downtown.

TABLE 3. ESTIMATED ENERGY RESERVES

	Estimated energy reserves in 1999 (Exajoule)					
	Solid	**Liquid**	**Gas**	**Uranium (1)**	**Hydro (2)**	**Total**
Total amount in place	10.28	4.54	13.74	3.77	5.40	37.72

(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.

The first European city endowed with electric street lighting was Timisoara, an exquisite town located in the western side of the country. This dates back to 1884. In 1906, the General Society for

Gas and Electricity of Bucharest was set up. It was a joint-stock company, with French shareholders, running according to the Romanian Commercial Code. The country's First Energy Law was passed in 1924. It specified explicitly that the installations for production, transmission and distribution of energy were state property. This law was amended and extended in 1930 and 1934, but not fundamentally altered. In 1938, the law for organizing the communal exploitation was enacted. After periods of amazing developments early 20th century, in-between the two world wars, the electricity sector knew a moderate development (an installed capacity of 501 MW and a production of 1.13 TW·h in 1938).

TABLE 4. ENERGY STATISTICS

Exajoule

								Average annual growth rate (%)	
	1960	1970	1980	1990	1999	2000	2001	1960 to 1980	1980 to 2000
Energy consumption									
- Total[1]	0.83	1.91	3.10	2.59	1.67	1.61	1,68	6.84	-3.22
- Solids[2]	0.17	0.42	0.62	0.55	0.32	0.30	0.46	6.80	-3.61
- Liquids	0.25	0.46	0.79	0.64	0.50	0.49	0.54	5.96	-2.38
- Gases	0.41	1.00	1.56	1.20	0.59	0.55	0.57	6.96	-5.06
- Primary electricity[3]		0.03	0.13	0.20	0.25	0.27	0.11	19.11	3.95
Energy production									
- Total	1.05	1.94	2.58	1.76	1.17	1.13	1.18	4.60	-4.07
- Solids	0.14	0.33	0.47	0.37	0.22	0.20	0.35	6.33	-4.23
- Liquids	0.49	0.58	0.48	0.33	0.27	0.27	0.26	-0.13	-2.93
- Gases	0.41	1.01	1.51	0.96	0.44	0.40	0.46	6.68	-6.42
- Primary electricity[3]		0.03	0.12	0.11	0.25	0.26	0.11	18.89	3.89
Net import (import - export)									
- Total	-0.23	-0.04	0.51	0.75	0.48	0.46	0.50	-4.18	-0.51
- Solids	0.03	0.08	0.15	0.19	0.09	0.09	0.11	8.68	-2.52
- Liquids	-0.25	-0.11	0.31	0.31	0.23	0.21	0.28	-1.16	-1.81
- Gases	-0.01	-0.01	0.05	0.24	0.16	0.16	0.11	-9.95	5.73

[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 Database; Romania Statistics Yearbook 2001.

TABLE 5. ENERGY INDEPENDENCE DEGREE

(%)	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	72.0	71.8	73.0	70.0	69.8	69.0	70.3	75.9	77.3
Coal	68.7	74.8	75.7	72.7	75.1	67.8	64.4	69.0	74.9
Crude oil	51.3	47.3	45.2	43.7	48.6	51.4	51.8	59.4	57.0
Natural gas	82.9	82.0	79.9	75.1	70.9	74.7	74.8	81.5	80.2

Source: National Commission for Statistics (CNS), Romanian Statistics Yearbook 2001

In 1948, the energy industry, like all other industries, was nationalized. The legal framework in the country became that of a centralized state economy. In 1949, the Ministry of electric energy and Power Engineering was founded. All local companies and enterprises were co-ordinated by this newly created structure.

In 1958, the National Power System was created through the interconnection of the local systems. In 1963, the completion of the first parallel - synchronous interconnection of the National Power System with the East European interconnected power system, through commissioning of the 220 kV overhead electric grid.

Electrification of the first railway section (i.e. Ploiesti - Brasov) in the country took place in 1966. In 1968, the Territorial Power Dispatching Centres was set up. From 1980 to 1989, the National Electricity System was confronted with severe difficulties. It operated in isolation, disconnected from the neighbouring countries; the system frequency often dropped from 50 Hz to 47 Hz and operated at

the failure margin, due to the very high industrial consumption dictated by the forced industrialization of the country and also to the inefficient energy consumption, the pressure of the natural gas in the distribution networks often below normal, particularly in the cold Romanian winters; the industrial plants operated below their design capacities. In the final years of the communist government, the energy sector was additionally corseted by regulations imposing military control; however this legal framework could not even make the energy sector function properly, much less enhance the efficiency of the energy use.

After this period, the electricity sector has embarked in a deep and total restructuring process, with efforts directed towards the marked economy. At the same time, a great decrease in the demand and a steady reduction of the available domestic primary energy resources were recorded between 1990 and 1995.

2.1. Structure of the Electricity Sector

A new restructuring programme started in July 1998 when RENEL has been split and reorganized. By Government Decision No. 365 / 02.07.1998, all nuclear activities were completely separated and the National Electricity Company (CONEL - S.A.) was founded as a joint stock company performing the tasks of transmission, system and market operator. It owned 100% shares in three affiliates:

- S.C.TERMOELECTRICA S.A., for electricity and heating generation in thermal power plants;
- S.C.HIDROELECTRICA S.A., for hydro power generation;
- S.C.ELECTRICA S.A., for power distribution and supply.

Also created was the state owned Autonomous Company for Nuclear Activities (RAAN).

The separation of the former Nuclear Power Group and the setting up of the National Nuclear Company S.N. NUCLEARELECTRICA S.A. had been an explicit commitment assumed by Romania when it ratified the Guarantee Agreement with the International Bank for Reconstruction and Development (BIRD) (Government Ordinance No. 41 / 29.08.1995) and the European Bank for Reconstruction and Development (BERD) (Government Ordinance No. 6 / 16.01.1996), which provides that the Romanian side will create an independent public institution for the nuclear activity.

The next stage of this reform process, lasting 12 months, started with the promotion of the new Electricity and Heat Law as Government Emergency Ordinance No. 63 / 28.12.1998, becoming effective in March 1999.

The major targets approached by the law have been:

- unbundling the main activities: electricity and heat generation, transmission, distribution and supply;
- competition in generation and supply activities;
- free access to the transmission and distribution networks;
- the legal framework to set up the National Electricity and Heat Regulatory Authority, i.e. the National Agency for Power Regulation (ANRE);
- the need for privatization, together with guarantees for non-discrimination by ownership and technological criteria.

The whole economic and technical operation and development of the electricity sector will be regulated, ruled, supervised and monitored by the ANRE created according to the new Electricity Law, set up by a Government Emergency Ordinance, in October 1998, as a public institution, independent and autonomous.

The national power company CONEL, as well as NUCLEARELECTRICA, are set as stock

companies. The relationship among basic activities – generation, transmission and distribution are based on commercial contracts. Accordingly, between ELECTRICA, the national distributor of electricity, and NUCLEARELECTRICA a power purchase agreement was recently signed in December 1999. The Electricity Law grants the third part access to the grid.

Contractualization of the power sector main activities is thus achieved and various prices can be settled for each activity and services: (i.e. regulated supply tariffs, regulated distribution tariffs, regulated transmission tariffs, the power purchase price, the system services tariffs, regulated purchase price from the NPP).

The subsequent restructuring stage settled the electricity wholesale market rules. The needed infrastructure for this market is also in process to be designed, achieved and commissioned (hardware, software, and telecommunication links, metering). ANRE is creating and approving the requested issuing prescriptions and rules to set-up the Electrical Power Market (secondary legislation i.e.: Grid Code, Commercial Code, Distribution Code, Supply Code, Metering Code, Licensing procedures and tariffs methodologies).

The electricity wholesale market will be determined by the activity of several producers and buyers, which are being kept in relation through market mechanisms. These mechanisms are supposed to balance the offer with the demand and to settle the market price.

The final restructuring stage will result in exercising the wholesale market functioning and further on, in spinning off the thermal power generating subsidiaries and the distribution subsidiaries. A number of independent companies are thus set up (by Government of Romania Decision No. 627/2000, former CONEL's branches becoming independent companies) and there will be considered for privatization as soon as possible; creating such a competitive structure for the Romanian electricity sector will provide enough incentives for private investors to set up independent power producers either by building new generating capacities or by buying or getting concessions for the existing capacities; private investors will be also encouraged to invest in the power sector.

With this Government Decision No. 627, the power sector has been technically, legally and commercially unbundled. There is a clear separation of generation, transmission/dispatch, distribution and supply activities. The Romanian electricity market is in a nutshell, together with the set up of TRANSELECTRICA S.A., as transmission system operator of the entire Romanian power system and administrating the specific market through its subsidiary - the market (commercial) operator named OPCOM.

The readiness of Transelectrica is mainly based on the transmission fee, fully regulated by ANRE and on the revenues from system services. Transelectrica buys the system services from producers and uses its for the power system needs.

The Romanian electricity market is now mainly based on bilateral contracts:

- regulated contracts (85% of the market) of main producers, suppliers and captive consumers;

- negotiated contracts, representing the competitive segment and the first pillar of the market, with generators, suppliers and contestable consumers.

This level of 15% of market competitiveness will gradually be increased. The regulated contracts of the wholesale electricity market offer a guarantee to the suppliers that are obliged to deliver electricity at regulated prices to the captive consumers. One of the most conspicuous features of the Romanian wholesale market, an inheritance of the past, is the fact that hydro generation is 4 times cheaper than the thermal one. This very large difference in prices on the wholesale market is expected to steadily disappear, by increasing the competitive component of the market. The regulated market will finally turn into a competitive market. The Romanian power sector has the regulatory framework for trade arrangements on the electricity market and is prepared for the next natural steps

of the restructuring process: distribution privatization in parallel with the privatization of a number of power plants.

Romania has officially requested for the integration of its power system to the Union for the Co-ordination of the Transport of Electricity of Western Power Systems (UCTE).

Main milestones for interconnection:

05.04.1994	Romanian Power System joined the second UCTE synchronous zone (Serbia, FYROM, Montenegro, Greece) for a trial parallel operation with the UCTE rules and recommendations observance
10.03.1997	Official application for the integration in the UCTE synchronous zone
17.07.1997	Technical Committee UCTE/Bulgaria/Romania to supervise the admission procedure is established
08.01 – 30.03.2001	Winter interconnection tests successfully performed
09.07 – 20.09.2001	Summer interconnection tests in progress
End of year 2001	1st Interim Report submission and approval for 1 year
Next steps:	
Year 2002	Interconnected operational test
Beginning of year 2003	Final Report submission and approval on definitive Interconnection

2.2. Decision Making Process and Future Trends

Considering the *strategic importance of the energy sector* in developing the national economy on sustainable basis, the sector evolution has to be outlined through prognosis and strategies on different horizons of time, so that the development perspectives and the energy supply to be correctly estimated. This necessity is emphasized in the *Governmental Programme* of the present administration, which takes into consideration "*Romania's Economic Strategy on medium term*" and *also "The Government Action Plan on 2000 - 2004"*, agreed with the European Commission.

In order to implement the *Governmental Programme*, the Ministry of Industries and Resources appreciated that it is necessary to elaborate a National Energy Strategy, which to emphasize conditionalities, possible options, related policies and correspondent impacts during the process of taking decisions and establishing directions to operate. This document has as starting point the *sustainable development of Romania in the context of further country's admission to EU*, and takes into consideration the main objectives and priorities of the long-term National Energy Strategy. The principles laying at the basis of this document are the following:

- Romania's admission in EU cannot be undertaken without an accelerate, long-term and stable economic growth - at a higher rate than that of the European Community one;
- The economic expansion should be of a main priority, it is not just a wish, but a core necessity;
- The further integration of the national industry in the European structures imposes to be achieved through the sustainable development of the energy sector;
- The change and restructuring process of the energy sector is of an extreme importance in the process of national economy reform;
- Accelerating the privatization in the energy sector will lead to the creation of new real competitive structures;
- The intensification of the investment efforts represents a vital necessity for the Romanian industry;
- The results of the measures implemented towards the fulfillment of European standards will depend of the competitive capability developed in the conditions of a fully opened electricity market.

To accomplish the energy strategy and the energy policies that will be applied to the sector in the next 4 years, a number of decisions must be taken:

- Accept a maximum import of 40% energy resources, considering security of supply reasons;
- Taking into consideration the previous decision, the decision-makers must decide how much of the electricity market will be opened; the same for the gas market;
- Choose the best solution regarding the restructuring process in electricity and heat sector, in gas and oil areas;
- Choose specific privatization options for each of the energy sub-sectors;
- Establish the most advantageous situation between the case of using imported gas and the case of using domestic coal and oil fuel, considering also the enhancement of environmental protection requirements;
- Maintain the same tariffs for all the country consumers, because of social cohesion reasons;
- Intensify the investment efforts, for energy resources and for the whole production-transport-distribution chain.

2.3. Main Indicators

At the end of the year 2001, the total installed capacity of the Romanian power sector was 16,286 MW: 8,660 MW in coal and oil, 5,934 MW in hydro, 706.5 MW in nuclear and 986 MW in other IPPs (Independent Power Producers). It seems to be a very large capacity, largely depassing the demand but we have to keep in mind the age, the availability, the technological level and the intrinsec efficiency of the majority of facilities.

The average production costs, in USD/MW·h, for different power sources are:

- hydro < 10;
- nuclear 12-13;
- gas 25-30;
- coal 40-45.

The electricity tariff for nuclear power, of about 30 USD/MW·h, covers SNN SA overall investment, production cost and financial expenses. The average selling price of electricity was in 2000 of about 45 USD/MW·h.

TABLE 6. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

								Average annual growth rate (%)	
	1960	1970	1980	1990	1999	2000	2001	1960 to 1980	1980 to 2000
Electricity production (TW·h)									
- Total[(1)]	7.65	35.09	67.49	64.31	53.20	51.83	53.89	11.50	-1.31
- Thermal	7.25	32.32	54.85	53.33	27.56	24.72	33.81	10.65	-3.91
- Hydro	0.40	2.77	12.64	10.98	20.83	22.06	14.63	18.89	2.82
- Nuclear					4.81	5.05	5.45	-	-
Capacity of electrical plants (GW(e))									
- Total	1.78	7.35	16.11	22.48	22.52	22.42	21.91	11.65	1.67
- Thermal	1.57	6.15	12.65	16.81	15.75	15.63	15.16	11.00	1.06
- Hydro	0.21	1.20	3.46	5.67	6.12	6.15	6.20	15.03	2.92
- Nuclear					0.65	0.65	0.65	-	-

(1) Electricity losses are not deducted.

Source: IAEA Energy and Economic Database; Nuclearelectrica SA, ANRE

Generally, the electricity consumption after 1989 followed the evolution of the whole national economy, mainly of the industrial activity, implying decrease periods, followed by growth periods. Between 1997 and 1999, the energy resources, electricity and heat consumption diminished according to national economy tightening. The decrease of energy consumption induced crisis phenomena in the energy sector, manifested by a supplementary deterioration of the financial situation, slow down of the investment and maintenance programmes, unemployment. Compared to 1999, in 2000 the consumption registered an increase of 2.7%, due to the small recovering of national economy, and

more evident in 2001. The trend of redressing status is obvious. Figure 1 shows the share of the electricity generation in 2001. Tables 6 and 7 show the main indicators of electricity and energy.

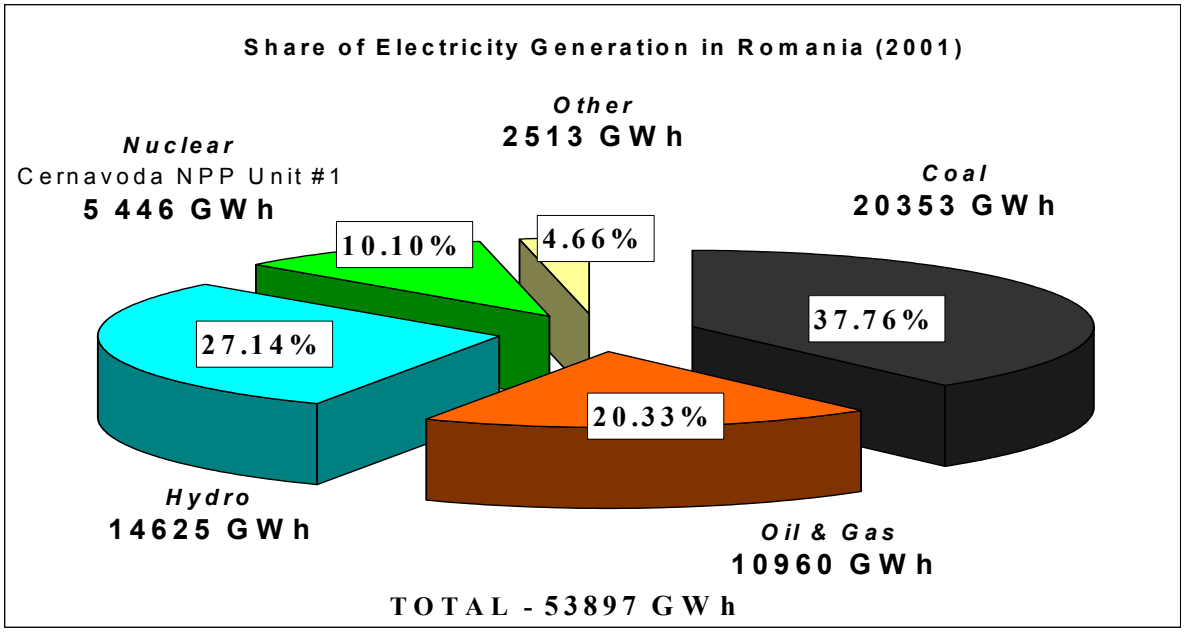

FIG. 1. Power Generation Structure-Romania 2001

TABLE 7. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1999	2000	2001
Energy consumption per capita (GJ/capita)	45	94	140	111	74	72	70
Electricity per capita (kW·h/capita)	416	1,630	2,860	2,967	2,258	2,236	2,484
Electricity production/Energy production (%)	7	16	24	22	16.2	14.8	16.4
Nuclear/total electricity (%)					9.9	10	10.1
Ratio of external dependency (%)[(1)]	-27	-2	16	29	29	29	30
Load factor of electricity plants							
- Total (%)	49	55	48	33	27	26	24
- Thermal	53	60	49	36	20	18	18
- Hydro	22	26	42	22	39	41	35
- Nuclear	-	-	-	-	84.5	88.3	88.25

[(1)] Net import / Total energy consumption

Source: IAEA Energy and Economic Database; Nuclearelectrica SA.

2.4. Impact of Open Electricity Market in the Nuclear Sector

General description of open market issues shows also its influence in the nuclear sector reorganization. There are mentioned de-regulation, competition, privatization mergers and acquisitions affected or may affect the electricity and nuclear sector.

The year 2001 was a reference for the energy sector, as it was rich in outstanding events with direct impact on the evolution of the regulatory activity. It started under the sign of the Californian energy crisis, went on with the suspension of deregulation in that state and ended with the collapse of Enron, until recently the incontestable leader on the electricity and natural gas markets. At European level, proposals to amending the directives on the internal markets for gas and electricity continued to stir many debates where legislative issues referring to the electricity transit played an important role.

Considering the above, Romania's Government adopted a package of legislative acts focussing on the energy sector strategy with a view to attracting investment and ensuring the necessary financial resources in order to increase performance and efficiency of the electricity and heat sector. Therefore, the restructuring of transmission and distribution continued more actively as well as the

externalization of certain capacities owned by Termoelectrica SA while the market opening degree was enhanced to 33%.

The Romanian wholesale electricity market was established and developed as per the regulatory principles stated in ANRE Commercial Code of the Wholesale Electricity Market, issued in 1999 and derived from the European Directive 96/92/EC and the national secondary legislation of the sector.

At the end of 2001, licenses were granted to 17 electricity producers, 28 suppliers and 19 consumers were declared eligible. 35% from the licensed producers, 25% from the licensed suppliers and 21% from the eligible consumers have been active on wholesale electricity market.

The main producers acting on the wholesale market are those coming from the former National Electricity Company (CONEL). The current structure of the generation sector shows a high degree of concentration on the market. The Hirschman-Herfindahl index (HHI), measuring this concentration level may vary between 0 and 10000 (an approx. 0 level means an ideal competitive market and an approx. 10000 level shows a perfect monopoly situation). For Romania, HHI is approx. 4000, meaning 2.5 equivalent companies at national level. (10000/HHI).

The competitive market has continued to develop. Almost 7% from the final consumption have been covered by direct contracts, at negotiated prices, between Hidroelectrica and Termoelectrica on one part and four eligible consumers on the other part. In order to protect the franchised customers, the hydropower production to be contracted at negotiated prices was limited to 15% from the annual production estimated for the domestic consumption. Consequently, certain eligible customers purchased electricity at regulated prices, as SC Termoelectrica was not able to offer smaller prices than the regulated ones. The opportunities offered by the tariff system which was designed to stimulate an adequate management of the consumption curve, the lack of metering units adequate to monitor the bilateral contracts and the compensation process according to the GEO No. 17/1996 approved by Law 68/1996 were other factors added to the situation.

The bilateral contracts concluded at negotiated prices between SC Hidroelectrica SA, SC Termoelectrica SA on one part and SC Electrica SA on the other part, the market transactions at marginal price and import transactions represented 6% from the final consumption level of 2001.

Based on ANRE statistics, the GEO No. 1272/2001 has been issued in December, stipulating the opening degree of the market at 25% (starting December 24, 2001) and at 33% (starting June 1, 2001) from the final electricity consumption level of 2001. The minimum annual consumption level is 144 TJ (40 GWh).

GEO No. 48/2002 stipulates an earlier deadline for achieving the 33% opening degree (February 2002, with four month earlier). The obligations assumed by the Romanian Government regarding the EU accession as stipulated in Chapter 14 – Energy are, therefore, accomplished earlier.

The retail electricity market during 2001 was based on the SC Electrica SA supply activity due to the opening degree of the electricity market during 2001 and the annual consumption of eligible consumers. Presently, this market is completely regulated and based on the supply framework contracts issued by ANRE and on the framework contracts for energy services delivered by consumers to the sub-consumers. The need to regulate the electricity retail market was also determined by the legal provision referring to the unique national tariff for franchised customers.

SC Electrica, the main supplier for franchised customers has bought 11.4% of 155,286 TJ (43,135 GWh) on the wholesale market from SN Nuclearelectrica SA on unique long term contract of PPA - Power Purchase Agreement type, mentioning the purchase of all quantity of energy that Nuclearelectrica S.A. can produce, at the price established by ANRE.

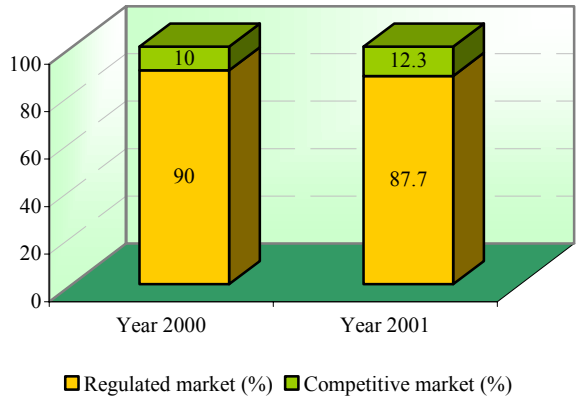

FIG. 2 - Evolution of Electricity Market Structure

3. NUCLEAR POWER SITUATION

3.1. Historical Development

From the details on the history of nuclear power in Romania, emphasized in the previous Nuclear Power Country Profile, we are re-iterating here only some aspects. A total of 5 nuclear power reactors were initially intended to be built in Romania on Cernavoda site, on the Danube river, selected in the '70s and fully complying with the requirements of the national and international standards related to nuclear power plants.

The works on the Cernavoda NPP site started in 1980 for Unit 1 and in 1982 for the other 4 units. To spare the financial efforts and to focus on Unit 1, in 1991 it was decided to proceed with the works on Unit 1 only and to stop temporarily the works on the other units. The project management activities on Unit 1 were assumed by AECL – ANSALDO Consortium (AAC) through a contract concluded in June 1991. Unit 1 has been completed in 1996.

The main actor in nuclear power is Societatea Nationala "NUCLEARELECTRICA" (SNN) S.A., a state 100% owned stock company, established in July 1998, following the first stage of restructuring in the power sector, splitted from the former centralized Romanian utility RENEL. "Nuclearelectrica" has three main branches:

- "CNE PROD", operating Cernavoda NPP Unit 1;
- "CNE INVEST", including Units 2 to 5, actually in charge with the completion of Unit 2;
- "FCN Pitesti", the nuclear fuel factory.

Cernavoda NPP Project is based on technology transfer process from Canada, Italy and United States. The transfer of a technology recognized as Western safe design covers mainly nuclear island, secondary cycle and turbo-generator.

Pitesti Fuel Plant supplies the whole nuclear fuel for Cernavoda Unit 1 and can double its capacity with minor changes.

Between 2 December 1996 and the end of 2001, Cernavoda Unit 1 has delivered more than 25 million MW·h of electricity. It reached a capacity factor of 86.9%, which is very good by international standards (see Figure 2). Only Romanian specialists professionally manage Cernavoda Unit 1, their

efficiency earning praise from foreign experts. It provides more than 10 % of Romania's electricity consumption, making superfluous an import of about 1.4 million tonnes of liquid fuels per year, leading to annual savings of over 110 million USD.

The first reactor started commercial activity under a trial authorization. The final two-year authorization license was granted by the National Commission for Nuclear Activity Control (CNCAN) in 1999 and renewed in 2001. The license can be revoked at anytime if the work force, population or environment is considered to be in danger. However, no radioactive emissions have ever been reported from the plant.

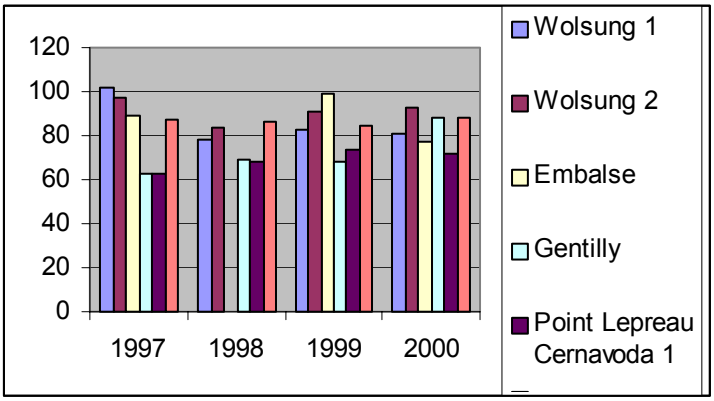

FIG. 3. CANDU 6 NPP Gross Capacity Factor

3.2. Status and Trends of Nuclear Power

First of all we have to underline the commitment of the Romanian authorities to complete Cernavoda Unit 2. The Ordinance No. 126 / 2000, issued on 31 August 2000 by the former Government of Romania, represents an important decision in favour of Unit 2. This one defines the completion of Cernavoda Unit 2 as a project of national interest and priority for Romania and defines the financing sources of the project (SNN own sources, external loans based on sovereign guarantee, public funds from the Government). It also offers a set of financial incentives for the project (profit tax exemption for SNN, exemption from any import taxes due in Romania; Romanian income taxes exemption for foreign contractual partners; the payment of the accounts payable which SNN registers at 30 June 2000 towards ministry of Finance, in respect of the sovereign guarantee for the external loans, contracted for the completion of Unit 1, were postponed until 31 December 2006 and the related penalties were cancelled).

A further preliminary evaluation of the influence of the Ordinance No. 126 / 2000 pointed out the tariff for delivered electricity maintaining the project efficiency decreased to about 30 US dollars/MW·h, compared with previous results.

The new Government, installed in November 2000, re-iterated from the beginning, that public funds from the state budget, SNN own resources, foreign loans for import and an EURATOM loan for the local portion of the contract, guaranteed by the Romanian Government, could be potential financing sources for the project.

The resulted input is reflected in the financing of activities for 2001, providing 1690 billion lei (equivalent of about 60 million US dollars) granted from budgetary funds, by Law No. 216 / 2001. Through the Government Decision No. 270 / 2001 it was established an inter-ministerial Committee for the co-ordination of commercial negotiations, providing the financing and for the follow-up of the works progress. We would like to emphasize some arguments sustaining the importance, within the specific condition of Romania, of completing the Cernavoda Nuclear Power Plant - Unit 2:

1. The necessity of increasing the power production in Romania results from the following

arguments:

- Considering the standard scenario for the development at a constant pace (Competitiveness Scenario)", from the 'National Sustainable Development Strategy of Romania", characterized by a GDP/capita average annual growth rate of 6.5%, which would allow Romania to reach in 2020 about 50% of the EU countries GDP/capita, selected as a realistic case by the Romanian Government, an increase of the electricity production of 4% arises, consistent with 2.5% increase of the final energy consumption for the interval 2001-2004;

  i. This scenario considers a decrease of 'energointensitivity' with 3% per year and a set of realistic measures for saving energy;

  ii, The GDP growth in 2001 was 5.3%, with an annual growth rate of the electricity demand of 2.1%, more than in the Government forecasting;

- Over than 50% of the installed capacity has more than 20 years of lifetime, characterized with poor maintenance and high pollution; some of this capacity will be rehabilitated, but about 4,500 MW capacities of obsolete conventional power plants will be retired from operation by 2004;

- The Government of Romania limits the import of primary resources at 40%, from Security in Energy Supply reasons;

The main power projects considered by the National Strategy for the Development of the Romanian Energy Sector for the next future are the following:

1. Completion of the 700 MW capacity of the Cernavoda NPP-Unit 2 by 2005;
2. Rehabilitation of 1280 MW of the existing thermal power plants within 2001-2004;
3. Concluding contracts for other 410 MW of the existing thermal power plants, to be completed after 2004;
4. Rehabilitation of about 2,200 MW of the existing hydro plants, projects completed after 2004;
5. Completion of 183 MW in hydro plants projects in progress;
6. Re-evaluation of about 900 MW in hydro plants, in different stages of progress, including relatively high investment costs;
7. New combined cycle capacities of about 300-400 MW, among them 100 MW are considered for the next future.

2. Cernavoda NPP — Unit 2 Project represents the main priority of the above mentioned programme, considering the following arguments:

   This Project represents a least cost option in accordance with the" Least Cost Development Study of the Romanian electricity and heat generation capacities" which was completed in April 1998 by an international consulting consortium TRACTEBEL-Belgium, SEP-Holland and EDF-France, financed by the European Commission with PHARE funds;

   Cernavoda NPP — UNIT 2 is considered by the National Strategy for the Development of Romanian Energy Sector, through its technological features and economical performance indicators, the best solution to fulfil the power demand considering the sustainable development of the country;

   After 5 years of commercial operation of the Cernavoda NPP - Unit 1, the technological and economical performance indicators, combined with the low environment impact, have proven that the decision to complete Unit 2 is a right one.

3. The necessity of EURATOM loan, as part of Cernavoda NPP — Unit 2 financing:

— Considering the Council Decision of 21 March 1994, amending the Decision 77/27O/EURATOM, to authorize the Commission to contract EURATOM borrowings in order to contribute to the financing required for improving the safety degree and efficiency of nuclear power stations in certain non-member countries (94/179/EURATOM), Romania is included on the list of eligible non-members countries. The Cernavoda NPP — Unit 2 Project is eligible for EURATOM loan considering the following:
  - The project is under construction;
  - A set of 156 design changes and 166 minor design modifications/ improvements are necessary for compliance with new licensing requirements applicable to Unit 2; they are confirmed by the by the Independent Consultants selected by the EC (Consortiums NNC-British Energy-INGENCO for Nuclear Safety and HPCAquatest for Environment Impact);
  - There are advantages of the EURATOM loan for the Cernavoda NPP-Unit 2 Project, also considering the accession process of Romania to the European Union.

We are listing some of these advantages:

- The Cernavoda NPP — Unit 2 is already started, and the Government of Romania has a strong commitment to complete this project; any delay in releasing the EURATOM credit will result in delays in completing the full finance of the project, and will increase the pressure over the State Budget, leading to the lack of funds allocated to sensitive sectors as culture, health, education, social programmes, etc; to replace these funds, Romania will request increased non-refundable grants from EU in order to fulfil the requirements of the *acquis communautaire;* EURATOM Loan will reduce the 'pressure' on the Romanian State Budget and consequently, funds could be re-directed to help satisfy the EU integration requirements;
- Cernavoda #2 will increase the contribution of 'clean energy' to electricity production In Romania, reducing CO_2 and other polluting emissions, as well as the volume of solid waste resulting from burning coal;
- Cernavoda #2 will reduce the dependence of Romania on external suppliers of primary resources, mainly natural gas and oil, geographically sited outside Europe, thus contributing to the increase of the 'Security of Energy Supply" of Romania and Europe;
- Cernavoda #2 represents an economic and competitive source of base-load electricity compared with burning fossil fuels, even though the price of fossil-fuel electricity does not include the internalization of ail costs, consolidating the internal Electricity Market, subject to future integration UCTE, and finally in the single EU power market;
- Increasing of technical and safety standard of the Romanian Grid, facilitating the connection to the European Grid (UCTE);
- The extension of the Western style managerial approach implemented inside "Nuclearelectrica" represents a good example to be extended to the Romanian industry;
- Extension of QA approach to the Romanian contractors, improving their performances and possibility of access on international markets.

The delays in Unit 2 commissioning will affect the Security of Energy supply, obliging Romania to increase the oil imports with about 1.4 million tonnes per year; the stability of the Romanian electrical grid, in process of interconnection with UCTE, could be also affected.

The traditional Canadian and Italian partners are now focused on securing financing to complete the project by 2005. When Unit 2 goes commercial, Cernavoda will cover almost 20% of domestic consumption, also enhancing Romania's chances to become a major electricity exporter. Certain nuclear equipment will be bought from Canada and Italy. The Romanian industry will receive about 400 million USD to complete Unit 2 and thousands of jobs will be created. Needless to say, the project will have a significant impact on Romania's economy over the next few years. Table 8 shows the actual status of the NPPs at Cernavoda site.

TABLE 8. STATUS OF NUCLEAR POWER PLANTS IN ROMANIA

Station	Type	Capacity	Operator	Status	Reactor Supplier
CERNAVODA-1	PHWR	650	SNN	Operational	AECL
CERNAVODA-2	PHWR	650	SNN	Under Construction	AECL

Station	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
CERNAVODA-1	01-Jul-1982	16-Apr-1996	11-Jul-1996	02-Dec-1996	
CERNAVODA-2	01-Jul-1983	31-Mar-2006	31-Jun-2006	31-Dec-2006	

Source: IAEA Power Reactor Information System as of 31 December 2001.

3.2.1. Cernavoda NPP Unit #2 Project Status

Preservation works were performed on Unit 2 between 1992 and 1995. Starting with the second half of 1996, remedy works were initiated especially in the construction area, and since 1 January 1998 a small progress work programme started inside the reactor building and the service building. Over that period important equipment and materials manufactured by the national industry were brought on site: feeders, heat exchangers, pumps etc. All this activities were performed under the project management of AECL – ANSALDO, based on addenda to the contract for Unit 1 concluded in 1991. Cernavoda Units 3 to 5 are under preservation for a final decision with respect to their future.

Briefly, the Unit #2 project status is being now the following:

- the amount of procured equipment and materials either installed or stored represents about 545 million USD out of which 255 million USD from import and 290 million USD from domestic suppliers. Those from import were procured from Canada (122 million USD for the nuclear part), from Italy (84 million USD for the balance of the plant) and from USA (49 million USD for the turbine – generator);
- construction-erection progress of the Unit #2 Project is evaluated to 42.8%;
- overall project completion is estimated at 56% as value.

Most of the procured mechanical equipment is under preservation in Unit #2 buildings or warehouses. The main erected equipment is in the following areas: in the reactor building – calandria (reactor vessel), steam generators, pressurizer, deaerator – condenser, cranes and hoists; in the service building – equipment airlock, water tanks; in the turbines building – steam turbine cylinders, de-aerator, condensate storage tank, draining pumps, heat exchangers of the intermediate cooling circuit, main cranes.

A Construction All Risk (CAR) Insurance is in force for Unit #2 starting from April 1995. Nuclear All Risk – Material Damage and Nuclear Liability insurance policies are placed to the international nuclear "pools" from February 1995.

The time schedule to perform the works necessary for Unit #2 completion, from the full financing available up to the commercial operation of Unit #2, is estimated at about 54 months. This is subject of further possible reduction considering the type of contract and project organization.

3.2.2. Project value, evaluation of the remaining works, works schedule for the Unit #2 completion

The overall cost amount related to Unit #2 Project has been estimated at about 1,400 mil. USD and comprises the following:

- Total cost of the already performed activities, is estimated at about 700 million USD;
- Value of the investment to complete the Project, is estimated at about 600 million USD;

- Value of heavy water and nuclear fuel is estimated at about 130 million USD. The heavy water and fuel required are produced in Romania.

In accordance with the AECL – ANSALDO proposal concerning the Unit #2 completion, estimated costs are shown in Table 9.

TABLE 9. ESTIMATED COSTS FOR UNIT #2 COMPLETION

No	Category	Estimated costs, million USD	Out of which imported
1.	Design & engineering works	15	10
2.	Equipment, materials and components procurement	290	150
3.	Construction – erection (manpower)	75	0
4.	Works management + technical assistance	160	140
5.	Commissioning	40	30
6.	Complementary works	20	10
7.	Miscellaneous and contingencies	20	20
	TOTAL	620	350
	Nuclear fuel and heavy water procurement (First Load)	130	-

Source: Nuclearelectrica SA.

The estimation was performed considering, in order to implement the Unit #2 project, an organization (Project Management Team–PMT) capable to ensure an integrated system of engineering and project management will be set up, similar with Unit 1 approach. Other foreign companies may participate in the Project, together with AECL-Canada and ANSALDO-Italy, in case their resources and facilities can be used to its benefit, accordingly with the principles for the new commercial contract, discussed by the end of 1999 with the traditional partners from Canada and Italy.

The contribution of the national industry in supplying equipment, materials and technical services was identified based on the actual capabilities of the domestic suppliers qualified for the Cernavoda project. Considering the uncertainty characteristic of the transition economy and the industry restructuring, it is possible that the predicted domestic supply level may change, increasing the cost of imported components and services. The costs for the first nuclear fuel load and heavy water inventory were considered at the level of the international market. The estimated cash flow of the capital cost is shown in Table 10.

3.2.3. National participation

The completion of the Unit #2, a replica of the Unit 1, will benefit from the existing infrastructures and technical facilities developed over the completion process of Unit 1, as well as of the Romanian staff (customer, contractors, suppliers and designers) properly qualified and organized. An important number of contractors, with qualified personnel and technology for nuclear power plant construction, is committed in works performance on site. Part of them were established before the year 1990 dedicated to support the nuclear programme, another part, private organizations now, were created after 1990 as a result of a natural restructuring process and of the economy reform.

TABLE 10. CAPITAL COST CASH FLOW

Year	Value	
	% of the total value to be fulfilled	million USD
1	21	157
2	24	180
3	22	165
4	19	145
5	14	103
TOTAL	100	750

Source: Nuclearelectrica SA.

Within former RENEL was developed an industrial support structure for the Cernavoda Project,

represented by the Nuclear Fuel Plant in Pitesti, and the Heavy Water Plant, located in the southwest of Romania, near Drobeta-Turnu Severin. The "brain" support for the Romanian Nuclear Programme was provided by the Nuclear Research Institute - ICN for specific Research and Development (R&D) activities and by the Center for Nuclear Projects Engineering and Technologies - CITON for design-engineering activities.

Romania also implemented a dedicated nuclear infrastructure, beginning with an educational system to industry and research-engineering capabilities. From the industrial sector can be mentioned: General Turbo Bucuresti, Petrotub Roman, Electroputere Craiova, Titan Nuclear Equipment TEN Bucuresti, FECNE Bucuresti, SCN Pitesti, ICN Pitesti, Aversa Bucuresti, UZUC Ploiesti, ARIO Bistrita, CONDEM Bucuresti, Ductil Buzau, TEPRO Iasi, Sarma Campia Turzii, Ventilatorul Bucuresti, Vulcan Bucuresti, CASTUMAG, Automatica, etc. from construction-erection sector: Nuclear Montaj, Trustul de Montaj Utilaj Chimic, CNE SA (Nuclear Civil Works Company), etc. from design-erection sector: Power Studies and Design Institute, EUROTEST, Institute for Thermopower Components Research and Design, etc. One can further mention players operating in international business, such as ROMENERGO, and in the financial sector banks or the specialized insuring market one finds in the Romanian Atomic Pool. Specialized industries such as uranium mining, milling and concentrating in Compania Nationala a Uraniului (CNU) were also developed.

There are key local on-site actors for Unit 2 completion as: CNE – S.A., Cernavoda, STIZO S.A., Cernavoda, UNIFY CO LTD., S.R.L. Cernavoda, HIDROCORA, S.R.L., Cernavoda (for civil works), NUCLEARMONTAJ S.A. Cernavoda, TMUCB S.A., Cernavoda (for equipment, piping, HVAC, structural steel), R&M NIMB S.A. Cernavoda, KATON EX-IM S.R.L., Cernavoda, AMEA S.A., Cernavoda, SIEA S.A., Cernavoda, ELCOMEX-I.E.A. S.A., Cernavoda, ELECTROCONSID S.A., Cernavoda (for electrical, control and instrumentation).

This attests to the breadth of the Romanian nuclear industry. This industry will play a greater role on completing Unit 2 than it did on Unit 1. If one looks at the Korean experience with CANDU 6 reactors, the future points to a growing role for Romania's nuclear industry in the completion of Units 3 and 4. It should be mentioned that the Romanian suppliers for Unit #2 were qualified from the point of view of the technical capabilities, quality assurance programme and of the manufacturing procedures in compliance with a methodology similar to that used by AECL and ANSALDO Energia to qualify its traditional suppliers.

3.2.4. Radioactive Waste Management and Plant Decommissioning

Each unit of Cernavoda NPP can accommodate spent fuel for ten years of full operation. Furthermore, Romania is developing radioactive waste management programmes and adopting concepts recognized world-wide (interim dry storage, near surface repository for low and medium level waste). Figure 4 shows the radwaste generation in Cernavoda NPP.

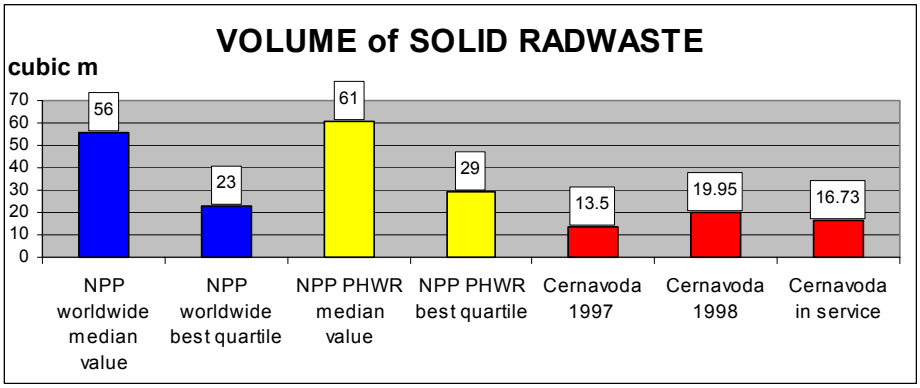

FIG. 4. Solid Radwaste Generation

A dry spent fuel intermediate storage facility project (DICA) is in progress; the contract was awarded by AECL, after an international competition. It is based on MACSTOR system designed by AECL, consisting in 27 concrete modules with a capacity of 12,000 fuel bundles each, protected in metal cylinders and stored in baskets. The first capacity will be commissioned in 2003 on the plant's site. All the facility will assure the storage of 300,000 fuel bundles coming from 2 units for a period of 50 years. Next step will be the decision related to the final disposal of low and medium level waste. The storage is envisaged to be sited at the Cernavoda area, and the commissioning is considered for 2005-2006. Site studies are advanced, and a decision will be taken considering the implementation of the process. For the final repository of spent nuclear fuel, generic survey studies are performed and the Romanian experts are looking for solutions consistent with international practice.

Based on the experience of decommissioning of older CANDU nuclear plants, i.e. Douglas Point 220 MW(e) and Gentilly 1,250 MW(e), decommissioning of the Cernavoda project has also been evaluated.

3.2.5. Environmental impact

Aside from some hydro-electric plants, most of Romania's conventional electricity generating capacity consists of obsolete thermal plants, close to the end of their design lifetime, with low availability, of which 40% burn coal, with high releases of CO_2, SO_2, NO_x, dust and ash. Table 11 shows a comparison between one unit CANDU from Cernavoda and a lignite fuelled thermal power unit of same output.

TABLE 11. COMPARISON BETWEEN A CANDU 600 NPP AND A LIGNITE FUELLED POWER PLANT

	Waste	Lignite fuelled thermal power	CANDU 600 NPP
Output (MW(e))		700	700
Annual fuel consumption (tonnes)		6,000,000	90
Annual waste amount (tonnes), out of which:	Ashes	1,500,000	-
	Fly ash	(20,000)	-
	CO_2	3 – 4,500,000	-
	SO_2	88,000	-
	NO_x	8,800	-
Nuclear spent fuel (tonnes/year)		-	90
Low and medium nuclear wastes m^3/year		-	30-50

Source: Nuclearelectrica SA.

To produce the equivalent yearly electrical power of Cernavoda Unit 1, a lignite coal power plant requires about 6,000,000 tonnes of lignite and "produces" 1,500,000 tonnes of ash, of which 20,000 tonnes is fly-ash, about 4.5 millions tonnes of CO_2 and significant quantities of SO_2 and NO_x. The nuclear option represents a good opportunity for Romania to reduce polluting emissions, within the United Nations Framework on Climate Change and agreed at the Conference in Kyoto, Japan.

It is also still a quite unknown fact that the radiological impact on the population of a nuclear power plant, such as the CANDU station at Cernavoda, is comparable, or less, than that associated with some other alternatives of electrical generation, such as coal (coal contains radioactive elements which are released into the atmosphere when it is burned).

3.2.6. Fulfillment of the Nuclear Safety Regulatory Authority requirements

The Cernavoda site fully complies to the requirements of international standards concerning nuclear power plants seismicity, geological characteristics, flooding capacity, meteorological phenomena, other events caused by human actions, dispersion in water and air, demographic distribution, the emergency programme, land usage means, cooling water supply under normal and failure conditions, the connection to the national grid, the access to site, industrial centres approaching, the environment protection as well as social-economic aspects. Unit #2 site is already licensed by CNCAN. The nuclear safety standards applicable to Cernavoda NPP Units 1&2 siting, construction and operation comply with all safety

principles included in IAEA guideline and regulations.

CNCAN also issued partial authorizations/permits for some mechanical erection activities, based on the Preliminary Safety Report and of other specific documents. The activities carried out up to now, on Unit #2, were based on these certificates. The licensing process for Unit #2 can take benefits from the experience acquired with Unit #1.

3.2.7. Economic data

The necessity of proceeding with the Cernavoda Unit #2 project was pertinently demonstrated by studies for the electric power sector development. The last of these studies was a "Least cost power and heat generation capacity development study, Romania", prepared by SEP (Holland), Tractebel (Belgium) and EdF (France) under the PHARE Energy Programme Management Unit. This study reviewed the electric power sector development over the period between 1996 - 2020.

In arriving at the optimum plan, a three stage analytical process was used: firstly, a screening analysis was performed to select an initial expansion plan. Secondly, the initial expansion plan together with variations were evaluated, using a sequential analytical model of the system operation imposing a few external constraints. Production costs were combined with the capital costs associated with a given expansion plan in order to determine the present value of the annual cost of system operation over the duration of the study. In the third stage, constraints such as fuel availability were considered in order to develop a practical optimum plan.

The initial expansion plan model used allowed a large number of alternative generating candidates to be considered with the most economical options selected. New projects were added in economic sequences as needed to maintain the desired level of electrical system reliability, or in excess when the fuel cost savings were higher than the additional capital cost induced by the construction of a new unit. The optimum solution was identified by a probabilistic production cost optimization approach incorporated in the models, which allowed a detailed production costing analyses.

The initial expansion strategy was varied to examine the impact of different sets of resources on production cost. New capacity was added to the system to replace units that had reached the end of their useful lives, to replace more expensive existing generation, or to provide for increased demand. It is to be noted that as of today 47% of the electric power stations have an operation life time longer than 20 years, and 84% longer than 10 years, as shown in Figure 5.

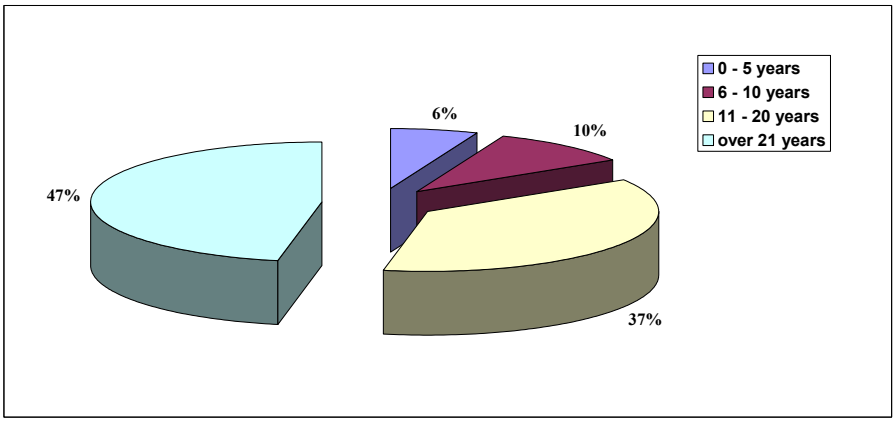

FIG. 5. Share of the Installed Capacity According to the Equipment Age in 1998

The resulting production cost overall value of each of the alternative strategies has been combined with the associated capital cost required for investment, in the present value of the total system cost over the simulation horizon. This allowed a fast and comprehensive comparison of the

alternative expansion strategies. To arrive at a comprehensive optimum strategy, decisions had to be made regarding five different aspects:

- the number of nuclear units to be completed;
- which, if any, new hydroelectric projects should be completed;
- which, if any, existing units should be rehabilitated;
- which, if any, existing units should be converted to hard coal;
- which new generating projects should be constructed and when a decision in one area affects the relative value of other decisions.

An iterative approach was used to reach conclusions. The reference expansion plan is revised, based on the outcome of the first round of individual studies, to incorporate those changes found to have beneficial effect. The individual studies are then repeated to confirm that they are still worthwhile when compared with the new reference plan. This process is repeated, with data improvements being made during each step, until a preliminary unconstrained optimum strategy is derived. The results of unconstrained expansion alternatives was used as the initial reference case for performing more detailed production costing analyses to obtain optimum strategy conclusions. In addition, constraints were imposed, most notably the obligation to avoid cyclic consumption of lignite, and the optimum strategy conclusion were again examined to produce a constrained optimum strategy.

The forecast of the electric power demand for 2000 - 2020 consider three scenarios with average annual growth rates for electricity of 2%, 2.8% and 3.8%. It is to be mentioned that the demand in 1997 was about 10% higher than in 1996.

As shown in the Least Cost "Executive Summary", the completion of the Cernavoda Unit #2 is part of the optimum strategy for both constrained and unconstrained strategies. This conclusion remains valid "even if Cernavoda 2 is assumed to have a higher than expected forced outage rate (15% versus the expected 8%) or if Cernavoda 2 is assumed to have a higher than expected capital cost (20% above the expected cost)". Accordingly the completion of Cernavoda Unit #2 represents a priority of the development of the electric power sector in our country, as stipulated in the Government Decision No. 35/1997.

3.2.8. Financing Plan of the Project

Up to 1998, the construction of Unit #2 was financed from public funds. The decreasing of available cash from state budget and the pressure to put the project in the market framework required new financing approaches.

This consists in financing from foreign loans, mainly from Canadian and Italian Export Credit Agencies, guaranteed by the Government or through other means, public funds and “Nuclearelectrica” Company’s own sources, resulting from electricity export or various commercial arrangements, as counter-trading. Multilateral credit agencies borrowings could contribute to the financing package of the project. In addition, equity participation from some investors groups could be considered.

The basic idea of this approach is to reduce Government’s level of risk for the foreign loans guarantee point of view. Table 12 below shows the designed financial scheme, mentioning the financing sources and the guarantee means, where necessary.

TABLE 12. FINANCIAL STRUCTURE

	Million USD	Destination
TOTAL FINANCING	750	
Out of which:		
- Public funds (State Budget)	210	Local portion, including heavy water and nuclear fuel
- External Loans	485	Import & local portion
- Other sources (electricity delivery and commercial arrangements)	55	Import

Source: Nuclearelectrica S.A., 2000

3.3. Current Policy Issues

The annual production of a CANDU 700 MWe nuclear unit amounts to about 4.7 TW·h. This leads to yearly 1.4 million tonnes oil equivalent reduction – representing more than 100 millions USD - and associated decrease of the noxious emissions.

Considering the strategic importance of the energy sector in developing the economy on sustainable basis, the sector evolution should be outlined, to better estimate the development prospectives and the assurance of energy supply.

Main issues related to present nuclear power policy, e.g., moratorium, public acceptance, open market, privatization, safety and waste management issues, role of the government in the nuclear R& D, human resources development economic and financing issues, and impact of nuclear power in avoiding CO_2 emissions, etc.

4. NUCLEAR POWER INDUSTRY

4.1. Supply of NPPs.

4.1.1. Heavy water production

The heavy water plant ROMAG is situated at 7 km north-east of Drobeta Turnu Severin town, on the national road DN67, in the south-western area of Romania, on the left side of the Danube River. ROMAG was projected to produce heavy water in two stages of development: 360 tonnes/year in the 1st stage, with 4 modules (90 tonnes/module), and 360 tonnes/year in the 2nd stage, with another 4 modules, an unfinished investment.

The factory produces heavy water of nuclear quality and it has the greatest capacity of Europe and the second in the world. The project was put into operation between 1980 and 1988. The first quantities of heavy water were produced on 17 July 1988.

The process is based on the isotopic change between H_2O and H_2S in a biterm system in Girdler-Sulphide installations, in which a primary concentration of deuterium oxide of 4 - 12 % is obtained. The raw material for the deuterium is taken from the Danube. The final concentration till at least 99.78 % D_2O is obtained by vacuum distillation.

The production had been halted for three years (1990 - 1992), when the technological installation, the production systems and those of environmental protection were modernized. Three modules of the 1st stage of development worked as follows: two were operating and one was overhauled; work on the fourth module was interrupted (at 92 % of completion).

4.2. Operation of NPPs

Indicating owners/operators if relevant, operation and maintenance service suppliers and operator training. National Company "NUCLEARELECTRICA" S.A. (SNN), which is the owner and operator of Cernavoda NPP, was founded by the Romanian Government Decision no. 365 in July 1998. CNE PROD Cernavoda, a subsidiary of SNN, has the responsibility for operating the Cernavoda Unit 1, and CNE INVEST Cernavoda, another subsidiary of SNN, for completion of the Cernavoda Unit 2 and preservation of the Units 3-5. There is another subsidiary of SNN, the Nuclear Fuel Plant in Pitesti - Mioveni, the local manufacturer of CANDU type nuclear fuel for the Cernavoda Unit 1. CNE PROD has its own maintenance division and a Training Center with a full scope simulator.

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

Nuclear Fuel Production

The nuclear fuel needed for the Cernavoda NPP –Unit 1 operation is supplied by the Nuclear Fuel Plant from Pitesti. Fabrication of CANDU nuclear fuel started in 1980, through the commissioning of a CANDU type Fuel Pilot Plant as a pilot department of the Nuclear Research institute (ICN). The separation of the Nuclear Fuel facility from ICN, as a distinct company, took place in 1992. In 1994, the Nuclear Fuel Plant was qualified by AECL and ZPI-Canada as a CANDU 6 nuclear fuel supplier.

The capacity of the plant is 90 tonnes per year, respectively 23 bundles per day. At present, FCN provides the annual amount of the fuel necessary for the Unit 1 operation, being able, with small investment to extend its production capacity in order to assure the operation of two units. The high quality of the domestic nuclear fuel is confirmed by the most severe test, so-called " fire test", that is directly into operation. No fuel bundle manufactured at FCN and used at Cernavoda NPP failed under the extremely tough conditions inside the core during the nuclear reactor operation. The average burnup factor achieved by the nuclear fuel bundles in 1998 was of 170.85 MW·h/kgU.

4.4. Research and Development Activities

Table 13 shows the actual status of some nuclear facilities other than NPPs.

TABLE 13. STATUS OF NUCLEAR RESEARCH REACTORS AND OTHER NUCLEAR RELATED FACILITIES IN ROMANIA

Nuclear Facilities	Type	Gross Capacity	Status
VVR-S	Nuclear Research Reactor	2 MW(th)	Shutdown state with nuclear fuel out of the core
TRIGA	Nuclear Research Reactor	14 MW(th) (Steady State Core) 20.000 MW(th) per pulse (Pulsating Core)	Operating
Nuclear Fuel Plant	CANDU-6 Nuclear Fuel	Nuclear Fuel needs for Cernavoda 1 NPP operation	Operating
Natural Uranium Concentration Plant	Natural Uranium	Uranium for Nuclear Fuel Plant	Operating
Heavy Water Plant	-	Heavy water needs for Cernavoda NPP	Operating
National final repository	LL & IL Radwastes	20,000 Standard (200 l) drums capacity	Operating

4.4.1. Competent Authorities for Promotion of Nuclear Activities

In the new Governmental organization, the Ministry of Education and Research took the responsibilities of the former National Agency for Science, Technology and Innovation (ANSTI) and is in charge, on one hand, with co-ordination of the overall nuclear programme, formulation, application, monitoring and assessment of policies in the area of research, development and innovation, and, on the other hand, with co-ordination of the formulation, application, monitoring and assessment of policies for development of quality infrastructures in accordance with the governmental strategy and programme in order to extend the national and international heritage in the area of science, technology and innovation with valuable contributions, to secure a sustainable economic development, access to the domestic, European and global markets, to finally develop a knowledge-based information society while meeting people's needs and increasing welfare. The Ministry of Education and Research is also in charge with the whole national education system. The ministry includes a specialized general division - the National Agency for Atomic Energy (ANEA) - through which it fulfils the following tasks related to the peaceful applications of atomic and nuclear phenomena and processes:

- formulation and monitoring of governmental strategy, policies and programmes for peaceful uses of atomic and nuclear phenomena and processes; in this respect, the Agency discusses the proposals by the specialized bodies of the central public administration, businesses, academic institutions and R & D units, which are in charge with the promotion and application of atomic and nuclear energy;
- devising, implementation and monitoring of governmental R & D and innovation strategy, policies and programmes;
- incentives for human resources development;
- stimulation of technical and scientific information communication and dissemination, in comply with the regulations in force, as well as information of citizens about the advantages and risks of nuclear applications and inducement of appropriate behaviour and feed-back;
- development of international partnerships; co-operation with the International Atomic Energy Agency of Vienna and other specialized international, regional or national organizations as well as Romania's representation in the relations with them; to this end, the Agency concludes regional or bilateral agreements and contracts for R & D, technical assistance, expertise, personnel information and/or training, or participates in promotional or other actions;
- monitoring or, if need be, co-ordination or control of specialized R & D units or R & D units involved in specific programmes;
- ensures the necessary environment for correlation of industrial policies and programmes, which are relevant for the considered area, with specific R & D and innovation policies and programmes.

The Ministry of Industry and Resources (MIR) is the responsible authority for definition of

national participation policies and strategies, for planning and co-ordination of the national nuclear industry activity, representing the State as shareholder of nuclear assets and for co-ordination of part of major R&D and engineering facilities. It has also primary responsibility for the safety of its nuclear installations through the following organizations:

National Company "NUCLEARELECTRICA" S.A. (SNN), already presented. The stockholders assembly (100% by the state) representatives and the members of Administration Board of the society are appointed by the Ministry of Industry and Resources of Romania.

Autonomous Reggie for Nuclear Activities (RAAN) through the Nuclear Research Subsidiary (ICN) Pitesti is the operator of the TRIGA type research reactor, the hot cell facility, the radioactive waste treatment facility on Pitesti - Colibasi site. RAAN, through the Technology and Engineering for Nuclear Projects Subsidiary (CITON), is also in charge with support design activities in the nuclear field and, through the Heavy Water Plant (ROMAG) located in Drobeta Turnu-Severin, in charge of covering the heavy water needs for the Cernavoda NPP.

4.4.2. Research Establishment

Nuclear Research Subsidiary (SCN) Pitesti – within the Autonomous Reggie for Nuclear Activities (RAAN)

The Nuclear Research Subsidiary (SCN) is consistently involved in the work associated with the national nuclear safety programmes: nuclear fuel, reactor physics, radiation protection, generic CANDU technologies, and management of radioactive wastes, TRIGA reactor conversion. Almost all activities of the Institute were oriented to provide a scientific and technical support for the Nuclear Power Programme in Romania. The major SCN R&D Programmes are focused on:

nuclear safety to ensure technical and scientific support needed for the safety assessment of Cernavoda NPP during its lifetime;

nuclear fuel to elaborate technology and new methods to optimize fuel utilization in Cernavoda NPP;

radiation protection to integrate all aspects regarding ecological impact of nuclear power and to develop techniques for operating nuclear installations based on ALARA principles;

CANDU technologies intended to ensure an optimized maintenance of NPP systems and components;

radioactive waste management to solve the problem of radioactive wastes generated by nuclear facilities, in accordance with national legislation and international standards;

radioisotopes, irradiation techniques and conversion of TRIGA – INR reactor for LEU fuel is intended to ensure, together with the fuel supplier (General Atomic, USA), the conversion of the ICN reactor to low-enriched fuel utilization.

Institute of Physics and Nuclear Engineering (IFIN-HH) Bucuresti-Magurele

The Institute for Physics and Nuclear Engineering performs research activities in the nuclear field and on radioactive waste treatment and is the owner of the research reactor type VVR-S and the national LL and IL radwaste repository. It will also operate the multi-purpose irradiation facility. Its main activities focus on:

- Nuclear technologies;
- Technological irradiation using neutrons, gamma rays and charged particles;
- Neutron activation analysis; X-ray fluorescence;
- Industrial defectoscopy;

- Magnetic resonance and tomography;
- Methods, instruments and devices using radioactive sources;
- Tracer applications to hydrology and geology;
- Radiochemistry; polymerisation in radiation fields;
- Radio-pharmaceutical production;
- Nuclear radiation metrology;
- Primary and secondary standards;
- Etalons for users in field of nuclear radiation research and applications;
- Quality assurance and control;.
- Neutron metrology;
- Radiation biophysics and biochemistry;
- Low dose irradiation effects on biological systems;
- Interaction of nonionising radiation with living systems;
- Cytotoxic effects due to internal contamination with tritium;
- Non conventional biochemical techniques: RIA, EIA, ELISA, biosensors;
- Pharmacology of labelled components of medical use and of U and Th compounds;
- Metallic pollutants in biological structures;
- Biokinetics of radionuclides and whole body monitoring;
- Radioecology;
- Development of a decision support system for nuclear emergency;
- Techniques and procedures for radioactive and chemical pollutants;
- Transfer mechanisms and ecological life time of radionuclides;
- Models for radionuclides transfer and dose prediction;
- Use of radioactive tracers in agriculture and environment;
- Environmental transfer and conversion of tritium from CANDU reactor;
- Nuclear risk assessment on public and environment;
- Nuclear medicine;
- Computerized tomography;
- Automatic systems for medical diagnosis;
- Apparatuses and devices for nuclear medicine and environment monitoring;
- Software for nuclear medicine and environment applications;
- Nuclear energy;
- Nuclear instruments;
- Non-fuel cycle radioactive waste collection, treatment, conditioning, interim, storage and disposal;
- Nuclear data;
- Computation methods;
- Decontamination and decommissioning of nuclear facilities;
- Instrumentation for nuclear research and technologies;
- Gas detectors for applications in industry and medicine;
- Detectors for radiation dosimetry and environmental radioactivity;
- Data acquisition systems;
- Modular electronic equipment for research and application in industry;
- NMR and EPR methods and instrumentation;
- Magnetometers for space applications:

Institute for Isotopic and Molecular Technology (ITIM) Bucuresti-Magurele

The research activity of the Institute for Isotopic and Molecular Technology is pointed to several significant directions.

- Stable isotope physics;
- Selective excitation in laser radiation field;

- Low temperature distillation (-196°C, liquid nitrogen) to the separation of oxygen, carbon and boron isotopes;
- Chemical isotopic exchange
- Thermal diffusion;
- Synthesis of stable isotopes labelled;
- Analytical methods and instrumentation;
- Stables isotopes separation and labelled compounds;
- Separation of oxygen and carbon isotopes by cryogenic distillation;
- ^{15}N Labelled compounds;
- Environment survey and protection;
- Separation of uranium from the radioactive contaminated waters;
- Methods for geological characterization of the rocks with stable isotopes;
- Determination of high sensitive counting technique for long life radionuclides determination applied in radioecology and dating.

National Institute of Cryogenics and Isotope Separations (ICSI) Ramnicu Valcea

ICSI is an institution of scientific research and technological development in co-ordination of the Romanian Agency of Science, Technology and Innovation. It was founded in the aim of researching and verifying the technologies for heavy water separation and further of tritium. The principal directions of the activities are:

- Research of equilibrium and hydrogen isotopes (tritium, deuterium) separation processes inclusive at industrial pilot plant level;
- Research and development of cryogenic process, equipment and specifically technologies, experimental stands;
- Research of equilibrium and gases separation process of purification and forward recovery technology;
- Achievement and development of advanced materials as adsorbents, catalysts, composite and fullerenes;
- Development of methods, apparatus and equipment for isotopic separation processes control and for cryogenic temperatures achievement;
- Development of static and dynamic equipment specifically for isotopic separation processes;
- Direct utilization of own researches in production (ultra pure gases and gases and gases mixtures, equipment, sodium sulphur, analysis apparatus, risk studies, expertise's);
- Technology transfer.

National Institute for Laser, Plasma and Radiation Physics (INFLPR) Bucuresti-Magurele

The National Institute for Laser, Plasma and Radiation Physics performs research activities in laser physics, plasma physics, physics of electron beams. The main research and development activities are focused on:

- Fusion plasma physics, theoretical studies and numerical simulations of the plasma evolution in tokamak devices;
- Physics and technology of plasma produced by high power particle beams and X-radiation in ultra fast transient plasmas;
- Plasma surface engineering;
- Crystal growth by plasma methods.

National Institute of Research and Development for Technical Physics (IFT) Iasi

The research activity of the National Institute of Research and Development for Technical Physics is pointed to several significant directions:

- Magnetic Materials and Devices;
- Special Alloys and Hard Magnetic Materials;
- Magnetic Separation and High Tc Superconductivity;
- Magnetometry and Magnetic Detection;
- Non-destructive Control.

Technology and Engineering for Nuclear Objectives, RAAN Subsidiary (CITON) Bucuresti-Magurele

CITON supports the nuclear programme in Romania with a large range of services under quality assurance regime by using codes and standards internationally recognised (ASTM, ASME, IEEE, ISI, IEC, CSA series and IAEA guidelines etc.). SITON services cover the following:

detail design for process and support systems associated to a CANDU-600 NPP, as well as civil design for the reactor building, the turbine hall, the service building, spent fuel and waste management; detail design for adjacent installations and support systems for nuclear research reactors and labs;

reliability and probabilistic assessment studies;

nuclear safety analyses, including environmental impact analyses in case of accidents, fires, earthquakes, flooding etc.;

thermohydraulic calculations and stress analyses for various working regimes using specialised computer programmes;

methodologies for computation and computer assisted design;

technical and economical studies for siting as well as cost estimates for new designs, operational design modifications for NPP systems and components;

technical assistance for equipment fabrication, their installation, testing and commissioning as well as testing and commissioning of process systems;

land registering and requirements for area classification;

analyses and optimizations of power consumption;

prognoses regarding the national power system development especially nuclear power trends.

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

Romania became a member State of the Agency of Vienna in 1957. From the mid-1960s to the mid-1970s, its technical co-operation program with IAEA covered mainly research in nuclear physics and some medical and other applications of radiation and isotopes. Since 1976, when Romania n nuclear power program was developed, the Agency has supported in particular the activities related to Cernavoda NPP. The assistance was dedicated to nuclear safety (44%), nuclear engineering and technology (15%). However, application nuclear techniques in other fields received also substantial support, as industry and hydrology (14%), medicine (9.5%) and agriculture (4.5%)

Since September 2001, Romania has become a member of the Board of Governors for the term 2001-2003 and contributed to the Secretariat activities related to safeguards, nuclear safety, technical co-operation, as well as to budgetary policy issues.

CNCAN empowered by the nuclear act, ensures implementation of agreements concluded.

Also CNCAN cooperates with the European Union working groups in the field of nuclear safety. In this context, it participates in meetings of the Nuclear Regulatory Working Group (NRWG), European Nuclear Installations Safety Group (ENISG), CONCERT Group, WENRA and NEA/OECD in legislative domain.

BILATERAL AGREEMENTS

• Agreement between Governments of Romania and Argentina for co-operation in the peaceful uses of nuclear energy	In force:	27 November 1990
• Agreement between Governments of Romania and the Hellenic Republic on early notification of a nuclear accident and information exchange on nuclear facilities – Athens, 10 March 1995	In force:	23 March 1995
• Agreement between CNCAN of Romania and Greek Commission for Atomic Energy on early notification of a nuclear accident and on information exchange about nuclear facilities –Bucharest, 22 December 1997	In force:	25 May 1998
• Protocol of understanding on co-operation in the nuclear safety domain between CNCAN of Romania and the Institute for Nuclear Safety of Republic of Korea (KINS) – Bucharest, 21 September 1996	In force:	11 November 1996
• Protocol of understanding on co-operation in the nuclear safety domain between CNCAN of Romania and Atomic Energy Control Board (AECB) of Canada – Ottawa, 23 June 1997	In force:	25 May 1998
• Agreement between Governments of Romania and Hungarian Republic on early notification of nuclear accidents– Bucharest, 26 May 1997	In force:	3 October 1997
• Protocol on co-operation and information exchange in the nuclear safety domain between CNCAN and Hungarian Authority for Atomic Energy – Budapest, 12 June 1997	In force:	25 May 1998
• Agreement between Governments of Romania and USA on peaceful applications of nuclear energy – Washington D.C., 15 July 1998	In force:	25 June 1999
• Agreement of co-operation and information exchange in the nuclear safety domain between CNCAN of Romania and the Society for Nuclear Safety of Facilities and Reactors of Germany – Berlin, 10 November 1998	In force:	23 February 1999
• Memorandum of Understanding for co-operation	In force:	8 May 2000

between CNCAN of Romania and the National Atomic Energy Commission (CNEA) of Argentina

- Administrative Understanding between Canadian Nuclear Safety Commission and CNCAN implementing the Agreement for Co-operation in the Development and Application of Atomic Energy for Peaceful Purposes — In force: 29 May 2000

Brief description of research and development activities carried out jointly with other countries and/or within the framework of international projects, technical and industrial co-operation, and transfer of know-how and technology.

5. REGULATORY FRAMEWORK

5.1. Safety Authority and Licensing Process

The National Commission for Nuclear Activities Control (CNCAN) is the national competent authority in the nuclear field exercising the regulation, authorization and control powers provided under the Law 111/1996, on the safe deployment of nuclear activities, republished. Since December 2000, CNCAN is an independent governmental body reporting only administratively to the Ministry of Waters and Environmental Protection. Actually, the president of CNCAN is a Secretary of State and the minister can not interfere in CNCAN president's decisions. CNCAN is responsible for full surveillance and control in all issues relevant to nuclear safety regarding siting, construction, commissioning, operation of nuclear plants, research reactors and all nuclear facilities in Romania. In addition, CNCAN is in charge with full surveillance and control in all issues relevant to quality assurance, radiation safety, safeguards, export/import control, physical protection and emergency preparedness and monitoring the radioactivity of the environment. CNCAN is the National Counterpart to the IAEA for nuclear safety, radiation safety, safeguards, physical protection, emergency preparedness, illicit trafficking events reporting, IRS and INES reporting systems and Safety Convention reporting activities. CNCAN plays the role of regulatory body integrator in the licensing process of nuclear installations.

The main tasks of CNCAN in the near future represent the completion of the reviewing process for the regulation system by the end of 2001, in order to accelerate actions for EU access and integration process. The credibility of CNCAN is increasing through work transparency, personnel competence, motivation and flexibility, management by projects, internal audits, self assessment, reduced response time, set-up of mobile units, closer involvement with utilities and applicants, etc.

The Ministry of Water and Environmental Protection is responsible for environmental protection legislation and regulations and for the licensing process from the environmental protection point of view. The MIR co-ordinates the Pressure Vessel Authority (ISCIR), which is responsible for licensing and control of pressure vessels, boilers and other pressure installations, including those from the nuclear field. The Ministry of Health is the responsible authority to organize the monitoring network of contamination with radioactive materials of food products over the whole food chain, inclusive drinking water as well as other goods designated to be used by the population, according to the law. Also, the epidemiological surveillance system of the health condition of personnel professionally exposed, and of the hygiene conditions in units in which nuclear activities are deployed, are under its responsibility. The Ministry of Interior is responsible for control of fire protection at nuclear installations and for supervision of physical protection of nuclear installations and nuclear material. The Ministry of Public Finance is the authority in charge of providing and controlling the financial support from Governmental budgetary funds, sovereign guarantees, etc.

5.2. Main National Laws and Regulations

Romania has had laws in place governing the regulation of nuclear activities since 1974. They remained in force until 1996, when a new legislation was issued. In January 1998, important amendments to the Law 111/1996 on the safe deployment of nuclear activities have been approved. Under the umbrella of this new Nuclear Act, all related rules, practices and regulations in nuclear field were started to be assessed for compliance with applicable IAEA guides and standards. The licensing experience gained during construction, commissioning and initial operation of the Cernavoda NPP Unit 1 was also carefully assessed and incorporated in the new legislative framework being now created in Romania.

A comprehensive set of technical instructions, directives, regulations, procedures, industrial standards, nuclear design and safety guides, concerning the quality assurance and safe operation of nuclear facilities and NPPs, cover activities such as project management, procurement, design, manufacturing, civil works, installation, commissioning and operation.

All AECL design guides and safety design guides were endorsed by CNCAN. The IAEA Safety Series are also used as a basis for the CNCAN regulations. Most of the applicable industrial standards have been used during the licensing process of the Cernavoda NPP Unit 1. As of today, technical standards, such as ASME, ASTM, IEEE etc., have been endorsed in Romania.

5.3. International, Multilateral and Bilateral Agreements

AGREEMENTS WITH THE IAEA

• Amendments to Articles VI and XIV of the Agency statute	Ratified:	22 February 2001
• Agreement on Privileges and Immunities	Entry into force:	7 October 1970
• NPT related safeguards agreement INFCIRC No: 180 82	Entry into force:	27 October 19
• Additional protocol	Entry into force:	7 July 2000
• Supplementary agreement on provision of technical assistance by the IAEA	Entry into force:	28 October 1981
• Agreement on the Agency's assistance for establishment of a research reactor project INFCIRC No: 206	Entry into force:	30 March 1973
• Agreement on assistance for the transfer of enriched uranium for irradiation studies in a research reactor; INFCIRC No: 307	Entry into force:	1 July 1983

MAIN INTERNATIONAL TREATIES

• NPT	Entry into force:	4 February 1970
• Convention on the physical protection of nuclear material	Entry into force:	23 December 1993
• Convention on early notification of a nuclear accident	Entry into force:	13 July 1990

• Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	13 July 1990
• Vienna convention on civil liability for nuclear damage	Entry into force:	29 March 1993
• Joint protocol relating to the application of Vienna and Paris conventions	Entry into force:	29 March 1993
• Protocol to amend the Vienna convention on civil liability for nuclear damage	Ratification:	29 December 1998
• Convention on supplementary compensation for nuclear damage	Ratification:	2 March 1999
• 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 etc.

• EURATOM	Non-Member	
• Agreement on trading and commercial and economical co-operation – Luxembourg, 22 October 1990	Entry into force:	15 March 1991
• Treaty on ban of nuclear weapon tests in the atmosphere, in outer space and under water	Entry into force:	23 December 1963
• Treaty on the prohibition of the emplacement of nuclear weapons and other weapons of mass destruction in depth of seas, oceans and their underground	Entry into force:	10 July 1972
• Comprehensive nuclear test ban treaty (CTBT)	Entry into force:	4 October 1999
• The Convention on the Physical Protection of Nuclear Material	Entry in force:	8 February 1987
• Improved procedures for designation of safeguards inspectors	Accepted on 22 February 1990 in statement to Board of Governors	
• Zangger Committee	Member (1974)	
• Wassenaar Arrangement	Member (1996)	
• Australia Group	Member (2000)	
• Nuclear Suppliers Group	Member	

• Nuclear Export Guidelines	Agreed
• Acceptance of NUSS Codes suitable	Summary: Revised codes considered for preparing and applying NPP's safety standards. In 1987 used by Regulatory Body as minimum requirement for adequate safety of NPP's operation. (21 March 1990)
• Unified Institute for Nuclear Research, (1992) Doubna, Russian Federation	Member – under the Modified Statute Ratification: 21 July 1994

REFERENCES

[1] "Overview of Nuclear Legislation in Central and Eastern Europe and the NIS", NEA/OECD, 1998.

[2] Least Cost power and Heat Generation Capacity Development Study, Romania, SEP, Tractebel and EdF, 1997.

[3] "Impuls", Information Bulletin of CONEL (in Romanian) 1997-2000.

[4] National Electricity Company S.A. - CONEL, Annual Report 1998.

[5] "Politici energetice ale Romaniei" (in Romanian), IEA. OECD, 1994.

[6] Statistics Year Book of Romania 1998-2001, Statistics National Commission (CNS).

[7] "Statistical Bulletin – Industry", CNS, 1999-2001.

[8] "Encyclopaedia Britannica", 1996.

[9] "Core Issues" The Journal of Uranium Institute, London, No. 1, 1999.

[10] "Larousse, Mica Enciclopedie de Geografie" (in Romanian), Editura Lider, Bucuresti, 1999.

[11] "Monitorul Oficial al Romaniei" (in Romanian), 1996-2001.

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

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

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

[15] TRANSELECTRICA S.A. - Annual Report 2001.

[16] Ministry of Industry and Resources, The National Strategy for the Development of Romanian Energy sector on Medium Term 2001-2004 (Synthesis), 2001.

[17] Government of Romania, Romania's Economic Strategy on medium term, 2001.

[18] Government of Romania, Action Plan on 2001-2004, 2001, www.guv.ro

[19] Nuclearelectrica S.A. - Semnal "N" (in Romanian), 2000 –2002.

[20] Nuclear Energy and the Kyoto Protocol, OECD/NEA, 2002.

[21] AREN, "Nuclear Energy" Magazine, vol. 13, 2002.

[22] Romanian Atomic Forum - ROMATOM Yearbook 2002.

[23] Price Waterhouse Coopers, Romania - Fact Sheet, April 2002

Appendix

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

MINISTRIES

Ministry of Industry and Resources
Energy General Division
Calea Victoriei No. 152, Sector 1
70034 Bucharest

Tel: +(40-21) 650 48 60
Fax: +(40-21) 2129409
Web: http://www.mincom.ro

Ministry of Public Finances
Apolodor str., No. 17, Sector 5
Bucharest

Tel: +(40-21) 410 11 89
Fax: +(40-21) 312 16 30
Web: http://www.mfinante.ro

Ministry of Education And Research
- Research Department
Mendeleev Str. No. 21-25, Sector 1 70168 Bucharest

Tel: +(40-21) 212 85 59
Fax: +(40-21) 312 14 10
E-mail: programe@mct.ro
Web: http://www.mct.ro

NATIONAL ATOMIC ENERGY AND POWER AUTHORITIES

National Atomic Energy Agency
Ministry of Education and Research
Mendeleev Str. No. 21-25, Sector 1
70168 Bucharest

Tel: (40-21) 3128707
Fax: (40-21) 6503175

National Commission for Nuclear Activities
Control (CNCAN) (Nuclear Regulatory Body)
B-dul Libertatii nr. 14, P.O.Box 42-4
Sector 5, Bucuresti,

Tel: +(40-21) 410 05 72
Fax: +(40-21) 337 3887
E-mail: lucian.biro@cncan.ro

National Agency For Power Regulation
(ANRE) (Electricity Regulatory Body)
Constantin Nacu nr. 3
Sector 2, 70219 - Bucharest

Tel. +(40-21) 311 22 44
Fax +(40-21) 312 43 65
E-mail: anre@anre.ro
Web: http://www.anre.ro

OTHER NUCLEAR ORGANIZATIONS

Institute of Geotechnical & Geophysical Studies
(GEOTEC SA Bucuresti)
Romanian Electricity Authority
5 –7 Galati Str. 70211, Sector 2
Bucharest

Tel: (40-21) 6148551
Fax: (40-21) 3127689
Telex: 11443 ISPH R

Institute for Nuclear Research & Engineering
P.O. Box 11-2
RO 72400, Bucharest

Tel: (40-248) 6148551
Fax: (40-248) 262 449

Horia Hulubei National Institute of Physics
and Nuclear Engineering
Str.Atomistilor no. 407
P.O.Box: MG-6

Tel:+40 21 7807040
Fax:+40 21 4231701
Email: ifin.nipne.ro
Web: http://www.ninpe.ro

RO 76900 Bucharest

Republican Commandment for Intervention
In case of Nuclear Accident (CANCOC)
19 Ceasornicului Str. Sector 1
Bucharest
Fax: (40-21) 3110265

NUCLEAR ELECTRICITY PRODUCER

CNE-PROD Cernavoda
(Branch of SNN-S.A.)
8625 Cernavoda str.
Medgidiei nr. 1 P.O.BOX 42
Tel: +(40 241) 238 610
Fax: +(40 241) 239 679
E-mail: ibucur@cne.ro
(Electricity producer, Cernavoda NPP Unit #1, in commercial operation since 1996)

TRANSMISSION SYSTEM OPERATOR

TRANSELECTRICA SA
Blvd. Magheru #33, Sector 1
70164 - Bucharest
Tel. +(40-21) 303 58 21
Web: http://portal.transelectrica.ro/

POWER MARKET OPERATOR

OPCOM S.A.
Blvd. Magheru #33, Sector 1
70164 - Bucharest
Tel. +(40-21) 307 14 10
Fax +(40-21) 307 14 00
Web: http://www.oper.ro

ELECTRICITY DISTRIBUTION

ELECTRICA S.A.
9, Grigore Alexandrescu Street, 1 Bucharest
Tel: + (4021) 208 5999
Fax: + (4021) 208 5998
e-mail: office@electrica.ro
Web: http://www.electrica.ro

NUCLEAR INDUSTRY

AMEA SA Cernavoda
8625 Cernavoda,
jud. Constanta
(Procurement of services and products)
Tel: +40 241237857
Fax: +40 241237857

ASA HOLDING SA Bucuresti
str. Luca Stroici Nr. 15, Sector 2
Cod 70224 Bucuresti
Tel.: +(40 21)211-8454; 211-7770
Fax: +(40 21)210-1588
doina@asa.ro, http://www.asa.ro

AUTOMATICA SA Bucuresti
Calea Floreasca 159, Sector 1
(Power Panels, Annunciation Equipment, Interconnecting Component, Regulating System/Reactivity Logic Cabinets)
Tel: +(4021)230 8364
Fax: +(4021)230 2841
autom@automation.ipa.ro

AVERSA SA Bucuresti
Str. Ziduri Mosi 25
(Cooling Pumps, Misc.Centrifugal Pumps, Nuclear & Non-nuclear Sump Pumps)
Tel: +4021 252 50 00
Fax: +4021 252 07 69
E-mail: aversa@fx.ro
Web: http://www.aversa.ro

CNE-INVEST Cernavoda
Tel: +40 241 239 962

(Branch of SNN-S.A.)
8625 str. Medgidiei nr. 3
P.O.BOX 1
Fax: +40 241 239 266
E-mail: marculescunv@impromex.ro
(Projects: Cernavoda NPP Units #2 <under construction>, #3-5<cancelled, in conservation>)

CITON Bucuresti – Magurele
P.O.Box 52(MG)
04 74554 Bucuresti – Magurele
Tel/Fax: +4021457 44 31
E-mail: panaita@router.citon.ro
(Design Services for Technology and Engineering for Nuclear Projects)

ELCOMEX srl Cernavoda
Cernavoda cod 8625
Constanta
Tel: +40 241 237 169
(Works for electric montage, actuators and electric facility for elevators)

ENERGOMONTAJ SA - GSE - IEA Bucuresti
Str.Ilioara nr.54
Sector 3, Bucuresti,
CP 74592
Tel: +4021 321 33 54
Fax: +40 21 212 22 10
Telex: 10320
(Electric & Automatic Facilities)

ENERGOMONTAJ SIEA SA Bucuresti
Str. Ilioara nr.54
Sector 3 Bucuresti
Cod 74592
Tel: +4021 321 33 54
Telex: 10320 R
(Supports for Electric Aparata & AMC, Piping for Insulated, Services & Tests for Relays & AMC)

EUROTEST SA Bucuresti
Str. Splaiul Unirii nr.313
cod 73204 sect.3
Tel: +4021 6206136
Fax: +4021 3232628
(Tray for thermal olding, tray for ante & post irradiation, tray for LOCA & earth)

FCN Pitesti
(Branch of SNN-S.A.)
Str. Cimpului nr. 1
0402 Mioveni Pitesti, CP 1
Judetul Arges
Tel: +40 248 260 160
Fax: +40 248 262 499
Telex: 18251 R
E-mail: fcn@fcn.ro
(Fuel Fabrication for Reactors CANDU)

FEA Bucuresti
Calea Floreasca nr.242-246
Bucuresti, Sector 1
Tel: +4021 633 39 74
Fax: +4021 312 76 33
(Current Alarm Units, Function Generators & Signal Selectors, Resistance To Current Converters)

FECNE SA Bucuresti
Sos.Berceni nr.104
Sector 4, 75632 Bucuresti,
Tel: +4021 683 60 05
Fax: +4021 330 34 04
Telex: 10243
(ECC System Tanks, Components Mechanic Welded & Non-destructive Controls)

FEPA SA Birlad
Str. Republicii nr.316 6400
Birlad
jud. Vaslui
Tel: +40235 415 990
Fax: 40236 467 977
Telex: 21723
(Electro Pneumatic Apparata for Automation)

GENERAL TURBO SA Bucuresti
Sos. Berceni nr. 104
Bucuresti, sector 4
(Turbogenerators, Asynchrony Engine)
Tel: +40 21 334 92 74
Fax: + 40 21 334 92 83

HESPER SA Bucuresti
Str.Dr.Constantin Istrati nr.1 75213
Bucuresti Sector 4
(Air Control Panels Closure Plug Installation, Valve Station, Cold Test Facility)
Tel: +4021 623 19 10
Fax: +4021 4237687 / 3372460
Telex: 11633

IAICA SA Alexandria
Str,Dunarii nr.372
Alexandria
judetul Teleorman, CP. 0700
(Pneumatic & Electric Dampers Diffuser, Air Handling Units)
Tel: +40 247 312 145
Telex: 16133

IAMSAT Bucuresti
Soseaua Orhideelor nr.27-29
Sector 4, Bucuresti, CP 77139
(Mounting for Electric & Automatic Equipment)
Tel: +4021 63 77 855
Telex: 10576

IAR SA Brasov
Str.Aeroportului, nr.1
Brasov, CP 2200
(Special Fire-resistant Doors)
Tel: 40921 50 014 or 61266

ICIM Bucuresti
Bucuresti
Splaiul Independentei nr.294
(Environment engineering research)
Tel: +40 21 637 30 20

ICN Pitesti
Pitesti, Colibasi
Judetul Arges
(Exploitation for Radwaste Treatment Station)
Tel: +40 248 213 535
Fax: +4021 312 58 96

ICPAIUC SA Bucuresti
Bucuresti str. Fabrica de Chibrituri nr.48
(Design & research institute for HVAC equipment)
Tel: +40 21 64130 00
Fax: +40 21 337 32 29

ICPET SA Bucuresti
Sos Berceni nr. 104.
cod 75632, sector 4
Bucuresti
Tel: +40 21 683 20 70
Fax: +40 21 683 27 47

PEROM SA Bacau
str. Republicii nr. 166
cod 5500, Bacau
Judetul Bacau
Tel.: +40234 174344; +4034 175 376
Fax: +40234 173 548

PROMT SA Timisoara
Aleea CFR nr 7
cod 1900, Timisoara
Judetul Timis
(Overhead Travelling Cranes, Boiler Room Cranes, New Fuel Handling Cranes, Monorails and Hoists)
Tel: +40256 194 880
Fax: +40256 194 880

IFIN Bucuresti
Str.Atomistilor, nr.1
Magurele, Bucuresti
Tel: +4021 780 70 40
Fax: +4021 312 22 45
Telex: 1291
(Portable and Fixed Contamination Monitors, Personal Monitors, Dosimetry Laboratory/Body Counters)

Kvaerner SA Bucuresti
Sos.Berceni nr.104
Sector 4, Bucuresti
Tel: +4021 684 10 20
Fax: +4021 684 69 30
(Sample Cabinets Canisters, Nuclear Pressure Reducing Devices, Ion Exchange Columns)

INDES SA Sibiu
Str.Ocnei, nr. 33
Cod 2400, Sibiu
Judetul Sibiu
Tel: + 40292 434 100
Telex: 69341
(Channel Closure Installation Equipment, Spent Fuel Storage Tray Supports)

IUG SA Craiova
Str. Tehnicii, nr.1
Craiova
Judetul Dolj, CP 1100
Tel: +40251 144 100
Telex: 41323
(Head Transport Carriage, Bridge & Maintenance Lock Tracks)

MECANICA FINA SA Bucuresti
Str. Popa Lazar
nr. 5-25, Sector 2
Bucuresti, CP 73334
Tel: +4021 635 00 00
Telex: 11583
(Pressure Gauges, Liquid Injection System Pressure Switches/Differential, Thermometers, Thermo-couples, Instrument Isolating Valves & Manifolds, Filter Regulators, Electric Pneumatic Transducers)

NIMB SA Cernavoda
Cernavoda
cod 8625, judetul Constanta
Tel: +40241 238 488
Fax: +40241 238 890
(Metallic build & facility for NPP)

NUCLEAR & VACUUM SA Bucuresti
Com. Magurele 76900
Str.Atomistilor 1, Sector 5
CP 52-06
Tel: +4021 807 365
Fax: +4021 807 365
Telex: 11350; 11397
(Nuclear Apparatus, Vacuum Pumps)

NUCLEAR MONTAJ SA Bucuresti
str. Caransebes nr. 1
sector 6
Bucuresti
Tel: +4094 344 233; 4095 114 590
Fax: +4094 734 211; 4095 734 580
E-mail: nuclearb@fx.ro
Web Site: www.nuclear.ro
(Mounting and Repairing of Mechanical Parts of Nuclear and Classic Power Plant Inclusive Auxiliaries)

PETROTUB SA Roman
Sos. Roman – Iasi
km. 333, Roman
judetul Neamt, CP 5550
Tel: +4033 731 201
Telex: 25263
(Rolled Pipes on Hot & Cold)

REGIA AUTONOMA PENTRU ACTIVITATI NUCLEARE (RAAN)
Calea Tg. Jiu km 7
Drobeta Turnu Severin
jud. Caras-Severin

Tel: +40252 323 848
Fax: +40252 322 335; +4052 323 685
E-mail: raan@expert.ro

REPUBLICA SA Bucuresti
Bd.Basarabiei nr. 256
Sector 3, Bucuresti
(C.S. & S.S. Pipe for Small Diameters)

Tel: +4021 627 59 45
Fax: +4021 627 45 70
Telex: 10862

RETROM SA Pascani
str. Moldovei nr. 17 bis
cod 5725 Pascani
jud. Iasi

Tel.: +40232 762 092
Fax: +40232 765 044

ROMENERGO SA Bucuresti
Calea Victoriei nr. 91 – 93
Sector 1 P.O.BOX 1 - 736 Bucharest
(Procurement for products and services for nuclear projects)

Tel: +4021 659 47 20
Fax: +4021 312 06 34
Telex: 011525

ROMAG Drobeta Turnu Severin
Calea Tg. Jiu km 7
Drobeta Turnu Severin
jud. Caras-Severin
Bucharest
(Heavy Water)

Tel:++40 (0)252 322 397
++40 (0)252 321 561
Fax:++40 (0)52 317908
Telex:42270
E-mail: romag@intelsev.ro
web: www.intelsev.ro.romag

SACRO SA Bucuresti
Soseaua Berceni nr 104
Sector 4, Bucharest

Tel: +4021 682 59 80
Fax: +4021 312 24 69
Telex: 11892

Societatea Nationala "NUCLEARELECTRICA" S.A.
Boulevard General Gheorghe Magheru nr. 33
6th floor, Sector 1, 70164-Bucharest
P.O.BOX 22-102 Bucharest
(National company for nuclear fuel and nuclear electricity production)

Tel: +40 21 203 82 00
Fax: +40 21 311 24 33
E-mail: irotaru@snn.rdsnet.ro
web: http://www.nuclearelectrica.ro

STIZO SA Bucuresti
Calea Mosilor nr.36
Sector 3, 75443-Bucharest
(Works for Technological Insulated, Insulating material on side of NPP)

Tel: + 4021 614 43 60
Telex: 11568 R

TEHNOMET SA Timisoara
Calea Buziasului nr. 5A
Cod 1500 Timisoara
Judetul Timis

Tel.: +40256 222 055;
+40256 222 097;
Fax: +40256 190 800;
E-mail: tehnomet@mail.dnttm.ro

TEN SA Bucuresti
Bd.Basarabiei nr.250
Bucuresti, Sector 3, cod 78011
(Manufacturing of Nuclear Components, Complex Products, Iron Constructions)

Tel.: +4021 628 64 80
Fax: +40 21 312 81 00
Telex: 011464 R

TMUCB SA Cernavoda
Cernavoda, cod 8625

Tel: + 40241 23 84 10
Telex: 14529

judetul Constanta
(Set-up tubes, pipes, metallic builds, large equipment & hangers)

TRAFO ELECTROPUTERE SA Craiova
Calea Bucuresti nr.144
(Transformer for Low and High Voltage, Transformer Plant, Transformer Balanced)
Tel: +40251 14 20 77
Telex: 41331

TURBOMECANICA SA Bucuresti
B-dul Pacii, nr 244
Sector 6, Bucuresti, cod 77826
(Mechanical Damper Devices for Seisms)
Tel: +4021 760 78 48
Telex: 10151

UMEB SA Bucuresti
Str General Vasile Milea
nr 4, cod 77035
Sector 6, Bucuresti
(Electric Engine Asynchrony for Low Voltage)
Tel: +4021 631 25 01
Telex: 10652

UNIFY SRL Cernavoda
Cernavoda, cod 8625
judetul Constanta
(Anticorrosive protection by insulated paint)
Tel: + 0421 237 581

UPET SA Tirgoviste
Str.Arsenalului, nr.20
cod 0200 Tirgoviste
judetul Dimbovita
(Safety Valves, Flaps)
Tel: +40292 6 31 600
Telex: 17236

UZUC SA Ploiesti
Str.Depoului nr.16
Ploiesti, judetul Prahova
(Chemical Equipment Works)
Tel: +40244 14 36 51
Fax: +40244 12 19 12
Telex: 19337

VENTILATORUL SA Bucuresti
Str. sergent Nutu Ion nr.44
Sector 5, Bucuresti
(Fans)
Tel: +401 410 27 58
Fax: +401 410 27 58
Telex: 10671

VULCAN SA Bucuresti
Str.Sebastian 86-88
Sector 5, 76305-Bucuresti
(Headers & Feeders Frame Assay, Strainers, Fittings, Tanks)
Tel: +4021 410 2061
Fax: +402 1 410 0185; 410 7434

NON GOVERNMENTAL ORGANIZATIONS (NGO)

Asociatia "Forumul Atomic Roman - ROMATOM
(Romanian Atomic Forum), FORATOM Member
33, Blvd. Magheru, 5th floor, 122 A suite
P.O.BOX 45-106 Bucharest
Tel: + 40 21 311 24 31
+ 40 21 203 82 02
Fax: + 40 21 311 24 43
e-mail: dchirica@snn.rdsnet.ro
Web: http://www.romatom.ro

Asociatia Romana "Energia Nucleara" - AREN
P.O.BOX MG-53
76900 Bucharest - Magurele
Tel.: +40 21 310 28 52
Fax: +40 21 311 24 34
e-mail: mstiopol@snn.rdsnet.ro

Societatea Romana de Radioprotectie (SRRp)
Str. Dr. Leonte, Nr. 1-3,
76256, Bucuresti, Sector 5

Tel.: +4021 7330/292
Fax: +4021 312 7780