Electricity Restructuring in Bulgaria

Stoyan Bekiarov, Member, IEEE and Mohammad Shahidehpour, *Fellow, IEEE*
Electric Power and Power Electronics Center
Illinois Institute of Technology
Chicago, Illinois 60616

***Abstract*: This paper discusses the current situation for the *restructuring of the electricity power sector in Bulgaria. It also* outlines the major issues related to the restructuring in EU and Central and Eastern European (CEE) countries. The paper discusses the social and technical problems that the Bulgarian power industry are expected to face during the transition from monopoly to competitive markets. In addition, the paper provides a set of recommendations for the proposed restructuring measures in the Bulgarian power sector.**

***Keywords:* Bulgaria, electricity markets, restructuring, competition, European Union, central and eastern Europe**

I. INTRODUCTION

During the early years of electrification, electric power companies were competing for customers in an open market. The technology at that time, however, was at such level that small companies were less efficient and less successful in retaining their large customers. So the regulation naturally took place and established a monopoly of electric utilities instead of free market. The regulation benefited both electric utilities and consumers. However, in 1960s, technological advances made it possible for smaller generators to be as efficient as large generating companies. Therefore, monopoly of electric utilities in 1960s had benefited electric utilities but not their consumers. As a result, a shift to restructuring took place, first in UK and then in USA, Scandinavian countries, other EU countries, Australia, Latin America, and presently in Central and Eastern European (CEE) countries. The ultimate goal of the restructuring in the power sector is to establish a competitive market for offering better services at lower prices.

Shahidehpour and Alomoush discussed extensively the electricity restructuring in the US, Canada, Australia, England and Wales, and Nord pool [1]. Rudnick and Zolezzi discussed the restructuring in Latin America [6]. Jancher [7] and Javerzac [8] discussed the restructuring in EU. Srivastava and Shahidehpour discussed the restructuring in India [5].

CEE countries have been in an electricity restructuring process since 1989, when major political and economical reforms took place in that part of Europe. Bulgaria has been trying to gain a leading position for establishing an electricity power market among South East European countries. In order to accomplish this task, Bulgaria has faced new challenges for its electricity which require extensive and long-term solutions.

II. RESTRUCTURING IN EU COUNTRIES

UK, in the early 1990s, opened its wholesale electrify market in which private generators could compete to supply the demand based on market prices. The ultimate goal for restructuring would be that both parties benefit, i.e., consumers from lower prices, and generation and distribution companies from higher efficiency.

The process of restructuring in EU was precipitant by Electricity Directive 96/92 EC of the European Parliament, from19 December 1996, whose objective was "to ensure the free trade of electricity within the European market, while improving the security of supply and the competitiveness of the European economy [9]." The Directive 96/92 established common rules for organization and operation of electricity sector, mainly in three areas: market access, system operations, and issuing of licenses [10]. The key issues of restructuring outlined by the Directive 96/92 EC were: development of new generating facilities, transmission network access, transmission and distribution system operation, gradual market competition and unbundling.

Although the electrical power industries of some of the EU countries have instituted a structure that is different from what is stated in the Directive 96/92 EC, it is perceived that all participants will ultimately satisfy the Directive's requirements.

III. RESTRUCTURING IN CEE COUNTRIES

Electrical power industries in CEE countries operated as state-owned monopolies prior to 1989, and their functioning and management were dominated by their respective government policies. After 1989, CEE countries embarked on political and economical reforms with an objective for establishing pluralistic and democratic societies with open market economies. Currently the most vibrant political and economical objective among CEE countries is their full integration and membership in EU. Consequently all countries in the region are trying to upgrade their political and economical structures in accordance with EU rules. So the Directive 96/92 EC would naturally provide an impetus for restructuring in CEE countries.

The initial driving force behind restructuring in CEE countries was the desire to enhance the efficiency in the power sector, as was the case in EU and perhaps throughout the world. However, this objective alone was not sufficient for enticing CEE countries to restructure their electrical power

0-7803-7989-6/03/$17.00

industry because of the special features of their transitional economies. These features included weak and inefficient infrastructures, obsolete equipment, huge investments required for overhauling the electrical power industry, and uncertain prospects for electricity demand in response to economical reforms. But the main slowdown has been the fact that electricity tariffs have been kept below the actual marginal cost and the entire power industry in those countries has been basically subsidized in order to soften the social hardship of monetary and macroeconomic stabilization policies. Several governments in CEE countries had considered the electricity sector as a strategic tool for controlling their respective societies.

Nevertheless, tremendous progress has been made for overhauling the electricity sector in CEE countries. Over the years, the need for transition from central electricity planning and operation to electricity markets has become clear. Restructuring of electricity has required the transformation of government energy agencies, first into state agencies, then into state- owned joint stock companies with a commercial mandate, and finally into privatized entities linked to major customers or investors [11].

In July 2000, Poland became the first Eastern European country to establish a power exchange. Gielda Energy currently operates a day-ahead market, with plans for hour-ahead and futures markets. This market has shown steady growth, though it is still very primitive [12]. However, restructuring gradually advances in Poland by means of competitive generation and third-party access through a "pool." The electricity market is scheduled to be fully operational by the end of 2005. Similar processes have been taking place in Hungary, Czech Republic, and Bulgaria, mostly as a "single buyer" market structure.

IV. POWER SECTOR IN BULGARIA

A. History and Special Features

Bulgaria's economy, until 1989, was one of the Eastern European economies that were most closely related to and dependent on the Soviet Union's economy. In 1989, Soviet imports supplied Bulgaria with 95% of its coal, 90% of its crude oil, and 100% of its natural gas at favorable prices. As a result Bulgaria followed a very energy-intensive development policy, with emphasis on heavy industries such as organic and inorganic chemical, metallurgical, and heavy machinery construction industries. There was very little concern about the energy efficiency in the technologies that were used at that time, because of the lack of competition, and respective markets were dominated by politics and not by efficiency.

Consequent to the recent economical reforms, Bulgaria now has a larger share of several industries among European countries, and the energy usage in support of the Bulgarian GDP is considerably higher than that of comparable economies. However, for the same level of productivity, Bulgaria uses seven times more fuel than the average usage in CEE countries. The per capita fuel usage in Bulgaria is three to four times higher than the EU average. There is the same tendency for a significantly higher usage of residential fuel in Bulgaria. Accordingly an average Bulgarian household uses three times more fuel than an average household in Romania, Slovakia, Estonia, Turkey and Latvia. For example in Turkey, where the GDP is twice as large, the fuel usage for a single household is lower than that of single household in Bulgaria [15].

B. Energy recourses

Currently, the Bulgarian energy sector accounts for 15% of its GDP. The resources for natural gas in Bulgaria are estimated at about 5.7 billion m^3 and the expectations for future development of oil and gas production in Bulgaria are not promising [15]. Bulgaria is still dependent on imports for about 70% of its energy supplies. These supplies have to be bought at world market prices in hard currency. Imports from Russia provide the majority of natural gas supply.

Bulgaria has large deposits of low quality brown coal which amount to 2.7 billion metric tons of lignite and 200 million metric tons of sub-bituminous coal. The low quality lignite coals are relatively inefficient energy producers and high pollutants. Bulgaria is highly dependent on coal imports from world markets.

Bulgaria has modest hydroelectric resources. Water accumulates in 50 large reservoirs at 77 hydroelectric power plants. The 14 of its largest plants work in four large complexes of cascading dams. They are used for covering the peak demand and for assuring the stable operation of the system. Due to a recent decrease in rainfalls, generation from hydroelectric power plants is at 50% of the country's designed capacity.

Bulgaria has one nuclear power plant, i.e., Kozloduy, which is located 200 km north of Sofia on the Danube River. It is the largest plant in the Balkan Peninsula. Kozloduy has 6 units of Russian-designed UVER reactors. Units 1, 2, 3 and 4 were commissioned in 1974, 1975, 1980 and 1982. Units 5 and 6 were commissioned in 1987 and 1993. The total capacity of Kozloduy is 3,538 MW. In 2000, the plant produced 18.178 billion kWh of energy, which represented 44.4% of the Bulgaria's total electrical consumption [16].

C. Generating facilities

The total installed capacity of the Bulgarian power system before the start of licensing was 13,183 MW out of which there are 6,553 MW (49.7%) of thermal power plants (TPPs), 3,760 MW (28.5%) of nuclear power plants (NPPs), and 2,878 MW (21.8%) of hydro (HPP) and pumped-storage (PSHPP) power plants [16].

D. Electricity Grid.

The power transmission network of Bulgaria consists of the following power lines: 85 km of 750 kV, 2207 km of 400 kV, 2650 km of 220 kV and 9167 km of 110 kV. The system operates in a ring mode. The inter-system transmission line of 750 kV, from Varna via Isaccea to Yujnoukrainskaya NPP, and the inter-system transmission line of 400 kV from

Dobrudja to Vulkanesti are presently in reserve. Recently Bulgaria started the construction of a second 400 kV cable (42-mile) to Turkey. A diagram of Bulgaria's electrical grid is shown in Fig.1 [15].

V. Restructuring in Bulgaria

A. History

As in the other CEE countries, the process of transition to pluralistic and democratic society and market-oriented economy was not as easy, fast, and straightforward as was expected. As a result, a significant decline in the Bulgarian economy was observed, especially in 1996-1997. During 1989-1999 the electricity consumption in Bulgaria was decreasing at a rate of 4% per year. In 1999, the total consumption dropped to 65% of its 1989 level and the per capita consumption in 1999 plummeted to 71% of its 1989 level. The major reasons for this drop were cited as price hikes in residential electricity and heat as well as free market-based prices for fuel which may have influenced the energy usage in the country considerably.

Many of the existing generating facilities are old and need rehabilitation or replacement, but the state itself is incapable of such investment programs. The Bulgarian government has been encouraging private and foreign investors to finance various projects in the energy sector in pursuit of electricity restructuring in Bulgaria. The need for foreign investments in Bulgaria is very clear. However, steps should be taken to decrease uncertainties in the development of Bulgarian economy. Correspondingly, short and long term forecasting of electrical load and prices would play a critical role in Bulgarian national policies and should be done with great cautious [3].

Fast and efficient reforms in the energy sector are vital in representing the government's intention for restructuring and opening the energy market to major foreign investors. The foreign investments will reduce the uncertainty in electricity production, which is regarded as the industrial backbone for Bulgaria, and will eliminate the need for unrealistic warranties by the government at the expense of social programs in Bulgaria.

Another major incentive for restructuring was the fact that Bulgaria was invited in December 1995 to start negotiations for membership in EU and is expected to become a full member in 2007. It is expected that Bulgarian power sector reforms would be in compliance with the requirements of Directive 92/96 EC of the European Parliament on the Common Rules of the Internal Power Market.

B. Institutional framework

The institutional framework for the restructuring of the Bulgarian electric power sector was set up by the new Energy and Energy Efficiency Act (EEEA) adopted by the National Parliament in 1999 and published in the State Gazette # 64/07.16.1999. EEEA establishes rules for the privatization of the energy sector. Its objective is to create competitive power markets and promote investments for the restructuring of electricity production and delivery in Bulgaria. The new energy law established three new institutions in the electricity sector including,

- State Agency on Energy and Energy Resources (SAEER),
- State Energy Regulatory Commission (SERC) and
- State Energy Efficiency Agency (SEEA).

These institutions and their responsibilities are discussed as follows:

1) State Agency on Energy and Energy Resources (SAEER):

SAEER, formerly known as Energy Committee, remains the leading structure in the electricity sector. It is charged with planning the national energy policies and strategies for the development of the electricity sector. SAEER also approves the proposed programs for the expansion of the sector, as well as its restructuring and privatization. It also determines additional investments that are curial and provides guidance to the Government for expanding the existing energy infrastructure.

2) State Energy Regulatory Commission (SERC):

SERC is authorized under EEEA to exercise state regulations for electricity, natural gas and regional heating [17]. The general purpose of SERC is to serve the consumer interest by improving the quality and efficiency of regulations in the public energy utility sector. The Commission has seven members inclusive of the Chairman and Vice Chairman who are appointed by the Prime Minister for a five-year period. The Commission's budget is appropriated by the Government. Under EEEA, the main functions of the Commission are: Develop instruments and take steps required to issue permits and licenses; Issue, amend, supplement, suspend, terminate and revoke permits for construction of energy facilities and licenses for the purposes of initiating activities in the energy sector; Define general terms and conditions for contracting the sales of electric power, heat and natural gas; Review default claims under granted licenses. SERC is also authorized to approve prices set by energy companies.

3) State Energy Efficiency Agency (SEEA):

SEEA is responsible for promoting energy efficiency and the use of renewable energy sources. SEEA participates in the development of the National Strategy for Energy and Energy Efficiency in conjunction with SEER [18].

VI. Restructuring of NEK

The state-owned vertically integrated utility in Bulgaria, referred to as National Electricity Company (NEK), was created in 1992. In 2001, NEK was restructured into two separate entities for generation and for transmission and distribution of electricity. This unbundling of functions in NEK was the beginning of restructuring in the electricity power sector in Bulgaria. The NEK restructuring included the segregation of medium and low voltage distribution operations from the new NEK and the establishment of seven

Fig. 1. Map of the Electric Power Network of Bulgaria

commercial distribution companies as independent legal distribution of electricity. This unbundling of functions in NEK was the beginning of restructuring in the electricity power sector in Bulgaria. The NEK restructuring included the segregation of medium and low voltage distribution operations and the establishment of seven commercial distribution companies as independent legal entities. The newly established distribution companies perform sales at medium and low-voltage levels. In addition, Kozloduy NPP, Rouse-East and Maritsa-East-1 TPP were declared as IPPs.

The generating facilities that were still managed by the new NEK included Maritsa East-3 TPP with a 840 MW capacity, the majority of hydro-power plants, including the large cascades of Belmaken-Sestrimo, Batak-Aleko, Vacha, and Arda, and the pumped-storage HPP referred to as Chaira with a total capacity of 2,755 MW for supplying peak loads and maintaining the frequency. The second phase of restructuring consisted of the unbundling of the remaining TPPs as IPPs.

The Bulgarian energy market was established in 2002. An important element of this market is the possibility for direct contacts between foreign or domestic consumers and IPPs. Under EEEA, the new NEK is a single buyer which carries out electric power purchases and sales at high-voltage level. The main functions of the new NEK are: integrated control and reliable operation of the transmission network [4]; centralized purchase and sale of electric power; import, export and wheeling of electric power; supply of electric power to transmission network customers; maintenance and enhancement of transmission network facilities; maintenance and expansion of auxiliary networks [2]; on-line control and supervision of the operation of the national power system.

The trade relations between NEK and IPPs, bulk power consumers, and power distribution companies are based on yearly power purchase and sale contracts. In 2001, NEK concluded 19 contracts for power purchases from IPPs. These contracts were signed for the purchase of energy, available capacity, and ancillary services for primary and secondary control.

Power purchase contracts at preferential prices were concluded with co-generation plants and plants using renewable energy sources. The electricity purchased by NEK from IPPs in 2001 amounted to 32,173 GWh. Furthermore, NEK concluded power sales contracts with 101 bulk power customers and 8 power distribution companies serving 13 power transmission regions of NEK. The amount of electricity sales to bulk power customers amounted to 5,621 GWh, and to power distribution companies amounted to 23,912 GWh.

VII. BOTTLENECKS FOR RESTRUCTURING IN BULGARIA

Most of the steps toward the restructuring in the Bulgarian electricity power sector are underway. These steps include setting up the regulatory framework, unbundling of the sector into generation, transmission, and distribution, and implementation of the single buyer model along with a possibility of bilateral contracts for eligible customers.

The international experience reveals that restructuring is a package of measures that should be implemented collectively. Otherwise, the failure of restructuring is very apparent. The measures that should be further implemented in order for the restructuring in Bulgaria to be completed can be separated into the following two groups:

A. Political issues

4) Full Separation of State and Commercial Issues in the Sector:

The role of the state in the management of the power industry should be restricted to regulatory issues. In this sense, the budget of SERC in the future should not be a part of the government budget and the members of SERC should not be appointed by the government, rather by a non-governmental organization. These measures will assure more separation of SERC and the state.

5) Full Liberalization of Prices:

Currently, electricity prices are set by the government. In the future, prices should be set fully by the electricity market. At the present time, there is a direct subsidy on residential electricity prices. The provision of subsidy results in higher electricity prices for industry than for households, although the cost for transmission and distribution to residential areas is higher. To soften the public outcry for relaxing the subsidies after liberalization of the electricity market, all organizations involved in the electricity power sector should be involved in more aggressive public relations campaign. Especially the government and SERC should do much more in explaining the core of the reform and its long-term consequences and benefits.

Furthermore, an aggressive load management strategy should be applied to bulk power consumers. Bulgarian industry is very energy-intensive and at the same time very weak in utilizing energy efficiency. As a result, every increment in the price of electricity could result in higher manufacturing costs, a corresponding increment in the prices of other goods, and eventually a higher increment in the cost of living in Bulgaria.

It should be taken into account that certain population sectors in Bulgaria with a relatively low income may not be able to bear any incremental increase in the cost of living. Therefore, it is essential to introduce incremental steps for initial increases in energy prices before competitions among suppliers could stabilize the market prices. For such groups of citizens, an appropriate compensation fund should be established by the government, in order to soften the social burdens of transition to a market economy.

6) Privatization:

Without a considerable participation of the private sector, the electricity market restructuring in Bulgaria will be a failure. This is due to the fact that the electrical power sector would require capital investments to refurbish and expand the old and inefficient generating, transmission, and distribution facilities. The foreign investment could be attracted to a reliable, non-bureaucratic and efficient access to the Bulgarian electricity market. In case the foreign investment cannot be secured, and the government cannot provide the subsidy for upgrading the energy infrastructure in Bulgaria. Accordingly, consumers may have to face higher prices for restructuring which may cause the public opposition. It is worth mentioning here that generally support for restructuring (i.e, better services, higher quality, lower prices) among the Bulgarian population is high. This support stems from the fact that NEK, like any other monopolist operation in Bulgaria, was viewed as a highly inefficient and bureaucratic organization.

7) Fully Open Market:

It is envisioned that the competitive power market should be fully accessible with a shift from a single buyer model to a third party access (TPA) model. The establishment of TPA is a very important step in the implementation of an European regional market, which may include Bulgaria, Romania, former Yugoslavia, Greece, Macedonia and Albania, with the overall consumption of about 100-200 TWh/year [10].

8) Solving the Problems with Thefts and Collections:

The problem with electricity thefts was a major issue (17% during 1998) before the NEK unbundling. In fact, there was a general belief that this problem would be an impossible task to tackle. However, after separation of distribution companies from NEK, it turned out that the distribution companies were able to manage the problem very reasonably. It is believed that these companies will be able to mange the problem even more efficiently with time.

B. Technical issues

1) Expansion and Enhancement of Transmission Grid:

Further development of the transmission grid will have two major impacts on the Bulgarian electricity system. First, it will reduce the possible market power imposed by certain generating companies and enhance the IPPs' free access to the grid. Second, a well-connected transmission network to neighboring nations will strengthen the strategic position of Bulgaria in the Balkan Peninsula and will enhance its position as a leader in the electricity power sector. In this aspect, the construction of the new 400 kV cable to Turkey is a good example that should be pursued further with consistency.

2) Energy Efficiency:

The energy efficiency for the Bulgarian electricity production is very low. Bulgaria uses seven times more energy for electricity production than the average EU countries [15]. The cited reasons include the poor fuel management and scheduling, lack of proper maintenance policy, as well as old and outdated facilities. However, certain Bulgarian entities are currently responsible for the development and implementation of new strategies for increasing the energy efficiency in Bulgaria.

3) Demanded Side Management (DSM):

DSM is a powerful tool among Bulgarian industries and retail electricity customers, which has been highly underestimated until now. However, initial studies point out to various opportunities for improvements in Bulgaria. Apart from reducing the cost of energy for bulk power consumers, DSM will also help reduce the additional capacity required for supplying reserves and daily peak loads. Second, immediate steps toward DSM and increasing the efficiency of electricity

consumption in residential areas should be mandated. It is perceived that the life style in Bulgaria provides many opportunities for energy saving and peak load shaving.

4) Load Following Capabilities:

One of the most important technical issues in electricity markets is the possibility of load following in a competitive environment. Currently, HPP units are used in Bulgaria for covering the peak demand, which constitutes a small portion of the overall installed capacity. Because of the low rainfall in recent years HPPs work with half of their installed capacity [15]. There are no reasons to believe that this tendency will be reversed in the near future. After restructuring and full liberalization of prices, it is expected that the demand curve in Bulgaria will become very volatile. This will be mostly because of the uncertainties and difficulties in the economy. As a result it is possible that in very dry years the available HPP will not be capable of covering the peak demand of the system. In this respect it is desirable to plan new generating facilities with short start-up and ramp times based on natural gas.

5) Ecological Problems:

The restructuring naturally brings out the concern with ecological problems. This problem is especially significant in Bulgaria whose environment is heavily polluted. The problem is that most of the agencies that are responsible for controlling the environment are newly established and lack sophisticated equipment, experience and staff. Accordingly, the next technical issue bears a significant place in electricity restructuring.

6) Education and Training of New Staff:

The actual reforms are implemented not by laws and directives, but by people. In this respect, the shortage of qualified staff that would be capable of fast and reliable implementation of reforms can be a significant obstacle for restructuring in Bulgaria. The problem should properly be addressed and appropriate steps should be taken to solve manpower shortages.

VIII. CONCLUSIONS

This paper presents a brief analysis of the electric power restructuring in Bulgaria. The presentation discusses some of the bottlenecks for restructuring in Bulgaria. The major problems are divided political and technical issues. The paper provides the following suggestions for initial enhancements in the Bulgarian restructuring process and improving the energy sector in Bulgaria:

- Unbundling of electric power generation, transmission and distribution and creation of conditions for establishing a complete transmission open access
- Establishment of competitive markets for electricity products and prices
- Establishment of more specific laws and less regulations for managing commercial power companies
- Establishments of more reforms and less regulations for sales and purchases of electricity in Bulgaria
- Facilitating electric power price forecasts (both long-term and short-term) as a basic factor for privatization and the expansion of the energy infrastructure in Bulgaria
- Encouraging foreign investments for the rehabilitation and construction of generation and transmission capacities in Bulgaria.

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Stoyan B. Bekiarov completed his MS degree in Bulgaria and is currently pursuing his PhD degree in the Electrics Power and Power Electronics Center at IIT.

Mohammad Shahidehpour is the director of Electric Power and Power Electronics Center at IIT. He has written extensively on electricity restructuring. He is an IEEE Fellow.