

LEBANON ENERGETIC PROBLEMS AND WAYS OF DECISION

**Buslova N.V., Candidate Of Technical Sciences, Associate Professor,
AL Boukhari Rami, undergraduate**

NTUU "KPI" department of electrical networks and systems

Introduction. Electricity of Lebanon EDL (Électricité Du Liban) is a public institution with an industrial and commercial vocation under the control of the Ministry of Energy and Water. It was founded in July 10, 1964, and mandated the responsibility of the generation, transmission, and distribution of electrical energy in Lebanon. the electricity sector is monopolized by Electricity of Lebanon Company that, currently, controls over 90% of the Lebanese electricity sector (including the Kadisha concession in North Lebanon). Other participants in the sector include hydroelectric power plants owned by the Litani River Authority (public company), concessions for hydroelectric power plants owned by Ibrahim and Al Bared (private companies) that sell their electrical production to EDL, and distribution concessions in Zahle, Jbeil, Aley, and Bhamdoun [EDL website], where EDL provides them with energy at reduced prices 50 to 75 LL/kWh as compared to the real cost of 255 LL/kWh.

The aim of this work is to make the survey of Lebanon energetic, describe its problems and feasible ways of decision.

Materials of work. Energy system of Lebanon includes thermal and hydraulic generation plants, electrical networks with voltage 400 kv, 220 kv, 150 kv and 66 kv. Currently, power generation plants are divided into two categories thermal and hydraulic. There is 6 thermal power plants, two combined cycle gas turbine plants combined cycle gas turbine, deir ammar and zahrani. Designed to operate using natural gas, these two plants are using gas oil/diesel instead. Two steam turbine plants, Zouk and Jieh, which operate using heavy fuel oil. Two open cycle gas turbine plants, Baalbek and tyre, which designed to operate using gas, they are using gas oil/diesel instead. In addition there is a steam turbine power plant, Alhreesha, which is owned by Kadisha and uses heavy fuel oil. The total installed capacity of these thermal power plants is 2038 MW. The hydraulic power plants are divided into litani, Al bared and Ibrahim, and Kadisha power plants. these hydro-power plants have total installed capacity of 273.6 MW. Zouk capacity 607 MW and jieh capacity 346 MW, ALhreesha 75 MW, Tyre 70 MW. Baalbek 70 MW, Zahrani 435 MW, Deir Ammar 435 MW. There is 2 installed hydropower plants, Awali 108 MW, Joun 48 MW, abed al 34 MW, Al Bared 13.5 MW. AL Bared2 3.7 MW, SAfa 13.7 MW, Balouza 8.4 MW, ABu ALI 7.4 MW, Mar Lichaa 3.1 MW, Bacharre 1.6 MW, IBrahim 32.5 MW. The power from plants transmits by airlines and cable lines. The length of airlines 220 kv is 290 km, 150 kv – 292 km, 66 kv – 754 km and the length of cable lines 220 kv – 60 km, 150 – 39 km, 66 kv – 180 km. Energy system of Lebanon has commutation lines with Syria with voltage 400 kv, 220 kv and 66 kv and from Syria commutation with Egypt, Jordan and Turkey.

Before 1975, eleven major power stations, linked in a common distribution network, supplied most of the country's electricity. In 1974, EDL produced 1700 GWh of

electricity, while smaller power companies produced about 0.296 GWh. In that year, 41.5% of the produced power was hydroelectric. However, during the civil war (1975-1990), the electricity sector infrastructure was subjected to a great damage and disregard. After that, a major rehabilitation plan (Power Sector Master Plan) was launched between 1992 and 2002. It involved the rehabilitation of the transmission and distribution networks as well as the expansion of generating capacity. However, this plan proved to be insufficient and deficient as the demand still exceeds the supply, where blackouts are common all around the year and in some cities reaching 13 hours per day [World Bank 2009a]. Self generation is estimated to represent up to 30% of all electricity generated [World Bank 2009b] and plays a very important role for many Lebanese to assure their need for electricity. Thus, the Lebanese are paying a double electrical bill, one for the EDL and the other for the back-up self generation that is almost twice the EDL bill. Moreover, considering this fact and given the low prices of electricity in the region, the Lebanese consumer currently pays the highest electricity bills, while unfortunately, experiencing the most unreliable and lowest quality service in the region. Losses on the grid are reported amounting to 40%, 15% corresponds to technical losses while the remaining are non-technical losses [MEW 2010]. Although non-technical losses are high, they have been substantially reduced during the last decade when they were estimated to be approximately 48% [Badelt and Yehia 2000]. Non technical losses are attributed to either electricity consumed through illegal connections, meter manipulations, or are consumed without being billed due to the shortcomings in the billing system. As stated before, the generation of electricity in Lebanon started to grow with a high rate since 1990, achieving a production of 10,5TWh in 2003 [ALMEE 2006]. In that year, 87% of the electricity was produced with oil products, mainly gas, diesel and fuel oil and the remaining 13% was produced with hydropower plants. The share of hydro power to overall electricity generation fell down to about 4.5% in 2009 [MEW 2010]. A research conducted by CAS (Central Administration for Statistics) stated that 5- 12% of electricity production comes from hydropower energy depending on rainfall and thermal plants productivity. The distribution of electricity among different sectors is: 45% for residential and business sectors (i.e. low-voltage demand), 23% for industry, 12% for administrative buildings, 5% for concessions, and 15% for technical losses [Abi Said 2005]. A document of the World Bank stated that at least 50% of the electricity went to residential and business customers, while the rest was divided (from higher demand to lower) between industrial, administrative buildings, and concessions, respectively [World Bank, 2008]. Other sources place residential demand higher at 65–73% of total electricity consumed [Hourri and Korfali 2005], or 80% if combined with the commercial sector [Hourri 2006].

Thus, there is a serious deficit in the generation capacity to meet demand. It is noticed that the demand increases versus a decreasing rate of supply and this fact increases the shortage gap and exerts large pressures on the government and society. There is a limitation and clear aging of two out of four major thermal groups that existed before the civil war (Zouk and Jieh). This limitation has led to an increase in the daily cost of maintenance and to a dramatic increase in technical problems and severe decrease in plant efficiencies. Despite the fact that four of

the generation plants were designed to use natural gas, they are being fuelled by expensive gas oil (diesel) which causes high generation costs. This is because natural gas is not yet effectively available .Absence of periodic preventive maintenance. In most cases, low quality fuel is used .Plant availability factors are far below normal international acceptable values .Load factors (i.e. ratio of actual output to potential output) are low, thus leading to a shortfall in the overall generation capacity .There are significant shortfalls in thermal efficiency which raise the production cost .The lack of proper and clear administrative orders to request fuel shipment on time. Moreover, oil installations (Zahrani and Tripoli) were forced to provide Electricity of Lebanon with the stock market prices and the transfer of fuel in tanks, leading to additional losses.

Conclusions. The immediate substitution of diesel oil by Natural Gas for operating Deir-Ammar and Zahrani thermal power plants. Rehabilitation of the existing power plants in Jieh and Zouk .Develop new hydro and thermal power plants .Establish regional electricity interconnections with the neighboring countries (Syria, Jordan, Egypt, Turkey). Increase of flexibility and diversify of the power supply system in order to cope with insecurities in power supply (by sources of energy, sizes, plant types, operators, etc.) Adopt a decentralized policy for energy production that allows commercial renewable energy investment in power generation and collection of fees. Establish operating guidelines for the informal electricity sector (private generators) that will protect and benefit consumers while ensuring continued availability of this alternative source .

Reference. Électricité Du Liban (<http://www.edl.gov.lb/>) and Farouk Fardoun, Oussama Ibrahim, Rafic Younes, Hasna Loualia- Gualous, Department of Industrial Engineering, Institute of Technology, Lebanese University, Saida-Lebanon Department of Mechanical Engineering, Lebanese University, Beirut, Lebanon Université de Caen Base Normandie, IUT de Cherbourg Manche, Saint Lô, France.