

Fédération Internationale pour la Sécurité des Usagers de l'Electricité International Federation for the Safety of Electricity Users Federacion Internacional para la Seguridad de los Usuarios de la Electricidad





Safety in Renewable Energy Integration into EDL's Grid

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المتحدون المانجون

- Main problems the Sector is facing
 - Administrative due:
 - The complicated laws and regulations dating from 1972.
 - The strategy of the Lebanese government to stop recruiting in the public sector that has been adopted since 1985 till now with a little exceptions.
 - The lacking of qualified human resources.
 - Financial:
 - A fixed tariff set in 1994 and has not been modified since.
 - The inability to reduce non-technical losses on our distribution network due to political and security concerns.
 - <u>Technical</u>:
 - the lack of major investments in the production, transmission and distribution sectors between 1998 and 2010.





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- The policy paper- way to improve the Electricity Sector in Lebanon:
 - It's a roadmap policy paper that was developed in the year 2010.
 - It presents a realistic implementation program for the fundamental rehabilitation and development of the electric sector in Lebanon to respond to the economic and social needs and objectives of the country.
 - The roadmap represents the foundation of the integrated national energy program that aims to modernize, restructure and rehabilitate the utility in an attempt to make it technically stable and economically profitable.





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- > Policy Paper 2010 Short Term Plan
 - The short term plan or the emergency plan that was issued in the year 2010 and financed by the Lebanese government through the law # 181, was a must to increase the production by 800 MW with all the corresponding investments in the transmission sector.
 - Most of the short term plan investments has been executed, like the reciprocating engines power plants in Zouk and Jeih with a total installed capacity of 270 MW and the three 220 kV substations in Daheih, Achrafeih and Behsas, and most of the 66 kV OHL in north Bekaa and Akkar.
 - In addition to the two 220 kV substations in Baalbek and Saida from the previous strategic plan.



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Master Plan Transmission 2017-2030:



- EDL requested EDF to prepare the Transmission Master to cover the period till the year 2030 based on the existing power plants locations in Deir Amar, Zouk, Jeih, Zahrain in addition to a new location in Selaata.
- The Transmission Master Plan designated all the necessary investments in Transmission that are required to evacuate the additional generated power from the new power plants to reach the demand centers.
- The Council of Ministers adopted the transmission Master Plan in September 2017.



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- > Policy Paper Update 2019.
 - The Ministry of Energy and Water in collaboration with EDL issued this updated policy paper which was settled after coordination with the World Bank and was lately approved by the Council of Ministers.
 - This policy paper aims to achieve three major cornerstones which will work in parallel;
 - Reducing the technical and non-technical losses and increasing the bill collections.
 - Increasing the Generation capabilities with higher efficiencies relaying on Natural Gas to reduce the cost.
 - Increasing the Tariff.
 - This roadmap is the last chance to overcome the major problems that the sector has been facing for the last four decades.







Beirut - Lebanon

> Renewable Energy

- The Lebanese government committed to adopt the utilization of renewable energies to reach:
- 12% of electric supply by the year 2020.
- 30% by the year 2030.









- Renewable Energy
 Beirut River Solar Snake
 - A Photovoltaic PV farm of 1 MW is in operation now.
 - It's planned to extend the farm to reach 7 MW, (Bids are under evaluation).







- Renewable Energy
 Electricity from waste
 - Landfill Power Plant in Naameh 7 MW .







- Renewable Energy
 Electricity from waste
 -Incinerators-
 - Planed incinerator in Beirut 60 to 70 MW
 - Several 5 to 10 MW
 Incinerators are planed in several places of the country.









Renewable Energy - Round one:

- 220 MW of wind farms in Kobaiyat, contracts were signed in the year 2018.
- 12 PV farms 10 to 15 MW each with a total capacity of 180 MW, still under technical evaluation.





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Renewable Energy - Round two

An expression of interest was lunched for round two:

- Wind Farms 200-400 MW.
- 3 PV farms 100 MW each with a storage capacity of 70 MWh for each one.





- Renewable Energy Hydro Power Plants:
 - Several hydro power plants, the 4 major plants are:
 - Janeh Dam ~100 MW
 - Boqaata Dam ~21 MW
 - Hdaine Dam ~24 MW
 - Daraya Dam~25 MW
 - The expected power generated from the planed 4 major hydro power plants is around 170 MW.











- Renewable Energy Hydro Power plants:
 - The expected power generated from the planed four major hydro power plants is around 170 MW.







- Safe Integration of Renewable Energy.
 As mentioned before the Lebanese
 Government committed to adopt the utilization of renewable energies to
 reach 12% by 2020 and 30% by
 2030 from all resources :
- Wind Farms
- PV with Storage
- PV farms
- Hydro Plants





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- Safe Integration of Renewable Energy-Wind Farms "Round 2"
 - Expected locations for "Round 2" Wind Farms are based on the wind atlas where the highest capacities are in Jabal Akkroum in Akkar, Rachaya, Marjoun and some locations in mount Lebanon with an approximate installed capacity between 200 to 400 MW.







- Safe Integration of Renewable
 Energy- PV Farms with Storage
 300 MW
 - Expected locations of PV farms with Storage with total capacity of 300 MW and 210 MWh. are expected in North Bekaa and in Akkar because of the high solar radiations, and also because of the relatively cheap lands.







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- Safe Integration of Renewable
- Another area of interest for PV farms is Tfail, located on the eastern border with Syria, with advantage that the land is entirely owned by Lebanon's Central Bank, from land ownership perspective, and it's ideal location for possible electricity trading with Syria in the future.
- The disadvantage is that its far from the grid with large capacity where it's integration requires a load flow study.







لبناو

- Safe Integration of Renewable Energy.
- Reinforcement of the Transmission Network for power evacuation
 - All these additional Renewable energy sources that could exceed 1000 MW in the future, requires to reinforce the Grid and specially in middle and north Bekaa to increase its evacuation capacity.
 - Accordingly EDL will lunch soon an addendum on the Transmission Master Plan which was approved by the council of Ministers in 2017.





Safe Integration of Renewable Energy
 The influence of Connecting Wind Farms on the Grid,



- Voltage Fluctuation
- Harmonics







> Voltage Fluctuations



- Voltage Fluctuations are the main problem associated with wind power. This can be the limiting factor on the amount of wind power which can be installed on a Grid.
- Voltage fluctuations are:

o Flicker during operationo Flicker due to switching

• The allowable flicker limits are generally established by individual utilities.



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> Harmonics

- Harmonic disturbances are a phenomenon associated with the distortion of the fundamental sine wave and are produced by non-linearity of electrical equipment. Harmonics causes increased currents, power losses and possible destructive overheating in equipment.
- Power electronic converters are used in variable speed wind turbine systems where the harmonics can be easily removed by smaller filters.
- In general harmonic standards can be met by modern wind turbines.



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Beirut - Lebano

> Impact on the Grid

- Integration of large scale wind power may have severe impacts on the power system operation.
- Traditionally, wind turbines were not required to participate in frequency and voltage control.
- Some Grid Codes have been defined to specify the steady and dynamic requirements that wind turbines must meet in order to be connected to the Grid like :
- Capabilities of contributing to frequency and voltage control by continuous modulation of active and reactive power supplied to the transmission system.
- Power regulation rate that a wind farm must provide.







- FISUEL GAM 2019 Beirut - Lebanon
- Existing situation of EDL's Network and its weak points towards integrating Wind Farms on large scale.
 - Deficiency in generation which is leading to load shedding, where there is no dedicated power plants to participate in voltage and frequency control since most of them are working in Base load regime , hence the ability to overcome the rapid variations of wind power production is very limited.
 - Lacking the Network stability due to the un achievement of the 220 kV network.





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- Existing situation of EDL's Network and its weak points towards integrating Wind Farms on large scale.
 - Renewable energy challenges conventional methods of dealing with contingency where it was traditionally defined as the loss of the largest generation unit.
 - Renewable energy generation is spread over many wind turbines, solar farms so that a "largest generation unit" cannot be identified.
 - The largest loss that can occur is 100% of the wind generation; if this represents 20 to 30% of the total capacity and it occurs during peak demand, this loss cannot be handled by ramping up conventional power reserves, and leads to a total "Black Out".





The steps to be taken to overcome the influence of Wind Farms integration on EDL's Grid



- Closing the 220 kV ring in Mansourieh and operating both circuits in Bekaa under 220 kV. The second circuit in Bekaa is expected within 6 months.
- Achieving the balance between Generation and demand with reserve power and that by implementing the Ministry Plan for Generation, Hence achieving the capability to overcome the full or partial unavailability of the expected integrated renewable energy like Wind Farms and PV farms.





The steps to be taken to overcome the influence of Wind Farms integration on EDL's Grid



- Interconnection with the neighboring electric power systems (7 connected countries) which leads to:
- Availability of large scale Power exchange, hence reducing the percentage of renewable with respect to the volume of the unified network and thus reducing its bad impacts like the voltage Fluctuation.





- The steps to be taken to overcome the influence of Wind Farms integration on EDL's Grid.
 - Energy Storage is an additional developed method of ensuring reliability of the Grid.
 - As renewable energy penetration grows, the increasing mismatch between variation of renewable energy resources and electricity demand makes it necessary to capture electricity generated by wind, solar and other renewable sources for later use.
 - Storage can help in achieving smooth fluctuations in both wind or solar energy generation.





- The implementation of new technologies to tackle the stability problems of electrical Grid are essential like:
 - Static voltage control under various load conditions (SVC).
 - Static VAR compensator to compensate the unwanted reactive power and accordingly transmission losses.
 - Frequency Stabilizer including active power storage and injection that helps in damping the active power oscillations hence eliminating the need of must-run-unites since this equipment bridges the time gap until primary reserves are fully available preventing from Black-outs.
 - Short Circuit Current Limiter, by triggering Thyristor switch to insert high impedance to limit the current, thus short circuit current ratings for existing infrastructure can be kept.



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THANK YOU MERCI



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