RESEARCH AND STUDIES REGARDING THE OPTIMIZATION OF WIND SYSTEMS

ABSTRACT

Electricity generating companies seek different sources of alternative energy production in terms of energy price instability and changes the regulations on environmental protection.

Corporates are restructuring the electricity production, the evolution of the technology optimization of wind systems, recent policies on the environment provides a basis for progress integrating wind energy sources as important option in the near future.

The European economy is based on safer, cleaner, more competitive and sustainable energy sources. Energy priorities tend to ensure a functioning, stable and continuous European internal market.

Under the circumstances, the theme of the thesis concerns the current optimization of the operation of wind systems. The thesis deals with a wide range of issues analysis operating modes including the special situations that may occur in the transitional arrangements.

All methods used are based on a rigorous theoretical approach, in the end will realise and implement software tools for general application.

The thesis is structured in 11 chapters, a preface and a list of references that includes representative works, classics but also there can be found recent works, that can be found in magazines published in the country or abroad.

Chapter 1 has an introductory character. It includes framing and justification topic that is the subject of doctoral thesis in the context of the current state of the development of power systems and the concerns existing in the world and in our country, summarizing the contents of each chapter of the thesis. Finally it highlights both: the data of research in the doctoral thesis (publications, research contracts, software tools) and the prospects for future research directions.

The second chapter is devoted to analyzing the current state of research on wind power systems. The analysis is based on the market situation in liberalized its energy and the need to ensure energy security for the future compliance with national and international standards environmental protection. The current energy issues are amplified becoming more complicated due to exhaustion of the classic energy resources: oil, gas, coal, uranium, etc. By analyzing the literature it has been found that in all work is expected to be captured a maximum energy from the wind. It tends, therefore, to work with wind power systems at full power. It represented Romania's energy strategy in the field of renewable energy.

In the 3rd chapter is a synthesis of the main issues relating to the integration of renewable energy of high power in the current power systems. It examines the wind and the default wind power. They are presented the depletion of fossil fuels and also implications of technical, economic and environmental issues related to renewable energy.

There are analyzes global issues and also the one specific for Romania.

Particular attention is given to protecting the environment especially as it is significantly polluted by the energy sector. Energy policies of the EU and Romania support significantly the implementation of renewable energies, mainly wind and solar energy.

In chapter 4 is determined the mechanical energy of the wind turbine captured and converted into electricity by a permanent magnet synchronous generator. By determining the system load, the energy obtained is maximized is one of the problems that can be found in this chapter. By using simulation is determined the optimum mechanical angular velocity and optimum load resistance, for the generator, where the energy is maximum considering the wind speed variable in time.

Chapter 5 is devoted to determining the value of the speed at which maximum energy is captured. This is the fundamental problem in any system of performance management. Because wind speed ranges as value in time and the optimal speed changes in time. Driving optimal in terms of wind energy system can be achieved in a timely manner, if known dependence value optimum speed to the wind velocity. Determining the relationship between wind speed and the optimum speed is the main objective of this thesis.

In chapter 6 the objective is to determine the optimal mechanical angular speed at which maximum energy is captured. The energy calculation is made by integrating power in a period of time of the oscillation given by the value of the wind speed. On the basis of the optimum speed can achieve an optimal driving. By determining the optimal operating speed, in terms of energy, the essential question is wind systems operating at different wind speeds over time. Mechanical angular velocity dependencies are analyzed (VUM). VUM wind speed decreases corresponding to maximum energy.

In chapter 7 is given a way to use the wind energy by hydraulic energy storage. In this way there is no longer a question of power fluctuations that occur at wind speeds time-varying fluctuations that disrupts the operation of the national power system (RPS), especially at wind speeds varying significantly over time, as the Romanian case. The system consists a wind turbine coupled with a permanent magnet synchronous generator (TV + GSMP), which discharges an electrical power asynchronous motor / synchronous coupled with a water pump. The question of determining speed, called the reference so as to achieve a maximum capture of wind energy on a large time interval (days). Pursuit of the maximum power at wind speeds variable in time, leads to values of time-varying powers, where the energy system is a destabilizing element.

For this reason it is necessary that power fluctuations to be stored in an energy storage system. It may be a hydro nature with two water tanks at high power, rechargeable battery or electric accumulators at medium and small power. It determines the behavior of the system (TV + GSMP) considering the speed / angular velocity of mechanical optimum, as well as the reference size in a leading system. There is an optimum wind system driving, so as to extract the maximum of mechanical energy at wind speeds varying time. The structure of leading is based on measuring wind speed and uses a momentary original model turbine wind .

In chapter 8 is can be found an analysis of the dynamics of wind systems operating at varying wind speeds in time. This analysis is based on numerical simulations based on the equation of motion. The leading system is achieved with regulators PI having as size reference angular speed mechanical VUM, the generator, based on measurements of wind speed in terms Getting maximum energy simulations is granting regulators, considering the wind speed variable in time.

In chapter 9 is given an original method for estimating wind power equivalent to systems operating at varying wind speeds in time. This method is based on a sample generator sitting idle, making it once the turbine stage of approval. Knowing the value of the speed at which maximum energy is captured, is the fundamental problem in any system of performance leading. The leading of a wind system requires optimal extraction (capture), an energy maximum wind speed varied significantly over time. This requires speed and torque control, also adjustment of the generator turbine wind speed. Determining speed data corresponding maximum energy turbine wind (TV), it is the main objective of this work. Check method given by simulations considering the wind speed varies in time.

Chapter 10 determines the areas of maximum wind energy systems operating at varying wind speeds in time. This analysis is based on numerical simulations that are based on the equation of motion. Based on measurements of the wind speed and of the generator speed can be defined two basic sizes: wind speed and optimum mechanical angular velocity the latter being a function of wind speed equivalent. By analyzing the temporal variation of the generator speed can be determined the optimal operation of energy efficient.

It states that each chapter ends with a final chapter, highlighting conclusions and original contributions.

The last chapter contains general conclusions of the thesis and presentation systematized original contributions of the author, and outlining directions and prospects for future research in this burgeoning field both technically and economically, the energy produced cost-effectively increased.

Theoretical and practical tests carried out in the thesis and the results achieved open a range of perspectives and directions for further approxi-foundation and further research in this field:

- analysis of the integration of renewable energy sources in other areas of SEN, depending on future developments in European and national level;

- analysis of the wind systems integration from the Baziaş-Orşova area in a micro-hydropower integrated separated of SEN, with hydro storage using for this power from the Iron Gates I;

- with the system can be achieved energy storage and wind at the same time act as powers vary according to the wind speed without affecting thereby the stability of the SEN;

- expanding software tool for old institutions that create energy using outdated technologies and operate under low energy efficiency in areas with high wind potential. Can be avoided energy loss and hence increase the effectiveness of wind farms, regardless of their strength;

-using mainframe systems for storage hydro power electric motors direct acting water pumps to large power variations due to variations of wind speed in time

- the optimum operation of energy efficient through a simple and highly effective: regulating the flow of water depending on the wind speed.