RESEARCH REGARDING THE DYNAMICS OF AERO-ELECTRIC AGGREGATES

ABSTRACT

Increasing global energy consumption and the permanent reduction of energy reserves, especially the fossils: coal, oil, natural gas, needs to attract new sources of alternative sources such as wind energy and solar power.

The issues addressed in this thesis by the author refers to the problems posed by wind power systems dynamics.

Recent studies show that annual wind speed that is complete and over 3 [m / s] makes the wind power systems vulnerable.

In developing the doctoral thesis were considered the following fundamental objectives:

-developing mathematical models of wind power systems;

-establish static limits and dynamic load changes;

-determining the nature, stable or unstable point (or points) of operation;

-development of control systems static and dynamically stable so that voltage and the frequency are within the limits;

-simulating wind power systems with variations of electric charge;

-analysis of wind power systems in existing literature and based on them for designing new systems;

-designing schemes to achieve maximum power operation of the TV;

-simulations of wind power systems on modifining wind speed and the load to the generator

-presenting the author's contributions in theoretical modeling issues, simulation and estimate the dynamic stability of the wind power systems.

Theoretical contributions: modeling and simulation of wind power systems also dynamic stability analysis of these systems, correlating the results with those of transition phase, gives this thesis an original character and practical application in renewable energy resources.

The proposed objectives are structured the thesis in 11 chapters whose content is briefly given below.

Chapter 1 illustrates the opportunities and objectives of the thesis and mentiones the importance of obtaining electricity from wind energy, renewable source that has high potential in Romania.

Chapter 2 presents the current state of research in this area. They are analyzed the most important works, on which the author will build mathematical models for analysis of wind power systems. Mathematical models of turbines and generators are designed by the author for the general case –phases.

Chapter 3 provides a summary of the main issues relating to integration of renewable high power energy sources in in power systems. It will examine wind energy and also wind power (CEE).

The aim of chapter 3 is to provide a summary of key issues relating to the integration of renewable high power energy in the current power systems. It will examine wind energy and also wind power (CEE). There are presented legislative problems, economical issues and technical matters. Given that the demand for energy is increasing the use of renewable energy sources (RES) is the solution to ensure energy needs and ensure safe operation and high efficiency power systems. There will be examinated the technical, economic and legislative aspects that are specific for Romania.

Chapter 4 analyzes the dynamics of a wind system and electrical energy stored in batteries for time-varying wind speeds. For low power and isolated areas the wind energy that is stored in batteries is optimal solution in terms of economic. The mechanical energy captured by the wind turbine is converted into electricity by permanent magnet synchronous generator. Permanent magnet synchronous generator debited by means of a rectifier, energy in a battery AE, in two versions: version 1- uncontrolled rectifier and version 2 -controlled rectifier and matched load. The simulation will determine the differences between the two versions.

Chapter 5 analyzes the dynamic processes and will give methods to run the wind power systems, EEA, based on the measurement of wind speed and the speed of the generator. By determining an equivalent wind speed will determine the optimum speed in energy terms, so the generator load changes to ensure the optimum operation.

Chapter 6 will estimate of the maximum wind energy systems operating at varying wind speeds in time. It will determine the speed at which maximum energy is captured. This requires speed control, torque turbine and adapting the generator to the wind speed. The determination of the appropriate speed for the maximum power given by the wind turbine is the main objective of this thesis.

Chapter 7 is focused on the dynamics of wind systems that operate at wind speeds time-varying. This analysis is based on numerical simulations that are based on the equation of motion. Based on measurements of the wind speed and the generator speed can be defined two basic sizes equivalent of wind speed and the optimum mechanical angular velocity, being a function of wind speed equivalent. Will givestudies

for capturing a maximum energy for a long period of time for wide variations of wind speed.

In chapter 8 the foundations of basic knowledge on the dynamics of a wind system for introducing the concept of equal power turbine, associated with the wind speed variable in time. The trial operation gives particularly useful information on the characteristics of wind turbine power and can determine the areas of maximum power at wind speeds time-varying by knowing the optimal speed.

In chapter 9 is determined electrical energy stored in batteries for a wind system operating at wind speeds time-varying. The mechanical energy captured by the wind turbine is converted into electricity and stored in a AE battery in two versions: version 1- uncontrolled rectifier and version 2- controlled rectifier and matched load. Simulation determines the differences between the two versions.

Chapter 10 is devoted for determining the optimal VUM from VUM stabilized sitting idle, obtained from speed measurements. Knowing the VUM of sitting idle, steady, is defining an equivalent speed, based on the actual speed of the wind.

The last chapter contains the general conclusions of the thesis and systematic presentation of original contributions of the author, outlining directions and prospects offered for further research, applying the results and experience gained. This chapter defines the importance of the contributions that the author brought. Except for the first two chapters, presenting the opportunities and the objectives that are a synthesis of the literature in this area, all other chapters are entirely original contributions for the dynamic analysis of wind systems operating at varying wind speeds over time. The research results were capitalized as part of research contracts concluded between "Politehnica" University of Timisoara and Thomson ISI and 3 other BDI.

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

-implementation of optimization methods in terms of energy and wind power plants currently operating in low yields;

-expanding software tool for dynamic analysis of the wind systems for the design phase and the operational phase.

- use the results for a design of an optimal control systems in terms of energy;

-implementing simple solutions and highly economic systems with electrical energy storage in batteries.