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Algeria's Satisfaction with the Valorisation of Renewable Energies in the Field of Electrification of Remote Regions of the Paid

Ahmed S[1]* and Nasser TM[2]

[1]*Department of Science, University Tahri Mohamed Béchar, Béchar, Algeria*
[2]*Department of Electrical Engineering, Tahri Mohamed Béchar, Béchar, Algeria*

Abstract

The diesel generator is the only way used for the production of energy in isolated sites and remote areas, Saharan Africa of the paid Algeria. Our goal is study and designs a power plant Production of mobile autonomous electricity, hybrid plant, which combines two renewable energy sources (wind, photovoltaic) and a diesel engine backup with storage. The objective of the work is the first step in our goal. We have simulated the conversion wind turbine by adopting the continuous model Converters. To control the DC bus voltage and the exchange of active and reactive powers, we have implanted proportional correctors integral.

Keywords: Renewable energy; Wind turbine; PV; Electrification isolated

Introduction

In most remote and remote areas such as the Algerian Sahara, the diesel generator is the main source of electrical power. For these regions, the price of extending the electricity grid is exorbitant and the price of fuel increases gradually with isolation. Over the last decade, the use of renewable energies has been effective in solving energy supply problems. Solar and wind energy sources are ubiquitous, freely available and respectful of the environment, these regions have a high solar and wind energy potential, which pleases in favor of the development of systems with renewable energy sources in these regions. It is then necessary to know the contribution of each source (photovoltaic and wind) to feed the load in order to bring out the optimal variant, taking into account the economic factor. The hybrid electric power generation system, in general, is one that combines and exploits several available sources. The system we are interested in is purely renewable, that is to say that of source of Wind and sun with a storage system explained in Figure 1.

The production of electricity from renewable energies, essentially this produced by wind energy, plays the role of complement to the productions of classical energies. The exploitation of renewable resources is gaining momentum in industrialized countries and even in some underdeveloped countries estimating wind energy resources presents a major challenge. Unlike fossil fuel reserves, the quantity of available energy varies with the season and the time of day, that it is wind dependent which an element whose study proves to be very complex, its characterization is a function of several parameters such as the measurement of the wind speed and its direction, the effect of the roughness of the ground, the effect of the obstacles, the effect of the stability of the atmosphere, etc. It is clear that in order to determine the wind potential of a sit, by the statistical treatment of wind speed measurements [1].

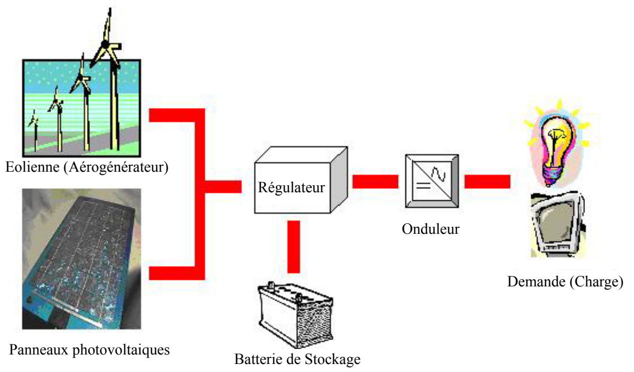

Figure 1: Synoptic diagram of the hybrid system.

Wind energy is further influenced by topography than solar energy. Moreover, the total amount of wind energy convertible on a nation's territory depends significantly on the characteristics, expected efficiency, sizing and horizontal distribution of the wind turbines [2].

The objective of the work is to study a wind power plant and then simulate the system under the Matlab-Simulink software and we present the results obtained for different cases (winter day, summer day or during the year) applied to isolated areas explained in Figure 2.

Description of the Energy System Used in the Production of Wind Energy

Wind turbines always use a synchronous or asynchronous squirrel cage generator as a generator; a wind turbine is constituted by a tower (Carrying element). At its top, the nacelle (active element) is fixed. The nacelle consists of a system of transformation of the wind energy into electrical energy with its control (The tower of the wind turbine is conical). Cables for transporting electrical energy, the control and control elements, the low voltage.

Distribution network connection equipment, are arranged inside the tower [3-6]. The wind turbine has two most commonly installed technologies.

Fixed-speed wind turbine

The is type of wind turbine therefore offers virtually no of the

***Corresponding author:** Ahmed S, Professor, Department of Science, University Tahri Mohamed Béchar, Béchar, Algeria, Tel: 226545641; E-mail: ahmed1976alg@yahoo.fr

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possibility of adjusting the generated power, especially since the direct connection to the network of an asynchronous generator requires the addition of banks of capacitors in order to limit the reactive power called to this network (Figure 3).

A variable speed wind turbine based on a MADA

High-power wind turbines connected to medium and high voltage networks based on a MADA (Double Asynchronous Machine) and operate more and more frequently at variable speed. In order to maximize the converted power, the speed of the turbine must therefore be adapted to the wind speed.

Conversion of Wind Energy in Electric Energy

The production of energy based on wind energy uses two energy systems fixed or variable speed. The production of electricity from wind turbines or wind turbines in an isolated site requires the use of the electrical machine - static converter unit [3,7]. We Know that the wind generates its wind energy, therefore, there is a relationship between wind speed and rotational speed, torque and power on the rotor of a wind turbine [8-12]. The mechanical power which can be extracted from the wind is determined by the following expression

Longitude (deg)	Latitude (deg)	V (m/s)
-8.10	27.40	4.6
0.28	29.25	5.1
6.13	33.12	3.3

Figure 2: Geographical map of Algeria (Geographical location of the regions studied).

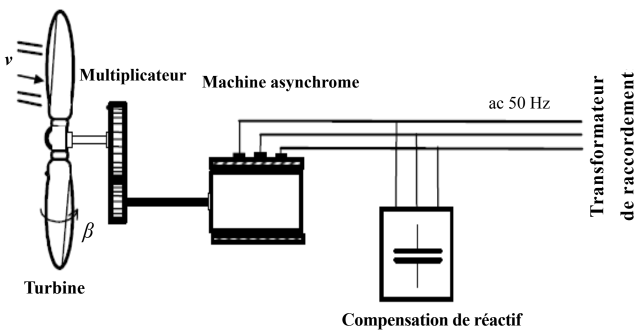

Figure 3: Fixed-speed wind turbine.

k	0	1.3	2.1	2.7	3.4	5	5.8	6.3
Cp	0	0.1	0.2	0.3	0.4	0.3	0.2	0.1

Table 1: k and cp coefficient values for wind turbine.

$$Pv = \frac{1}{2}\rho.S.V^3 \quad (1)$$

Or :

ρ: Density of air (kg/m^3),

S: Surface crossed by air (m^2), S = π.R2,

R: Radius of the rotor of the wind turbine,

V: Wind speed (m/s).

The power supplied by the rotor of the wind turbine is given by the following relation:

$$Pv = Cp\frac{1}{2}\rho.S.V^3 \quad (2)$$

Cp: Coefficient of power.

This coefficient depends on the shape of the rotor and the wind speed. It corresponds to the aerodynamic efficiency of the turbine, to a nonlinear evolution as a function of the speed ratio k, it is given by the manufacturer as a function of the type of sensor as indicated in Table 1 [12-15].

$$k = \omega\frac{R}{V} \quad (3)$$

Where

R: The radius of the turbine.

ω: The mechanical speed of the turbine

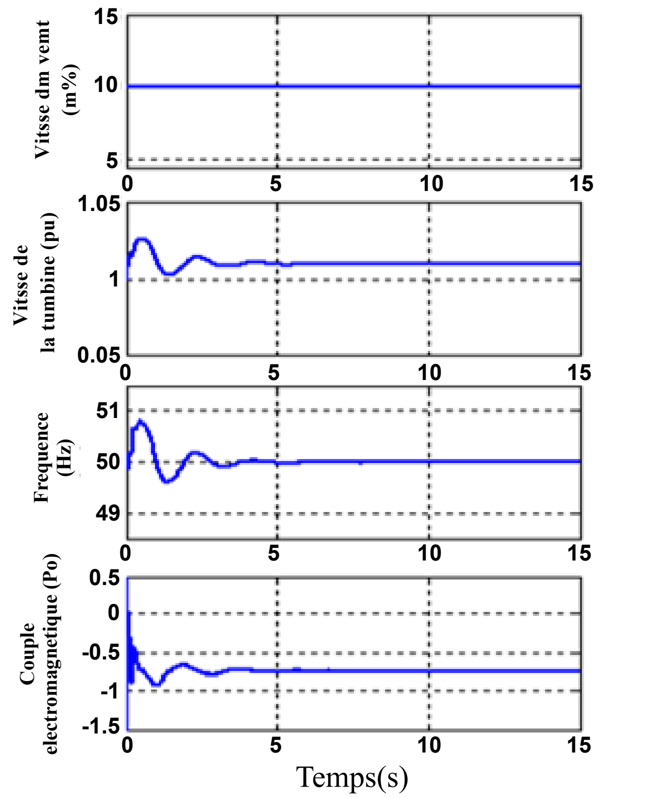

Figure 4: Waveforms of wind speed, turbine speed, frequency and electromagnetic torque for two cases of fixed speed and variable speed operation.

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The characteristic of the power coefficient varies with the orientation angle of the blades (β). The relationship (1) shows that a small variation in wind speed induces a large variation in the generated power [12,6].

Simulation and Interpretation of Results

A wind power plant is our model for a site isolated from SIMULINK /MATLAB. The choice of this example is suitable for application on isolated areas explained in Figures 4-8.

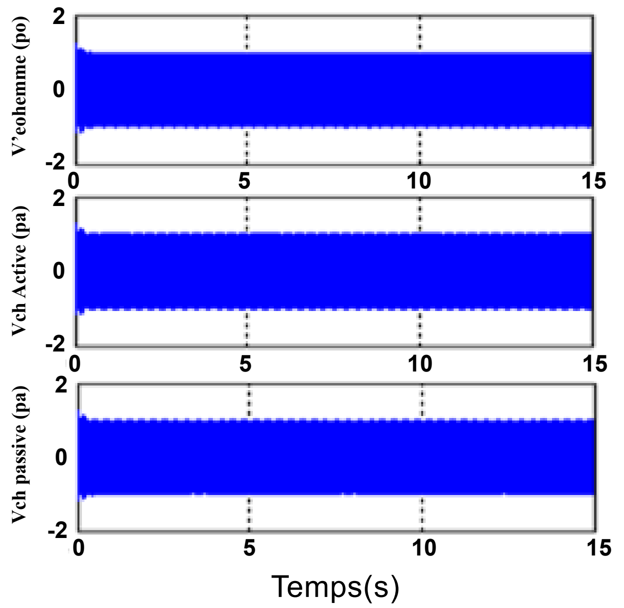

Figure 5: Waveforms of generator-side voltage, wind side and passive and active load terminals for two operating modes, fixed speed and variable speed.

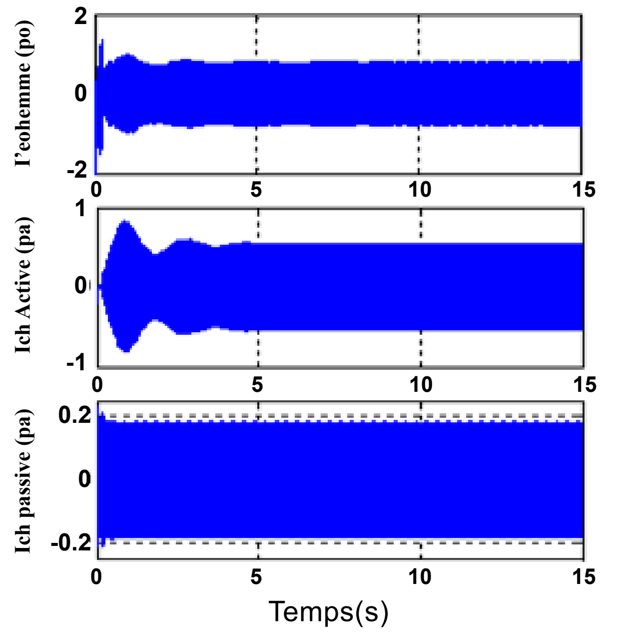

Figure 6: Waveforms of the generating side current, wind side and passive and active load terminals for two operating modes, fixed speed and variable speed.

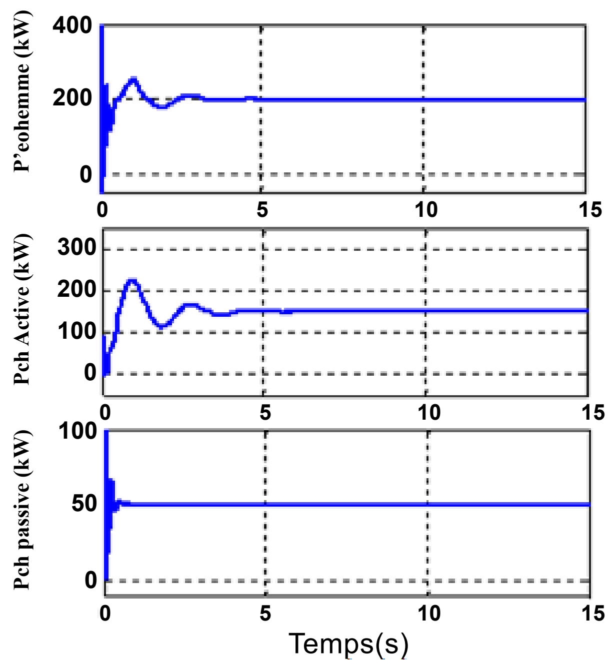

Figure 7: Waveforms of the active powers on the generator side, on the wind side and at the terminals of the passive and active loads for two operating cases, fixed speed and variable speed.

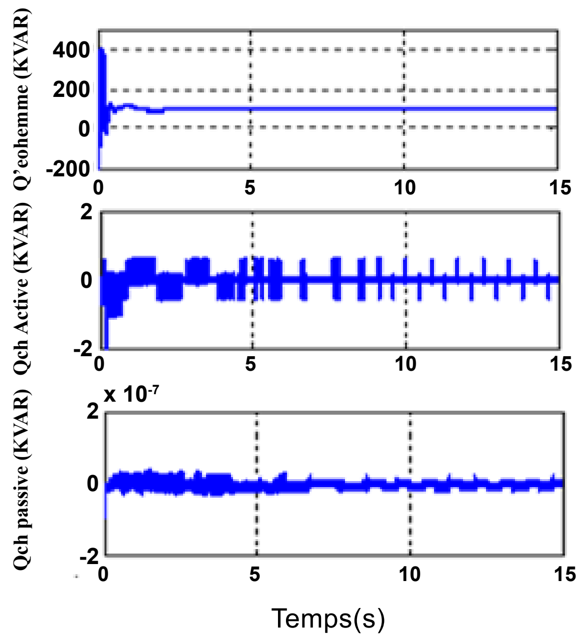

Figure 8: Waveforms of reactive power on the generator side, on the wind side and at the terminals of the passive and active loads for two operating cases, fixed speed and variable speed.

Conclusion

The simulation results show good functioning of the wind system. The voltage and frequency are kept constant and the load is continuously used during all operating modes. At the beginning of the simulation, the wind turbine starts to provide active power but remains insufficient. To compensate for the lack of power, we can add Gd the regulation of the voltage and the frequency in the case with constant wind is ensured by the Gd. In order to ensure optimum electrical energy quality and given the randomness of the wind, and to ensure our goal (mobile renewable energy station) will do our next job.

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