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Comparing SCIG and DFIG for Wind Generating Conditions in Macedonia

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Abstract – The wind energy has become the most potential renewable energy source recently. The technological and industrial development in the wind power generation indicates that wind power should be seen as one of the main domestic sources for electricity generation in all countries. This paper gives an overall observation of the most commonly used electrical machines, i.e. the squirrel cage induction generators (SCIG) and doubly fed induction generators (DFIG) in the wind generation systems. Using the Matlab/Simulink, a simulation of wind farm with the two types of generators has been made in order to compare the results and to comment on the best option based on the output characteristics of the generator and wind turbine.

1.Introduction

European dependency on imported fossil fuel as well as Macedonian as a part of Europe has become a threat to economic stability increasing uncertainties over energy prices. Environmental effects of fossil based power plants add another dimension of the problem. These power plants load the atmosphere with greenhouse gases resulting in global warming and climate changes.

For these reasons one of the key points on the European energy policy agenda is to increase the share of the energy demand that is covered from the renewable energy sources. According to the European Commission by 2020, 34% of EU energy demands will be covered by renewable energy sources (RES) and wind energy will meet 12% of EU electricity demands by 2020.

Most promising from the RES are the wind and solar energy. The difference between the conventional sources and these sources is that the primary energy of the RES has stochastic nature and the fluctuations are uncontrollable and permanent. Wind power is the most potential renewable source, very promising and mature renewable technology. Electricity is the commonly used energy source in the industry and in the private sector in Macedonia. Macedonia is highly dependent on energy imports (oil, natural gas, electricity) which have grown rapidly in recent years. The whole energy sources in Macedonia are based on conventional power plants. The approximate structure of coverage is 75% domestic electricity production (where 80% from coil TPP and 20% HPP) and 25% is provided by import. Inclusion of the renewable energy for electricity production will allow improved and more stable electricity supply and will reduce the energy imports.

2.Wind turbines

Most of the wind turbines use induction generators because of their advantageously characteristics. Induction machines are simple and rugged in construction, offer impressive efficiency under varying operating conditions, relatively inexpensive and require minimum maintenance and care. Characteristics of these generators like the over speed capability make them suitable for the wind turbine application.

The wind power captured by the turbine rotor and converted to mechanical power is dependent on the average wind speed over the rotor surface and the rotational speed of the rotor. Therefore maximum wind energy capture can be achieved only if the rotor speed is varied tracking the changes of the wind. Variable speed operation of the wind turbines is necessary to gain high efficiency in the generating systems. Additional advantages of the variable speed operation are the reduction of the drive train mechanical stresses which permits the use of lighter transmissions, the improvement of the output power quality and the reduction of the noise emitted from the wind turbines.

The induction generators that are used in the wind turbine are usually squirrel cage induction generators (SCIG) and in nowadays doubly fed induction generators (DFIG). Doubly fed induction generators have windings on stator and rotor where both of the windings transfer significant power between the shaft and the electrical system.

3. Equivalent circuit of asynchronous machines

It is often necessary to make quantitative predictions about the behavior of the asynchronous machines under different operating conditions. For this purpose it is useful to present an equivalent circuit for the machines in operating mode in a stationary condition (Fig.1).