TRANSIENT RESPONSE ENHANCEMENT OF A GRID CONNECTED WIND FARM USING FLY WHEEL ENERGY

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Abstract. This paper presents a novel adaptive neuro fuzzy interface system (ANFIS) controlled fly wheel energy storage (FESS) to enhance the transient stability of a grid connected wind farm. A doubly-fed induction generator (DFIG) acts as a FESS. The FESS controlling strategy is based on cascaded control scheme of an insulated gate bipolar transistor (IGBT) based voltage source converter (VSC). The controller proposed in this study is used to control the gate signals of all the IGBTs. The effectiveness of the novel controlling technique is justified by comparing the results with the conventional PI-controller. In depth modelling of the system and the control strategies are presented along with the simulation results. The validity of the system is substantiated from the simulation outcomes obtained from standard dynamic power system simulator (PSCAD/EMTDC) and MATLAB/Simulink respectively.

Keywords: adaptive neuro fuzzy interface system (ANFIS), fly wheel energy storage (FESS), insulated gate bipolar transistor (IGBT), voltage source converter (VSC), wind farms

INTRODUCTION

In recent years, wind energy has been the center of focus among different renewable energy generation alternatives. However, with the greater expanse of Wind Energy Conversion System (WECS) integration with the power distribution networks, it has become more important to have a reliable system which can regulate the variations in the output power supplied to the grid under fluctuating wind speeds [1]. One of the most highlighted issue in wind power generation is the irregular and inconsistent nature of the wind speed. As we know, the output power of WTG depends upon the wind speed, so a small fluctuation in the wind speed causes a significant variation in the output power generated by the farm.

In order to enhance the wind farm output power characteristics and reduce the fluctuations caused by the varying natural parameters like wind speed, a fly-wheel energy storage system (FESS) is proposed to be used with the WTG. One of the major advantages of flywheels is the ability to handle high power levels. This is a desirable quality in e.g. a vehicle, where a large peak power is necessary during acceleration and, if electrical breaks are used, a large amount of power is generated for a short while when breaking, which implies a more efficient use of energy, resulting in lower fuel consumption. The FESS is controlled by using an advanced non-linear controlling mechanism which controls the storage of electric power under inconsistent wind speeds and other environmental conditions.

The WECS dynamic and transient modeling will be developed in order to analyze and improve the stability of the wind farm. The modeling of individual system components including the control strategy for the proposed model and how the artificial controller strategy smoothes the output power fluctuations are explained. Modelling and simulation will be performed using PSCAD/EMTDC.

PAPER ATTRIBUTES

The paper will mainly be consisting of the following seven sections starting from modelling the complete system, then moving on to the modelling of wind turbine and building the model of a DFIG to act as FESS. Then configuring the FESS in order to serve our goal appropriately. The, applying the traditional PI controller technique to assess the performance of the wind farm under variable wind speed and also during fault. Later on, the advanced control techniques are applied to improve the performance of the said system. Finally, in the end our model is coupled with IEEE standard 39 bus system in order to see the effect of out proposed model on an actual real life power system model respectively.

Model of the System

Modelling and Controlling Scheme

Wind Turbine Modelling

Doubly Fed Induction genitor model (DFIG)

Configuration of FESS

Classical PI controller to smooth the output power using FESS

Advanved ANFIS controller

Implementation of our proposed model on IEEE standard 39 bus sytem

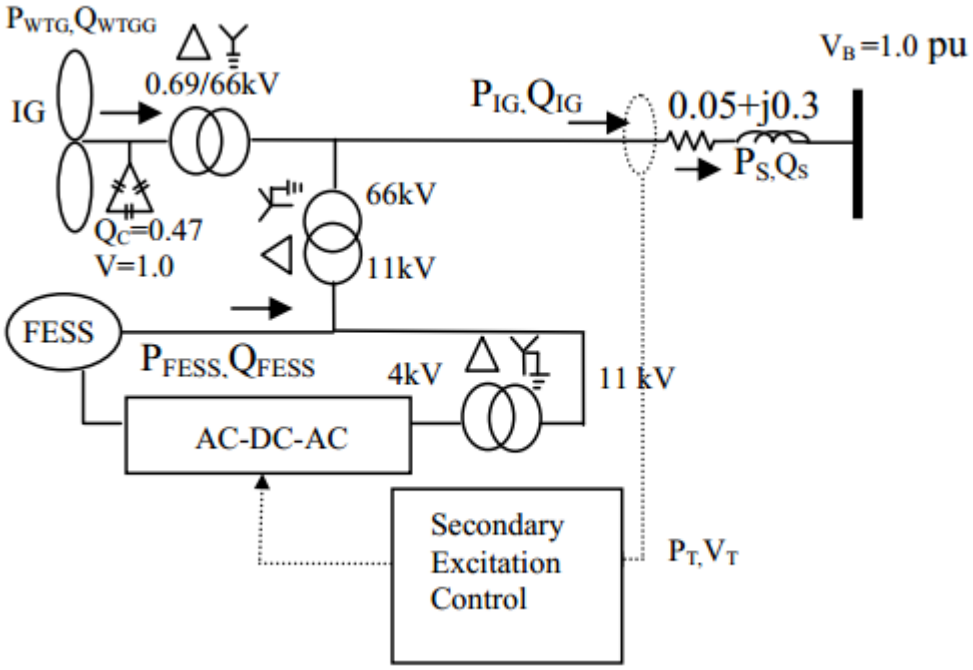

Figure 1The System Model

The detailed system modelling, controlling diagrams and the simulation results will be presented in the final paper. The results for all the sections are ready and will be provided in the final paper after the approval from your side.

CONCLUSIONS

The proposed research analyze the effects of variable wind speeds on the electrical output power of a wind farm. The FESS improves the dynamic response of a wind farm and enhances the transient stability of a grid connected wind farm. The ANFIS drastically improved the behaviors of the complete model. The standard 39 bus system of IEEE worked to great effect and the model works efficiently in real power networks.

REFERENCES

[1] Greigarn, T.; Garcia-Sanz, M., "Control of Flywheel Energy Storage Systems for wind farm power fluctuation mitigation," Energytech, 2011 IEEE , vol., no., pp.1,6, 25-26 May 2011