Stabilty Enhancement of Grid by Direct Power Control Strategy & Fuzzy controller method for the reduction of Wind power fluctuation

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Abstract—***In Recent years, the renewable energy plays a major role in Grid. Also at the same time, the grid stability also reduced due to the wind power fluctuation which leads to frequency variation and voltage flickers. To overcome this, the comparative case study is proposed as wind energy system with fuzzy controller and wind energy system with Direct power control strategy using Variable speed pumped storage system. The case study is made by considering conventional synchronous machines for hydropower and thermal power plans in the grid and induction machines for the VSPS and wind turbines.***

Keywords—*Grid stability, frequency variation, voltage flicker, Variable speed pumped storage system, Fuzzy controller*

I. INTRODUCTION

In Thermal Power Plant, the heat energy is obtained by combustion of coal, then that heat energy is converted as a steam energy which is high in pressure and temperature will reach the prime mover (Turbine). Next is the renewable energy resources like solar, wind, fuel cells, diesel generators are also produces the electrical energy to the Grid. The penetration of renewable energy is increasing day by day and also facing the many problems like voltage flicker, frequency variation, AC Bus voltage variation. This results in grid facing unstable condition.

II. COMPARATIVE STYDY

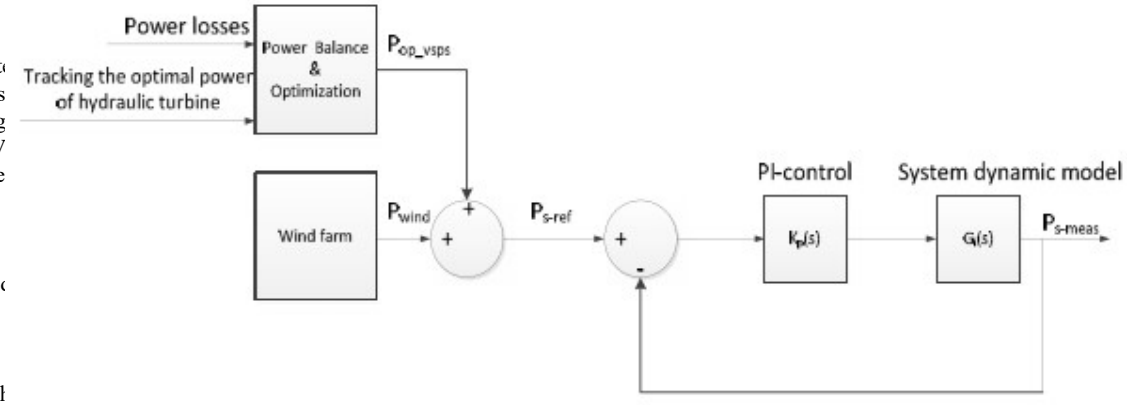
This comparative study is fully deals with two concepts. They are as follows.,

i) Direct power control strategy,
ii) Fuzzy controller method.

A. Direct power control strategy

For an influence system even with moderate alternative energy penetration, the fluctuations ought to be alleviated otherwise this could cause substantial deviations within the grid frequency [2], voltage flicker at the grid buses[3], equipment damage and system collapse at large. Study in [4] shows that the VSPS can improve the steady state operations and dynamic stability of the power system. Therefore, the pumped energy storage plant can play a key role in stabilizing the deviations of the grid frequency and voltage flickers caused by wind power fluctuation.

A direct power control (DPC) strategy is employed to have fast response and lets the control system compensate the wind power fluctuations directly and effectively. Even if this is a local control scheme that is placed in the VSPS unit, the significant output that is an adjustable and nearly constant power flow can be seen from the network of the facility system as way because the VSPS operates among the desired limits. The power command Pop-vsps of the VSPS is determined from the capacity of the VSPS and its efficiency.



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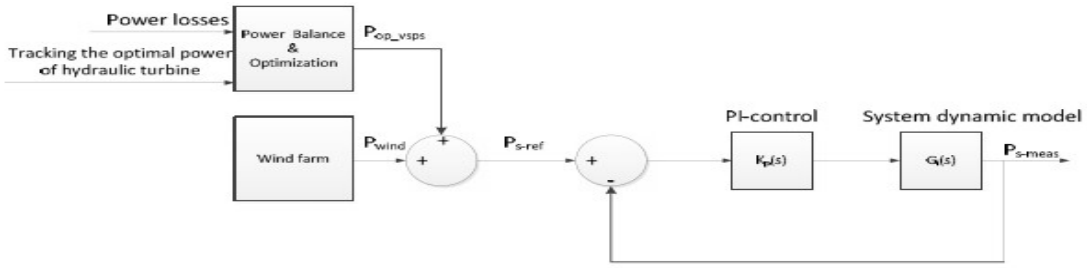

Fig. 1: Direct power control method by Variable speed pumped storage system

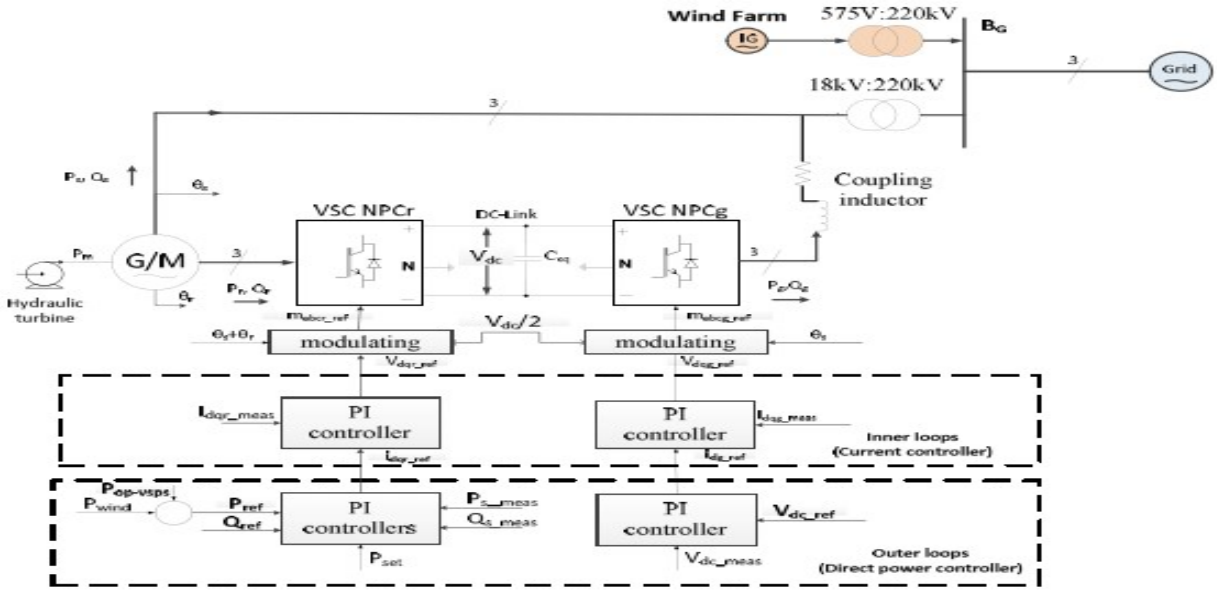

Fig. 2: Overview of a DPC system for the VSC converter topology of the VSPS system

B. Fuzzy control system

Wind generators may operate above rated wind speed or below rated wind speed (the rated wind speed in this study is 13.3 m/s). Two fuzzy logic systems (flss) have been incorporated in the pitch angle controller for the operation of wind turbine above the rated wind incident (FLS-A) and below the rated wind incident (FLS-B).

In this paper, a fuzzy logic pitch angle controller is proposed on the motivation of better smoothing performance with a lesser drop in output power. Pitch angle controller with the FLS is advantageous in a numerous ways. Wind turbine system is highly non-linear with many uncertain factors like meteorological conditions and continuously varying ac system loads [14]. It also contains some unknown ambiguous dynamics which makes accurate dynamic modeling of a wind turbine system difficult or even impossible [15].

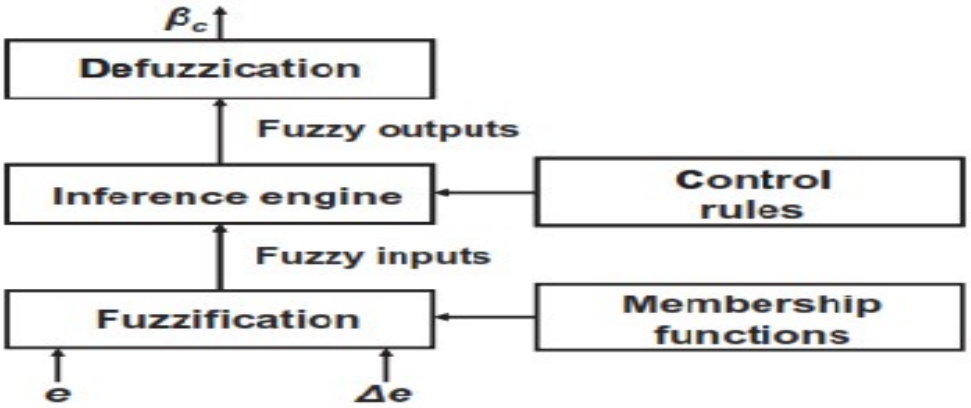

Fig. 3: Block diagram of an FLS

However, the rules of the FLS possess expert adaptability and learning capability to reason precisely with imprecise, uncertain, incomplete and non-linear data from a wind turbine system [16]. Moreover, It is cheap, reliable, robust and energy efficient.

An FLS comprises of three basic blocks, namely, Fuzzification, Inference system and Defuzzification as shown in Fig. 3.

An FLS cannot handle crisp input signals, rather needs to describe them in fuzzy terms. Therefore, the crisp input signals have to be expressed in terms of membership function of the fuzzy sets, and then the input variables are processed to determine the method of Fuzzification.

The smoothing technique of method is to determine a command output power (Pg_com) from the reference output power (the output power from the wind turbine with the conventional PI controller has been considered as reference output power (Pg_ref)) and generate pitch angle in such a way so that the generated output power can follow the command output power. To accomplish this,

- Command output power must be smooth.
- Smoothing is achieved by the generation of pitch angle with some drop in output power. As the generated output power is always lower than the reference output power, command output power must be ensured to be lower than the reference value so that the fuzzy rules for the generation of pitch angle are effectively set up by ensuring control input of variation of reference output power from the command output power.

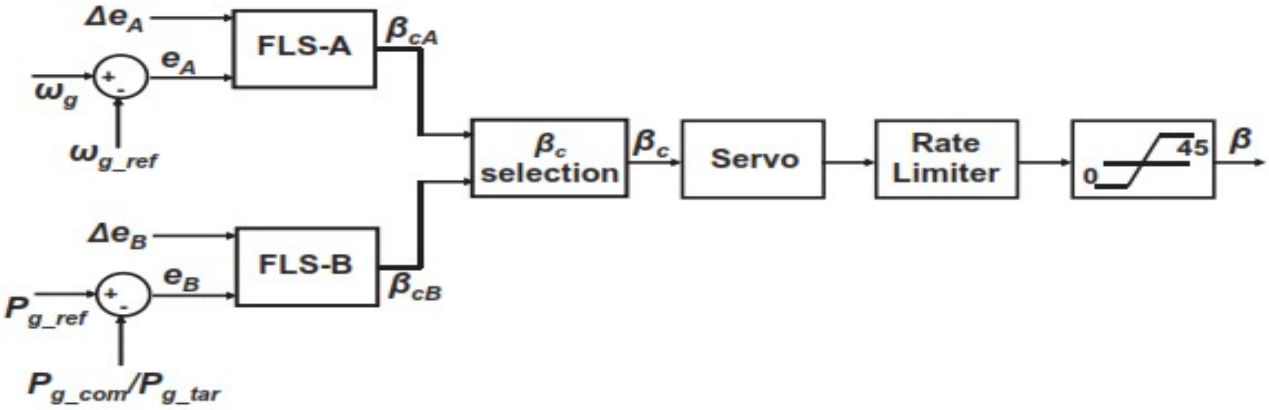

Fig. 4: Control scheme of fuzzy logic pitch angle controller

III. CONCLUSION

From this comparative study, the direct power control strategy is the good one and advanced method when compared with the fuzzy control system method. In future, the results based on the direct power control method by using variable speed pumped storage system for the reduction of wind power fluctuations by the simulation results using MATLAB/Simulink.

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