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Participation of DFIG Based Wind Turbine in Hybrid Power System for System Frequency Control - A Review

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A B S T R A C T

To reduce the proportion of electricity generated from fossil fuels, the current electricity generation trend focuses on renewable energy resources such as wind power and solar power. Among various wind turbines, the variable speed wind turbine is the main type of wind turbine, and they generally operate in the tracking mode for the maximum power point. However, uneven wind speeds can cause temporary instability as numerous wind turbines are integrated into power systems. Therefore, the frequency stability of a power system should be examined and the technology used to maintain frequency stability should be carefully examined in order to minimize the negative effects of integrating wind power into power systems. This article examined the frequency regulation technologies of variable speed wind turbine. First, this article introduces the frequency response of the VSWTs. Next, this article summarizes common control methods for control methods for frequency control of wind farms based on double-feed induction generators (DFIG).

Keywords: Doubly fed induction generators (DFIGs), frequency regulation, inertia control and maximum power point tracking.

1. Introduction

As the penetration ratio of wind power increases, methods of controlling the balance between supply and demand are of great importance. Power grid operators must consider any unsafe situations caused by change in wind speed or unpredictable power from renewable energy sources.Installed wind energy accumulated worldwide is growing rapidly. According to data from the Global Wind Energy Council (GWEC), there were 743 GW of wind power capacity worldwide in 2020 [1].The trend to improve the frequency control performance of wind turbines is growing rapidly, as frequency stability is important for the operation of the grid. Wind power generation is growing rapidly among the various types of renewable energy sources and most wind farms are connected to transmission grids.The most common wind power generators are squirrel-cage induction generators (SCIG), double-feed induction generators (DFIG), and synchronous generators with full-power electronic converters [2]. For safer operation, wind turbine generation should be more grid-friendly [3].Conventional variable speed wind turbines do not support frequency control when an emergency occurs on the grid. Therefore, if there is no frequency control technology, the grid frequency changes, which shows the importance of frequency control technologies in wind turbines.

Types of Control Methods for Frequency Regulation

A. Virtual Inertia Control

Utilizing the inertial control, the dynamic vitality put away interior the wind turbine can be discharged when the framework frequency drops. Inertial control comprises of inactivity circle and hang circle, as appeared in Fig. 1. To begin with, the dormancy circle generates the sum of dynamic control alter that's proportional to the subordinate of the measured recurrence [4]. This response is just like the unique behavior of routine synchronous machines. Moment, the compensated control that is decided based on the recurrence deviation is called as the droop control.
As appeared in Fig. 1, the low-pass channel that's associated behind the recurrence differentiator can diminish the measurement blunder caused by clamor, and the high-pass filter that's set behind the recurrence deviation permits as it were the transitory component of recurrence to be passed. K is the

proportionality coefficient for the idleness circle whereas the consistent 1/R can decide the output of the hang loop. That's, in case the esteem of the 1/R is bigger, at that point the output of the hang circle is littler, viceversa [5].

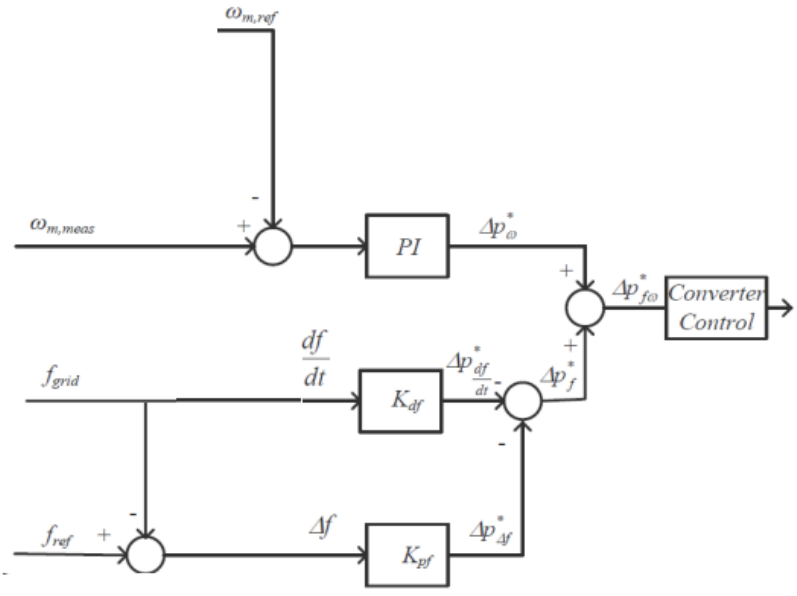

Fig. 1 Virtual inertia control

B. De-loaded Control

In typical working conditions, the edge of the WT assimilates control as much as conceivable. Be that as it may, it implies that the wind turbines cannot give overabundance control compensation. In other words, when the network recurrence changes, the control yield of the wind turbine is about constant. Hence, a few plans, such as the de-loaded power control or others, have been proposed to provide potential saved control in cases of recurrence drop. Within the de-loaded control, there are two common strategies to accomplish the objective for recurrence control: one is the control of the turbine speed, and the other is the pitch control [6-7].

DFIG based Gird Integration

The utilize of STATCOM for moving forward solidness of SCIG and DFIG based wind frameworks is examined in [8]. A decreased arrange DFIG demonstrate for solidness investigation is proposed in [9]. A nitty gritty demonstrate to think about control quality of a lattice is proposed in [10]. A nonspecific show of controller that employments molecule swarm optimization is proposed in [11]. The utilize of TurbSim, Quick and Simulink for solidness investigation is detailed in [12]. In [13] the impact of different show parameters of DFIG based wind cultivate on transitory reactions is considered. A Reality based controller to smother the impact of sub-synchronous reverberation in arrangement compensated control framework containing acceptance generators is considered in [14]. A linearized show for DFIG based wind control plant associated to a arrangement compensated transmission line is proposed in [15]. It is proposed in [16] that a wind cultivate can be modeled in a way comparable to the customary generator for consistent state examination. The greatest extractable control from a renewable vitality source depends not as it were on wind but too on the working point of the vitality change framework. A common demonstrate that can be utilized to speak to all sorts of variable speed wind turbines in control framework reenactment thinks about is given in [17]. A control framework to function DFIG at diverse control figure and for greatest point following is proposed in [18]. A coordinate power control methodology for a DFIG based wind turbine framework is proposed in [19]. A sensor less most extreme wind control tracking controller is proposed in [20].

As per Ireland's network code, the wind turbine framework ought to remain associated amid the blame whereas voltage at the point of connection drops to 15% of the ostensible esteem for a period of 625 ms [21]. Amid blame, a network associated DFIG encounters serious rotor over streams which may harm the rotor side converter [22]. Ordinarily crowbar conspire is utilized to brief circuit the rotor when a blame happens [23]. Be that as it may, the genuine and reactive control yield of the DFIG cannot be controlled beneath this condition. An expression for calculating the DFIG top rotor blame current and required rotor voltage for accomplishing fault ride through are inferred in [24]. A control technique for limiting the dc interface voltage change is proposed in [25]. A scheme in which rotor side converter is detached and paralleled with network side converter for nourishing responsive control to lattice is proposed in [26-28].

Conclusions

Numerous progressed and novel approaches for supporting recurrence control by wind turbines were proposed in later a long time. This paper summarizes the inertial control and power save control to bargain with the recurrence control issue, and examines the focal points and drawbacks of distinctive recurrence controllers in WTs. As the sum of wind power entrance is developed, the auxiliary benefit given by the wind turbines gets to be more critical to control systems.This paper has also focused on the diverse viewpoints of network integration of DFIG based frameworks. Indeed, in spite of the fact that there are numerous ways to bargain with network integration, more research is required to decide the foremost viable approach for particular circumstance. The recurrence steadiness is additionally vital for smaller scale networks. Due to the low inertia of smaller scale frameworks, it is challengeable to maintain the recurrence steadiness in smaller scale grids.

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