Review On Voltage Stability of DFIG Wind Turbine By Using DVR

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ABSTRACT

This paper proposes a low-voltage journey-thru method of a doubly fed induction generator (DFIG) wind turbine system via the usage of the use of of a dynamic voltage restorer (DVR). Also studied the utility of a dynamic voltage restorer (DVR) involved to a wind-turbine-driven DFIG. For tremendous control of the DVR, digital all-pass filters are used for extracting the positive-sequence element from the unbalanced grid voltage because they have the advantages of giving a favored phase shift and no magnitude reduction over traditional low- or high-pass filters. Using the positive-sequence component, the phase angles for the positive- and negative-sequence elements of the grid voltage are derived. A control algorithm for the DVR that is dual voltage controllers most effective is utilized for the two collection factors in the dq synchronous reference frame. In order to obtain the energy rating reduction of the DVR, the stator energy reference for the DFIG is decreased throughout faults. In addition, a control scheme of pitch angle device is utilized to stabilize the operation of the wind turbine system in the event of grid faults. PSCAD/EMTDC simulations exhibit the effectiveness of the proposed method and a feasibility of decreasing the energy rating of DVR for the fault ride via functionality of DFIG. The validity of the proposed control scheme for the DVR has additionally been proven by way of experimental results. The low-voltage experience-through of the DFIG the utilization of a crowbar that does no longer enable continuous reactive power manufacturing as evaluate with effectiveness of the DVR.

Keyword: - *Doubly fed induction generator (DFIG), dynamic voltage restorer (DVR), SCA, PSCAD/EMTDC, grid code.* VFC.

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1. INTRODUCTION:

The growing penetration of wind power into the power grid is reshaping the way that wind farms are operated in. During certain intervals of giant wind generation and mild load conditions, most of the power in the system can be included through the wind. The share of wind power in relation to the stiffness of electricity grid and different power plants is accomplishing the level where wind power may additionally reason issues to system operators, such as voltage variations, grid voltage unbalance, and grid instability. Wind farms can no longer be considered as a simple energy source. Now, they have to be operated as power plants and be capable to provide reactive power, continue to be linked all through system faults, and adapt their manipulate to the desires of the system. The most demanding requirement for wind farms, in particular with doubly fed induction generators (DFIG), is the fault ride-through capability. Wind farms linked to high-voltage (usually above 100 kV) transmission system have to continue to be linked when a voltage dip takes place in the grid, or else the unexpected disconnection of an excellent quantity of wind energy may also exacerbate the voltage dip, with extreme consequences. A DFIG is essentially a wound-rotor induction generator with slip rings; the stator is linked directly to the grid, and the rotor is interfaced via a partly rated variable frequency ac/dc/ac converter (VFC), which only desires to manage a fraction (25–30%) of the complete DFIG power to obtain full manipulate of the generator. The VFC consists of a rotor-side converter (RSC) and a grid-side converter (GSC) linked back-to-back through a dc-link capacitor. The trouble with a DFIG when a voltage dip happens is that the stator flux cannot comply with the surprising change in stator voltage and a dc component in the stator flux appears, due to the fact the fundamental time period is decreased and the stator flux vector turns into almost stationary. The rotor continues rotating and a high slip occurs, which tends to reason an overvoltage and overcurrent in the rotor circuit due to the effect of velocity voltage. Asymmetrical faults reason greater over currents and over voltages in the rotor for the reason that a negative sequence component exists in the stator voltage and the slip of this negative sequence component is very high. A massive number of research projects are being carried out in order to control the behavior of the DFIG wind generators under voltage dip conditions, and these exhibit that overcurrent in the rotor takes location at the voltage dip. Furthermore, the excessive modern-day in the rotor increases the voltage in the dc bus. Also, oscillations appear in the currents and in the active and reactive energy of the machine. When a grid fault is detected, the RSC of the DFIG may additionally be blocked to protect it from excessive current transients in the rotor circuit. The wind turbine normally trips rapidly after the converter has been blocked and is routinely reconnected to the power network after the fault is cleared and the regular operation is restored. However, this is no longer desirable under new grid codes. New grid codes require that the wind farm stays linked to the grid in the course of the voltage dip. In this scheme, the RSC is blocked and the rotor is short-circuited through a crowbar (an external resistor); the DFIG turns into a traditional induction generator and begins to absorb the reactive power from the power system. The wind turbine continues its operation to produce some active power, and the GSC can be set to control the reactive power and voltage at the grid connection. The pitch angle controller might be activated to stop the wind turbine from deadly over speeding. When the fault is cleared, the voltage and the frequency in the utility grid are reestablished, the RSC will restart, and the wind turbine will return to everyday operation. However, in the case of a weak energy network and at some point of a grid fault, the GSC cannot supply enough reactive power and voltage assist due to its small power capacity, and there can be a chance of voltage instability. To handle this trouble that may reason tripping of the DFIG from the grid, a static synchronous compensator (STATCOM) has been proposed to help with the uninterrupted operation of a DFIG all through grid faults. The STATCOM is a shunt compensator linked to the point of frequent coupling. As noted earlier, the DFIG will become a conventional induction generator and starts off evolved to absorb reactive power in the course of a grid fault. To minimize the burden on the power network, the STATCOM can be used to provide a lot reactive energy that cannot be supplied by means of the GSC due to its small power capacity. However, the STATCOM is now not used alone for the DFIG ride-through capability since it cannot guard the RSC at some point of a grid fault. In different words, it have to be used in addition to the crowbar circuit that protects the RSC from the rotor overcurrent at some point of the grid fault. A static collection compensator (SSC) or a DVR has been proposed as a solution to isolate the DFIG wind turbine from the voltage dip at some point of the grid fault. However, it is now not wonderful for unbalance voltage dips on the grounds that it does no longer deal with the negative sequence component of the grid voltage. Also, it is observed that the DVR utility to the FRT functionality of the DFIG is expensive.

In this paper, the utility of the DVR to enhance the FRT functionality of the DFIG is investigated in which the DVR is a voltage-source converter (VSC) connected in sequence between the grid and the wind turbine generator. The DVR output voltage is brought to the grid voltage right now for the constant stator voltage, via which the stator voltage can be saved regular under grid fault situation as well as ordinary condition such as balanced and unbalanced voltage dips. Hence, the grid disturbances have no direct impact on the generator operation. Therefore, the proposed method is capable to take away the transient in the generator current and power at grid fault condition. The control algorithm of the DVR system is proposed to overcome most faults in the grid utility. In addition, a control scheme for the control of the DFIG, in which the stator energy reference is reduced throughout grid faults, is proposed to minimize the power rating of the DVR. The validity of the proposed control algorithm is proven by means of simulation and experimental results.

2. LITERATURE REVIEW:

Shuying Yang, Tianbao Zhou, Liuchen Chang, Zhen Xie, and Xing Zhang [1]. Studied an idea of equal fault source is introduced with which the transient manner all through voltage dips is decomposed into the response of the equivalent stator fault source and the response of the equal rotor fault source. The former consequences from dips in the supply voltage, whilst the latter occur from variations in both the rotor resistance and the manage voltage produced via crowbar activation. This makes it viable to include the interval, i.e. the triggering delay, into the analytical solution. Additionally, this decomposition approach permits for the physical mechanisms at the back of the individual transient aspects to be greater sincerely understood. Some intrinsic characteristics of the transients are identified by using analytical formulas. The comparative accuracy and advantages of this analytical technique over the traditional strategy is verified through simulations using a 2 MW DFIG for commercial WTs and similarly confirmed experimentally on a laboratory-scale test rig. With this technique a set of analytical formulation have been acquired to describe the transient response. Equivalent fault sources were described in the stator and rotor circuits respectively, and the analytical solution used to be formulated by way of including the pre-fault steady-state solution with the two zero-state responses to the described fault sources separately. With this methodology, for the first time, the delay to trigger the crowbar circuit, various with the charge of rotor current amplify and the design of triggering logic used to be included in the analytical solution, and as end result the accuracy of the solution used to be improved. With the help of the express expressions, the characteristics and the underlying mechanisms of the transient phenomena were truly revealed, imparting a foundation for development and investigation of doable schemes for LVRT operation of DFIG-based WTs. The benefit in accuracy of the proposed approach was demonstrated via comparisons in opposition to the benchmark of conventional methods. In summary, the proposed analytical method gives a convenient way for analytically deciding the transients accurately, main to a clear perception of the dynamic response, as required for investigation and development of extended schemes for LVRT operation of DFIG-based WTs, and the find out about of wind power integrated power systems. If the response of the rotor modern-day manage loop can be covered in the course of the extend period, the accuracy ought to be improved further.

Saroja Kanti Sahoo, A. K. Sinha, N. K. Kishore [2]. In his paper, an answer to each voltage dip and absence of a speed encoder is addressed for a 22 kW DFIG setup. They provides a sensor less vector manage the use of rotor current-based MRAS method with LVRT of DFIG. With speed estimation being employed, the problems with speed encoder are no longer applicable. Further, the protection method is to make sure a secure and steady operation of the system. A certain mathematical modeling with sensor less vector control and safety towards sudden voltage drop is studied and simulated in MATLAB/SIMULINK environment.

Lei Chen, Changhong Deng, Feng Zheng, Shichun Li, Yang Liu, and Yuxiang Liao [3]. Proposed, a modified flux-coupling-type superconducting fault current limiter (SFCL) is recommended to improve the fault ride-through (FRT) functionality of DFIGs. The SFCL’s shape and precept is first presented. Then, considering that the SFCL can be mounted at a DFIG’s different locations, its affect mechanism to the DFIG’s FRT functionality is analyzed, and some technical discussions on the plan of the SFCL are carried out. Furthermore, the simulation model of a 1.5-MW/690-V DFIG built-in with the SFCL is built, and the overall performance evaluation is conducted. From the results, introducing the SFCL can correctly restrict the fault currents across the DFIG’s stator and rotor sides, and when the stator side is chosen as the set up site, the terminal-voltage sag can be also improved, which helps prevent the disconnection of the DFIG from the electricity grid. Theoretical derivation, technical dialogue and simulation evaluation are performed. From the verified results, introducing the SFCL can correctly limit the fault currents across the DFIG’s stator and rotor sides, and when the stator side is chosen as the set up site, the DFIG’s terminal-voltage sag can additionally be improved, which helps to prevent the disconnection of the DFIG from the main grid and meanwhile enhance the wind energy built-in system’s operational stability. Regarding the modified SFCL’s parameter optimization, AC loss calculation and engineering design, follow-up research will be carried out and suggested in the close to future.

Heng Nian, Member, IEEE, Peng Cheng, and Z. Q. Zhu [4]. Presents an unbiased operation of the rotor-side converter (RSC) and grid-side converter (GSC) for a doubly fed induction generator (DFIG)-based wind power conversion device underneath unbalanced grid voltage conditions. The RSC is managed to reap four specific control targets, inclusive of balanced stator current, sinusoidal rotor current, smooth stator active and reactive powers, and steady DFIG electromagnetic torque. The GSC is commanded to hold the dc voltage at a constant value. Additional feedback compensators the use of resonant regulators for the RSC are employed, and the decompositions of the positive and negative sequence elements and calculations of the rotor negative current references can be avoided. Another comparable compensator is used in the GSC to suppress the dc voltage fluctuates and eliminate the GSC reactive power oscillations except the stator or rotor power information. The proposed technique can make the RSC and GSC available to an unbiased operation with an easy implementation for greater reliability. The experimental effects display the effectiveness of the proposed manipulate strategy for both the RSC and GSC underneath unbalanced grid voltage conditions. An impartial and reinforced operation for DFIG structures below unbalanced grid voltage conditions has been investigated in this study. Detailed designs of the proposed control approach are presented. The experimental consequences on a laboratory setup of the 1.5 kW DFIG system validate the effectiveness of the proposed manage strategy.

Massimo Bongiorno and Torbjorn Thiringer [6]. The modeling of a Doubly fed induction generator (DFIG) device for a wind turbine utility & A familiar model is investigated. The electrical producing system is equipped with a dc crowbar machine for fault ride through ability. After putting up the simple machine, converter, and grid-filter equations, the more than a few controllers are derived and the selection of the regulator parameters is discussed. To validate the derived model, the investigated DFIG system is simulated the use of PSCAD/EMTDC and its dynamic response to voltage dips is compared to the dip behavior of a current 2-MW wind turbine. It will be shown that the developed common model exhibits the identical dynamic overall performance as the proper wind turbine during and directly after a voltage dip recorded at the wind-turbine site, even in case of a severe event the place the voltage at the connection point drops to 0%during the voltage dip. The DFIG model also comprised a dc-link crowbar to protect the converter from over voltages throughout the dc-link capacitors. The main goal was once to derive and present the validity of such a model, in which all the ingoing factors are given which includes the applied fault ride-through system, both from a hardware and a software point of view. The model was implemented in PSCAD/EMTDC and it was proven that the model was capable to ride-through severe voltage dips, as required in the majority of the grid codes. To validate the investigated popular model, the results had been compared to the response of a present 2 MW wind turbine exposed to severe dips. The 2MWturbine had been equipped with a massive number of sensors having a high bandwidth, and data were recorded the usage of a sampling rate of about 20 kHz. One case demonstrates the response to a symmetrical voltage dip down to 0%remaining voltage magnitude. Despite the simplicity of the investigated standard model, it has been proven that the derived model very properly mimics the dynamic performance of the true turbine. Also the measured response to an unsymmetrical dip confirmed very excellent agreement when it was once simulated the use of the model.

Sajjad Tohidi, Hashem Oraee, Mohammad Reza Zolghadri, Shiyi Shao, and Peter Tavner [7].Discusses the dynamic behavior of the brushless doubly fed induction generator at some point of the grid faults which lead to a reduce in the generator's terminal voltage. The variant of the fluxes, back EMFs, and currents are analyzed at some point of and after the voltage dip. Furthermore, two choice techniques are proposed to enhance the generator ride-through capability the usage of crowbar and series dynamic resistor circuits. Appropriate values for their resistances are calculated analytically. Finally, the coupled circuit model and the generator's speed and reactive power controllers are simulated to validate the theoretical results and the effectiveness of the proposed solutions. Moreover, experiments are carried out to validate the coupled circuit model used. The shape and synchronous operation of BDFIG are brought temporarily in this paper. Variation of linkage fluxes and returned electromotive forces are investigated analytically using the laptop dq model in the p1 pole pair synchronously rotating reference frame. The equal dynamic circuit of the CW is then obtained. The evaluation indicates that during or after a voltage dip, the EMF induced in the CW can be higher than its pre fault value, and hence high transient CW currents can also appear. Two techniques are recommended to overcome this problem: the use of crowbar, as has traditionally been the case with DFIG, or the use of SDR. Simple relations to decide suitable values for each are proposed. First, the validity of the model used for simulation is checked by way of comparing simulation with experimental consequences on a D180 BDFIG. Then, the proposed options are applied in simulations, and their efficacy is explored. The effects exhibit that both the crowbar and SDR options increase an area of viable voltage dip operation for the BDFIG up to maximum rotor speed. While the use of crowbar gives extra CW current damping, it leads to higher reactive power import. On the different hand, the use of SDR effects in better control on active and reactive powers, however its conductive loss reduces the steady-state efficiency.

Teng Long, Shiyi Shao, Ehsan Abdi, Richard A. McMahon, and Shi Liu [8].Compared with the Doubly fed induction turbines (DFIG), the brushless doubly fed induction generator (BDFIG) has an industrial potential for wind energy technology due to its decrease value and higher reliability. In the latest grid codes, wind generators are required to be capable of riding thru low voltage faults. As an end result of the negative sequence, induction generators response in a different way in asymmetrical voltage dips compared with the symmetrical dip. This paper gave a full conduct evaluation of the BDFIG under special kinds of the asymmetrical fault and proposed a novel manipulate method for the BDFIG to ride via asymmetrical low voltage dips except any greater hardware such as crowbars. The proposed control techniques are experimentally proven with the aid of a 250-kW BDFIG. They analyzed the conduct of the BDFIG beneath asymmetrical low voltage faults in cases of the phase to phase, phase to ground, and phase to phase to ground short circuits. Analysis suggests that the main problem for an asymmetrical low voltage fault is from the zero sequence of the CW current but not the backward sequence current. The severity of these three kinds of asymmetrical faults has been compared. This paper has also added a practical control scheme for the BDFIG to ride through asymmetrical LVRT. Experimental results have proven that the BDFIG with the proposed controller has potential to ride via asymmetrical low voltage faults except more hardware such as crowbars. The BDFIG-based wind turbine with the proposed control scheme is capable to exhibit excessive steadiness and a low value of grid integration.

Firouz Badrkhani Ajaei, Shahrokh Farhangi, and Reza Iravani [10]. Introduces an auxiliary control mechanism to allow the DVR to interrupt downstream fault currents in a radial distribution feeder. This control feature is an addition to the voltage-sag compensation control of the DVR. The overall performance of the proposed controller, beneath one of a kind fault scenarios, such as arcing fault conditions, is investigated based totally on time-domain simulation research in the PSCAD/EMTDC environment. They evaluates an auxiliary control method for downstream fault current interruption in a radial distribution line by way of skill of a dynamic voltage restorer (DVR). The proposed controller supplements the voltage-sag compensation control of the DVR. It does now not require phase-locked loop and independently controls the magnitude and phase angle of the injected voltage for every phase. Fast least error squares digital filters are used to estimate the magnitude and phase of the measured voltages and correctly minimize the influences of noise, harmonics, and disturbances on the estimated phasor parameters, and this permits superb fault current interrupting even below arcing fault conditions. The outcomes of the simulation research performed in the PSCAD/EMTDC software surroundings indicate that the proposed. Control scheme: 1) can restrict the fault current to less than the nominal load current and restoration the point of common coupling voltage within 10 ms. 2) can interrupt the fault current in much less than two cycles. 3) Limits the dc-link voltage rise and, thus, has no restrictions on the duration of fault current interruption. 4) Performs satisfactorily even underneath arcing fault conditions and 5) can interrupt the fault current underneath low dc-link voltage conditions.

Hailiang Xu, Jiabing Hu and Yikang He [11].Presents improved control techniques for doubly fed induction generator (DFIG)-based wind power generation systems beneath distorted grid voltage conditions. The mathematical model of DFIG, in view of the fifth- and seventh-order factors of grid voltage harmonics, is proposed and analyzed in detail. Based on the analytical model, in addition research are carried out on the distortions of stator/rotor currents and the oscillations in the stator active/reactive powers as nicely as the electromagnetic torque, the place they have an effect on of DFIG’s load stipulations is considered. Meanwhile, choice rotor current references are calculated to enhance the uninterruptable operation functionality of the wind-turbine-driven DFIG systems underneath distorted grid conditions. An improved software PLL is designed, which is successful of precisely and rapidly monitoring the frequency and phase angle of the imperative grid voltage below distorted grid conditions. A proportional fundamental plus resonant (PI-R) current controller in the synchronously rotating $(dq)^+$ reference frame is employed to simultaneously modify the necessary and harmonic elements of rotor currents barring any sequential element decomposition. Experiment consequences on a 3-kW DFIG prototype show the correctness of the analytical consequences and the effectiveness of the software PLL and PI-R current controller when the grid voltage is distorted.

Ahmad Osman Ibrahim, Thanh Hai Nguyen, Dong-Choon Lee and Su-Chang Kim [12].Proposes a low-voltage ride-through method of a doubly fed induction generator (DFIG) wind turbine system using a dynamic voltage restorer (DVR). For advantageous control of the DVR, digital all-pass filters are used for extracting the positive-sequence aspect from the unbalanced grid voltage considering they have the benefits of giving a preferred phase shift and no magnitude reduction over traditional low- or high-pass filters. Using the positive-sequence component, the phase angles for the positive- and negative-sequence elements of the grid voltage are derived. A control algorithm for the DVR that is dual voltage controllers only is implemented for the two sequence elements in the dq synchronous reference frame. In order to obtain the energy rating reduction of the DVR, the stator energy reference for the DFIG is decreased throughout faults. In addition, a control scheme of pitch angle system is utilized to stabilize the operation of the wind turbine machine in the event of grid faults. PSCAD/EMTDC simulations show the effectiveness of the proposed method and a feasibility of decreasing the power rating of DVR for the fault ride via capability of DFIG. The validity of the proposed control scheme for the DVR has also been tested through experimental results.
In his paper, application of the DVR has been proposed as a nice way to enhance the FRT capability of DFIG wind turbine systems. The circuit configuration and sequence of operation have been analyzed in detail. Furthermore, it has been proven that the proposed control schemes of the DVR and the DFIG by stopping MPPT manipulate of wind turbines and lowering the stator energy reference for unusual grid voltages can limit the DVR energy rating significantly. The proposed technique affords the stable operation for the DFIG wind turbine system under one-of-a-kind sorts of grid faults.

Christian Wessels, Fabian Gebhardtand Friedrich Wilhelm Fuchs [14]. Studied the application of a dynamic voltage restorer (DVR) related to a wind-turbine-driven doubly fed induction generator (DFIG). The setup permits the wind turbine system an uninterruptible fault ride-through of voltage dips. The DVR can compensate the inaccurate line voltage, whilst the DFIG wind turbine can proceed its nominal operation as demanded in true grid codes. Simulation outcomes for a 2 MW wind turbine and measurement consequences on a 22 kW laboratory setup are presented, especially for asymmetrical grid faults. They exhibit the effectiveness of the DVR in assessment to the low-voltage ride-through of the DFIG the usage of a crowbar that does not allow non-stop reactive power production. The DVR can be used to defend already established wind turbines that do not supply enough fault ride-through behavior or to guard any distributed load in a microgrid.

Gonzalo Abad, Miguel Angel Rodrıguez, Grzegorz Iwanski, and Javier Poza [15].Proposed a new hassle related with DFIG-based wind generators has been addressed. Under unbalanced voltage grid operation conditions, it has been proven that an easy DPC method accompanied by using a applicable active and reactive energy reference generation method is capable to remove the electromagnetic torque oscillations and non-sinusoidal current exchange with the grid. These phenomena are first analyzed theoretically as a function of the stator energetic and reactive instant energy change by means of the stator of the DFIG and the grid-side converter (GSC). Also evaluation provides the important ideas for generation of the energetic and reactive energy references for the rotor-side converter (RSC) and the GSC, controlled by means of direct power manipulate techniques. Therefore, this paper proposes a new algorithm that generates the RSC energy references, besides the necessity of a sequence element extraction, in order to take away torque oscillations and obtain sinusoidal stator currents exchange. On the contrary, the GSC power references are furnished via means of voltage and current sequence extraction. Finally, simulation and experimental consequences correctly validate the proposed power reference generation methods.

3. SYSTEM CONFIGURATION:

The configuration of the overall system is shown in Fig. 1. It involves a DFIG wind turbine and back-to-back pulse width modulation (PWM) converters that are linked between the rotor of 2-MWDFIG and the grid utility. To take away the switching harmonics generated by the back-to-back converter, an excessive frequency ac filter is related to the stator side. A DVR, three-phase VSC, is linked in series with the power line with the aid of three single-phase transformers (0.8 MVA and 690/690 V) to inject the compensation voltages. Fig.2. provides a single-phase diagram of the main section of the DVR. A low-pass LC filter (Lf =0.2mHand Cf =1000 μF) is linked between the VSC and the series transformer. The dc-link capacitance of the DVR is charged from a passive shunt converter, three-phase diode rectifier, linked to the DFIG side. An LC shunt passive filter is connected to the ac aspect of the diode rectifier in order to remove the fifth and seventh harmonic currents. A discharging resistor is linked in parallel with the dc link of the DVR that can dissipate the full energy from the DFIG at some stage in gird faults. A Y-Δ step-up transformer whose neutral is grounded (2.0 MVA and 0.69/33 kV) connects the DFIG with the DVR to the distribution network so that zero-sequence currents will no longer propagate through the transformer when unbalanced faults happen on the high-voltage side. Thus, there is no need to compensate for zero-sequence voltages. To simplify the controller design, it is assumed that the three single-phase injection transformers are best (no losses, no leakage inductance, and endless magnetizing inductance). Thus, the injected voltage of the SSC is the equal as the LC-filter capacitor voltage. The overall performance of the DVR depends on the effectiveness of the control method used in switching the inverters.

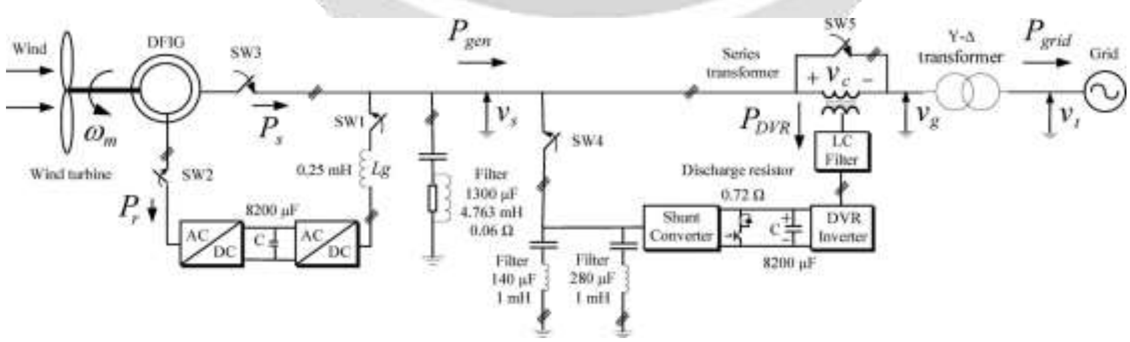

FIGURE 1. DFIG wind turbine system with ride-through capability using DVR.

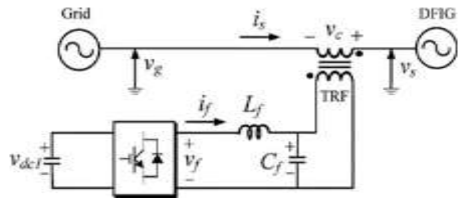

FIGURE 2. Single-line diagram of DVR.

4. SEQUENCE OF OPERATION:

The technique of connecting the DFIG to the grid consists of two stages: the synchronization stage and the walking stage. For starting, the first step is to charge the dc-link capacitor of the back-to-back converters with the aid of closing SW1 in Fig. 1. At the equal time, SW4 is additionally closed to cost the dc-link capacitor of the DVR. Next, SW2 is closed, which lets in the rotor control to perform. The rotor speed is accelerated by way of the pitch angle control. After synchronization is achieved, SW3 is closed. SW5 is then opened, which permits the series transformers to be connected, and at the identical time the DVR is activated.

5. CONCLUSIONS:

The application of a DVR linked to a wind-turbine-driven DFIG to permit uninterruptible fault ride-through of grid voltage faults is investigated. The circuit configuration and sequence of operation have been analyzed in detail. Furthermore, it has been proven that the proposed control schemes of the DVR and the DFIG with the aid of stopping MPPT control of wind generators and reducing the stator energy reference for odd grid voltages can minimize the DVR power rating significantly. The DVR can compensate the faulty line voltage, whilst the DFIG wind turbine can proceed its nominal operation and fulfill any grid code requirement except the want for extra safety methods. The proposed technique affords the stable operation for the DFIG wind turbine system beneath distinct kinds of grid faults. The simulation and experimental outcomes have validated the proposed method.

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