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Dynamic Analysis of Wind Turbine Driven doubly Fed Induction Generator: A Literature Review

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ABSTRACT

The doubly fed induction generators (DFIGs) has been using in wind turbine last few years. This has been growing rapidly in wind power system due to continues analysis issues like wind turbine fault effects on the grid, over current in rotor and stator circuits, grid fault disturbances (voltage dips), with common dynamic and Transient behaviours on the wind system. Improper dynamic and transient behaviour would not only lead to protect the doubly fed induction system, but control methods can also lead the system operation. The electrical behaviours and control methods used in grid system, rotor and stator circuits in DFIG to limit the over current and fault tolerant. There are several research studies to solve DFIG problem by various objectives and their imposed constraints. However, the principle for this subject is still an obscure problem. This paper presents an overview and general backgrounds of research and development in the field of different solution methods for dynamic behaviours and control conversion methods found in the literature. This paper has reviewed some of the most popular methods including various algorithms, circuit design and computational simulation methods. This paper provides useful guidelines for the future studies for those interested in the problem or intending to do additional research in this area.

Keywords: Doubly fed induction generators (DFIGs); Dynamic and Transient behaviour; Computational simulation.

I. INTRODUCTION

In recent years, Renewable energy including solar, wind, tidal, small hydro geothermal, refused derived fuel and fuel cell energies is sustainable, reusable and environmentally friendly. Among the other renewable energy sources wind energy has proven to be one of the most economical one. The combination of doubly fed induction generators with variable speed win generation system connected through the electrical grid is more features and hence influencing the system dynamics. This has developing suitable models for doubly fed induction generators to be integrated into power system operation. Constant speed wind energy conversion systems were proposed to generate constant frequency voltages from the variable wind. However, Variable speed wind energy conversion system operations can be considered advantageous, because additional energy can be collected as the wind speed increases. Variable speed wind energy conversion system must use a power electronic converter.

In power electronics system rotor side converter, stator side converter and crowbar resistance circuits are employed. The rotor windings of the DFIG are connected to an ac–dc converter commonly referred to as the machine side converter (MSC). The ac side of a second dc–ac converter, commonly referred to as the grid side converter (GSC), is connected in parallel with the machine stator windings. Various methods such as hysteresis controller, stationary PI controller and synchronous PI controller have been adopted in order to control current-regulated induction machine. Among which, synchronous PI controller has been acknowledged as being superior.

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The main advantages of doubly fed induction generator compared to other systems as follows:

- The amplitude range and frequency of the voltage remains constant while operating at variable speed.
- The amount of power generated as a function of an available wind power is optimised.
- Sudden variation in the rotor torque and generator output power is virtually eliminated.
- Electrical power generation happen s even at low wind speed.
- Maintain the power factor at unity.

The doubly fed induction generator has attracted many researchers' attention recently due to its ability to obviate defects caused by improper design of power electronics controlled unit, such as grid fault, over current, dynamic and transient behaviour etc. The doubly fed induction generator having following few methods of proposed behaviours are there:

- The minimization of the wind turbine fault effect on the grid and cost maintenance minimization.
- Limit the rotor current, due to transient disturbances occurring in the Electrical grid.
- To reduce the dynamic behaviour of the induction machine during three-phase voltage dips.
- To obtain optimal controllers to the Rotor-side converter of doubly fed induction generators (DFIGs), in variable-speed wind generation systems connected to the electrical grid.
- To improve the global system dynamic behaviour during and after the fault period, also increasing the transient stability margin of the power system and the fault ride-through capability.
- Reduce the network disturbance and fault tolerant. And also to limit the grid fault via reduce the negative sequence component.
- Improving Power system dynamic Behaviour and Control the active power and reactive power by using AC-DC-AC link.
- To control the initial over currents that appears in the generator during voltage sags.

Eight methods have been proposed in determining the electrical behaviour of DFIG. Some authors have used the analytical techniques for DFIG in terms of different algorithm. Genetic algorithm, Fuzzy logic algorithm, finite element methods, neural network algorithm, crowbar system, Flux linkages tracking based LVRT, Crowbar - IGBT, Crowbar- FRT, pole placement theory, Crowbar with DC Chopper, Evolutionary programming have come to be the most widely used tools for solving DFIG electrical behaviour problems.

II. REVIEW OF LITRATURE

This paper gives general backgrounds of research and development in the field of DFIG wind system in power system network based on over 30 published articles. The following open literature presents the summary and application of each method for DFIG electrical fault in wind power system network. The related assumptions made, strengths and weaknesses of each solution methods are highlighted.

1. In 2013, A. Khattara, M. Becherif, M. Y. Ayad M. Bahri and A. Aboubou presented Optimal Number of DFIG Wind Turbines in Farm Using Pareto Genetic Algorithm to Minimize Cost and Turbines fault effect. The main objective of this paper is the minimization of the wind turbine fault effect on the grid and cost maintenance minimization. Doubly fed induction generator (DFIG) wind turbines are broadly utilized today as a part of wind ranches and their establishment and support raise numerous specialized issues, for example, the minimization of the wind turbine flaw impact on the framework and cost minimization. In this paper, a scientific estimate and a Pareto hereditary calculation system are produced to compute the base establishment and support expense of a wind ranch with the base lost of force amid perpetual and transient line flaw. This methodology permits getting the ideal

number of DFIG wind turbines that ought to be associated in the same transport with respect to the considered criteria.

2. In 2008, Joao P. A. Vieira, Marcus N. A. Nunes, and Ubiratan H. Bezerra presented Design of Optimal PI Controllers for Doubly Fed Induction Generators in Wind Turbines Using Genetic Algorithm. The main objective of this paper is to limit the rotor current, due to transient disturbances occurring in the Electrical grid. The converter of the DFIG has an assurance framework that screens ceaselessly the machine operation, emanating a blocking summon when the cutoff of the rotor current is disregarded, because of transient unsettling influences happening in the electrical lattice. That infers in deactivating the DFIG control circles which influence adversely the framework worldwide controllability. This control activity of the DFIG converter is expert by PI controllers, which pick up conformities are not a paltry assignment, because of the nonlinearities and the high multifaceted nature of the framework.

3. In September 2007, Jesus Lopez,, Pablo Sanchis, Xavier Roboam, and Luis Marroyo presented Dynamic Behaviour of the Doubly Fed Induction Generator During Three-Phase Voltage Dips. The main objective of this paper is to control the dynamic behaviour of the induction machine during three-phase voltage dips. These machines provide variable speed and are driven with a power converter which is sized for a small percentage of the turbine-rated power. A disadvantage of the DFIG is that it is extremely delicate to network unsettling influences, particularly to voltage plunges. Be that as it may, the operation of the machine in these circumstances has just been examined in the writing by method for re-enactments. This paper adds to a hypothetical investigation of the dynamic conduct of the impelling machine amid three-stage voltage plunges. The proposed examination adds to comprehension the reasons for the issue and speaks to an exceptionally helpful device to enhance the current arrangements and propose new choices.

4. In December 2008, .P.A. Vieira, M.V.A. Nunes, A.C. do Nascimento, presented Designing optimal controllers for doubly fed induction generators using a genetic algorithm. The main objective of this paper is to improve the global system dynamic behaviour during and after the fault period, also increasing the transient stability margin of the power system and the fault ride-through capability. The control activity of the DFIG converters is proficient by corresponding and fundamental controllers, whose increases' conformity is not a unimportant assignment, as a result of the high many-sided quality of the framework.

5. In 2005, Slavamir Seman, , Jouko Niiranen, Sami Kanerva, Antero Arkkio, and Julius Saitz presented Performance Study of a Doubly Fed Wind-Power Induction Generator under Network Disturbances. The main aim of this paper is to reduce the network disturbance. Transient performance of a 1.7-MW wind-power doubly fed induction generator (DFIG) under network disturbances is studied using a coupled ûeld-circuit simulator. The test system comprises of the ûnite-component technique model of a DFIG combined with the circuit model of the recurrence converter, a transformer, and a straightforward model of the system. The recreation results demonstrate the transient conduct of the DFIG when a sudden voltage plunge is presented.

6. In May 2008, Patrick S. Flannery and Giri Venkataramanan presented A Fault Tolerant Doubly Fed Induction Generator Wind Turbine Using a Parallel Grid Side rectiûer and Series Grid Side Converter. The main objective of this paper is to reduce the fault tolerant. The doubly fed induction generation (DFIG) architecture for providing ride-through result in compromised control of the turbine shaft and grid current during fault events. A DFIG architecture in which the grid side converter is connected in series as opposed to parallel with the grid connection has shown improved low voltage ride through but poor power processing capabilities. In this paper, a uniûed DFIG wind turbine architecture which employs a parallel grid side rectifier and series grid side converter is presented. The blend of

these two converters empowers unrestricted force preparing and hearty voltage aggravation ride through. A dynamic model and control structure for this design is produced. The operation of the framework is outlined utilizing PC reproductions.

7. In November 2004, Rogerio G. de Almeida, J. A. Pecas Lopes, J. A. L. Barreiros presented Improving Power System Dynamic Behaviour through Doubly Fed Induction Machines Controlled by Static Converter Using Fuzzy Control. The aim of this presented paper is to Improving Power system dynamic Behaviour and Control the active power and reactive power by using AC-DC-AC link. The control of the rotor-side converter is acknowledged by fluffy controllers whose exhibitions are contrasted and that of traditional Proportional-Integral controllers. The control of the matrix side converter is done by a control square taking into account the immediate force hypothesis and it is controlled to keep up the DC join voltage steady and to enhance the force component of the framework. Fluffy rationale with PI controller are utilized to outline the converters.

8. In 2015, J.S. Sathiyanarayanan, A. Senthilkumar and J. Jayashree presented performance Evaluation of Doubly Fed Induction Generator Using Neural Network. The main aim of this paper is to improve its low voltage ride through capability. And also improve the dynamic performance. This project proposes a coordinated control strategy of the DFIG converters during a grid fault, managing to ride-through the fault without the use of any auxiliary hardware. The coordination of the two controllers is achieved through a neural network controller. This technique is to improve the dynamic performance of the DFIG driven by wind energy conversion system.

9. In September 2006, Dawei Xiang, Li Ran, Peter J. Tavner, and Shunchang Yang presented Control of a Doubly Fed Induction Generator in a Wind Turbine During Grid Fault Ride-Through. The aim of this method is to limit the grid fault via reduce the negative sequence component. The fundamental difficulty for the DFIG in ride-through is the electromotive force (EMF) induced in the machine rotor during the fault, which depends on the dc and negative sequence components in the stator-ûux linkage and the rotor speed. The investigation develops a control method to increase the probability of successful grid fault ride-through, given the current and voltage capabilities of the rotor-side converter. A time-domain computer simulation model is developed and laboratory experiments are conducted to verify the model and a control method is proposed.

10. In January 2010, Francisco K. A. Lima, Alvaro Luna, Pedro Rodriguez, Edson H. Watanabe, and Frede Blaabjerg presented Rotor Voltage Dynamics in the Doubly Fed Induction Generator during Grid Faults. The aim of this paper is the rotor-side converter (RSC) of wind turbines (WTs) based on doubly fed induction generators (DFIG) that intends to improve its low-voltage ride through capability. And to control the initial over currents that appear in the generator during voltage sags. In order to validate the proposed control system simulation, results have been collected using PSCAD/EMTDC and experimental tests have been carried out in a scaled prototype.

11. In 2011, Shuai Xiao, Geng Yang, Honglin Zhou, and Hua Geng presented A LVRT Control Strategy based on Flux Linkage tracking for DFIG-based WECS. The main aim of this paper is to limit the over current in DFIG. For doubly-fed induction generator (DFIG)-based wind energy conversion systems (WECS), large electromotive force (EMF) will be induced in the rotor circuit during grid faults. Without proper protection scheme, the rotor side of DFIG will suffer from over-currents, which may even destroy the rotor side converter (RSC). To mitigate this problem, a new ûux linkage tracking-based low voltage ride-through (LVRT) control strategy is proposed to suppress the short circuit rotor current. Under the proposed control strategy, the rotor ûux linkage is controlled to track a reduced fraction of the changing stator ûux linkage by switching the control algorithm of RSC during grid faults. To validate the proposed control strategy, a case study of a typical 1.5 MW

DFIG-based WECS is carried out by simulation using the full order model in SIMULINK/Sim Power Systems.

12. In June 2012, Omar Noureldeen presented Behavior of DFIG Wind Turbines with Crowbar Protection under Short Circuit. The main aim of this paper is to analysis the dynamic interaction between variable speed DFIG wind turbines and the power system which is subjected to disturbances, such as short circuit faults. The ability of the wind power plant to stay connected to the grid during disturbances is important to avoid a cascading effect due to lack of power. This paper investigates the impact of fault ride through on the stability of DFIG wind turbine using crowbar resistance. Simulation test using MATLAB-Simulink toolbox is implemented on a 9 MW wind farm exports its power to 120 KV grids. The simulation is performed using different crowbar resistances. The variations of rotor current, rotor speed, DC-link voltage, active power and reactive power of the wind farm are investigated.
13. In April 2010, Maurício B. C. Salles, Kay Hameyer ,José R. Cardoso, Ahda, P. Grilo and Claudia Rahmann presented Crowbar System in Doubly Fed Induction Wind Generators. The main aim of this paper is the dynamic interaction between variable speed DFIG wind turbines and the power system which is subjected to disturbances, such as short circuit faults. The use of doubly fed induction machines in modern variable-speed wind turbines has increased rapidly. This development has been driven by the cost reduction as well as the low-loss generation of Insulated Gate Bipolar Transistors (IGBT). By framework code prerequisites, wind turbines must stay associated with the lattice amid matrix unsettling influences. Besides, they should likewise add to voltage support amid and after matrix flaws. The crowbar framework is crucial to dodge the detachment of the doubly bolstered prompting wind generators from the system amid shortcomings. The insertion of the crowbar in the rotor circuits for a brief timeframe empowers a more productive terminal voltage control. When in doubt, the initiation and the deactivation of the crowbar framework is construct just in light of the DC-join voltage level of the consecutive converters.
14. In January 2014, V.Vanitha and K.Santhosh presented Effect of crowbar resistance on fault ride through capability of doubly fed Induction generator. The purpose of this work is the machine is controlled via converters connected between the rotor and the grid. The size of these converters determines the speed range of the DFIG. DFIGs are the generators which are connected to the grid on both stator and rotor sides. The machine is controlled by means of converters associated between the rotor and the framework. The span of these converters decides the rate scope of the DFIG. Wind ranch associations with the framework must fulfill lattice necessities set by Transmission System Operators (TSO). This implies the study on element reaction of wind homesteads subjected to feeble and solid unsettling influences and their Fault Ride through (FRT) capacities have turned into a basic issue. This is progressively vital for affectation generators, because of their developing size and number. A few PC programming exists to do their dynamical reproductions. This paper concentrates on the utilization of DigSILENT Power Factory programming to Study the impact of crow bar resistance on the FRT ability of DFIG.
15. In 2007, B.Chitti Babu, K.B.Mohanty and C.Poongothai presented Wind Turbine Driven Doubly-Fed Induction Generator with Grid Disconnection. The aim of this paper is the transient behaviour of a doubly-fed induction generator (DFIG) driven by wind turbine after its disconnection from the grid. The instigation machine keeps running at a particular pace with the stator detached from the network (Is=0), the rotor is all of a sudden energized with slip-recurrence voltages got from voltage controllers in order to create recognized open-circuit stator terminal voltage. Conduct under fluctuating rotor speed normally saw in wind turbines is likewise reported. A MATLAB PC reenactment study was attempted and comes about on 1.5 kW wind turbine are exhibited.

16. July 2009, F. Poitiers, T. Bouaouiche, and M. Machmoum presented advanced control of a doubly-fed induction generator for wind energy conversion. The aim of this paper is to propose a control method for a doubly-fed induction generator used in wind energy conversion systems. First, stator active and reactive powers are regulated by controlling the machine inverter with three different controllers: Proportional Integral, polynomial RST based on pole-placement theory and Linear Quadratic Gaussian. The machine is tested in association with a wind turbine emulator. Secondly a control strategy for the grid-converter is proposed. Simulations results are presented and discussed for each converter control and for the whole system.
17. In June 2005, Johan Morren, and S. joerd W. H. de Haan presented Ridethrough of Wind Turbines with Doubly-Fed Induction Generator During a Voltage Dip. The main aim of this paper is to process Perform the dynamic behaviour. The key of the solution is to limit the high current in the rotor in order to protect the converter and to provide a bypass for this current via a set of resistors that are connected to the rotor windings. With these resistors, it is possible to ride through grid faults without disconnecting the turbine from the grid. Because the generator and converter stay connected, the synchronism of operation remains established during and after the fault and normal operation can be continued immediately after the fault has been cleared. An additional feature is that reactive power can be supplied to the grid during long dips in order to facilitate voltage restoration.
18. Jin Yang, John E. Fletcher, and John O'Reilly presented A Series Dynamic Resistor Based Converter Protection Scheme for Doubly-Fed Induction Generator during Various Fault Conditions. The main aim of this paper is to perform the dynamic behaviours of the DFIG wind system a new converter protection method, primarily based on a series dynamic resistor (SDR), that avoids the doubly-fed induction generator (DFIG) control being disabled by crowbar protection during fault conditions. A combined converter protection scheme based on the proposed series dynamic resistor and conventional crowbar is analysed and discussed. The main protection advantages are due to the series topology when compared with crowbar and DC-chopper protection. Various fault over-current conditions (both symmetrical and asymmetrical) are analysed and used to design the protection in detail, including the switching strategy and coordination with crowbar, and resistance value calculations.
19. In July 2009, Alejandro Rolan, Alvaro Luna, Gerardo Vazquez, Daniel Aguilar and Gustavo Azevedo presented Modelling of a Variable Speed Wind Turbine with a Permanent Magnet Synchronous Generator. The purpose of this paper is to perform the dynamic behaviours of DFIG with variable speed performance. A Wind Turbine Generator System (WTGS) outfitted with a Variable Speed Generator. Doubly- nourished instigation generators are as a rule broadly utilized on WTGS, albeit synchronous generators are in effect widely used as well. There are distinctive sorts of synchronous generators, however the multi-shaft Permanent Magnet Synchronous Generator (PMSG) is picked keeping in mind the end goal to get its model. It offers better execution because of higher proficiency and less upkeep since it doesn't have rotor current and can be utilized without a gearbox, which additionally suggests a diminishment of the heaviness of the nacelle and a decrease of expenses. Aside from the generator, the examined WTGS comprises of three sections: wind speed, wind turbine and drive train. These components have been displayed and the mathematical statements that clarify their conduct have been presented. Besides, the entire WTGS has been actualized in MATLAB/Simulink interface.
20. In February 2013, J. G. Slootweg, S. W. H. de Haan, H. Polinder, and W. L. Kling presented General Model for Representing Variable Speed Wind Turbines in Power System Dynamics Simulations. The motivation behind this work is the Dynamic conduct with variable rate execution. A model that can be utilized to speak to a wide range of variable rate wind turbines in force framework progress reenactments is introduced. In the first place, the demonstrating methodology is remarked upon and

models of the subsystems of which a variable rate wind turbine comprises are talked about. At that point, a few results acquired after consolidation of the model in PSS/E, a generally utilized force framework elements reproduction programming bundle, are given and thought about estimations.

21. In March 2006, Yazhou Lei, Alan Mullane, Gordon Lightbody, and Robert Yacamini presented Modeling of the Wind Turbine with a Doubly Fed Induction Generator for Grid Integration Studies. The main aim of this paper develops a simple DFIG wind turbine model in which the power converter is simulated as a controlled voltage source, regulating the rotor current to meet the command of real and reactive power production. This model has the form of traditional generator model and hence is easy to integrate into the power system simulation tool such as PSS/E. As an example, the interaction between the Arklow Bank Wind Farm and the Irish National Grid was simulated using the proposed model. The model performance and accuracy was also compared with the detailed model developed by DIgSILENT.

22. In June 2005, Richard Gagnon, Gilbert Sybille, Serge Bernard, Daniel Paré, Silvano Casoria, Christian Larose presented Modeling and Real-Time Simulation of a Doubly-Fed Induction Generator Driven by a Wind Turbine. The Matlab/Simulink/ SimPowerSystems software is used to develop the model for simulation of electromagnetic transients in power systems. The code generated by the Real-Time Workshop of Simulink is linked to the Hypersim digital real-time simulator.

23. In July 2008, A.A. El-Sattar, N.H. Saad, M.Z. Shams El-Dein presented Dynamic response of doubly fed induction generator variable speed wind turbine under fault. The performance of doubly fed induction generator (DFIG) variable speed wind turbine under network fault is studied using simulator developed in MATLAB/SIMULINK. Simulation results show the transient behaviour of the doubly fed induction generator when a sudden short circuit at the generator bus is introduced. After the clearance of the short-circuit fault the control schemes manage to restore the wind turbines normal operation. The controller performance is demonstrated by simulation results both during the fault and after the clearance of the fault. A crowbar is used to protect the rotor converter against short-circuit current during faults.

24. In May 2008, Jun Yao, Hui Li, Yong Liao, and Zhe Chen presented An Improved Control Strategy of Limiting the DC-Link Voltage Fluctuation for a Doubly Fed Induction Wind Generator. The paper presents to develop a new control strategy of limiting the dc-link voltage ûuctuation for a back to-back pulse width modulation converter in a doubly fed induction generator (DFIG) for wind turbine systems. The reasons of dc-link voltage ûuctuation are analyzed. An improved control strategy with the instantaneous rotor power feedback is proposed to limit the ûuctuation range of the dc-link voltage. An experimental rig is set up to valid the proposed strategy, and the dynamic performances of the DFIG are compared with the traditional control method under a constant grid voltage. Furthermore, the capabilities of keeping the dc-link voltage stable are also compared in the ride-through control of DFIG during a three-phase grid fault, by using a developed 2 MW DFIG wind power system model. Both the experimental and simulation results have shown that the proposed control strategy is more effective, and the ûuctuation of the dc-link voltage may be successfully limited in a small range under a constant grid voltage and a non-serious grid voltage dip.

25. October 2007 and Retrieved on January 2016, F. Wu, X.-P. Zhang, K. Godfrey and P. Ju presented Small signal stability analysis and optimal control of a wind turbine with doubly fed induction generator. A novel method using particle swarm optimisation (PSO) is proposed for optimising parameters of controllers of a wind turbine (WT) with doubly fed induction generator (DFIG). The PSO algorithm is employed in the proposed parameter tuning method to search for the optimal parameters of controllers and achieve the optimal coordinated control of multiple controllers of WT system. The implementation of the algorithm for optimising the controllers' parameters is

described in detail. In the analysis, the generic dynamic model of WT with DFIG and its associated controllers is presented, and the small signal stability model is derived; based on this, an Eigen value-based objective function is utilised in the PSO-based optimisation algorithm to optimise the controllers' parameters. With the optimised controller parameters, the system stability is improved under both small and large disturbances. Furthermore, the fault ride-through capability of the WT with DFIG can be improved using the optimised controller. Simulations are performed to illustrate the control performance.

26. In December 2012, M.T.V.L. RAVI KUMAR MADA, CH. SRINIVAS, K. SHASHIDHAR REDDY presented Doubly-Fed Induction Generator for Variable Speed Wind Energy Conversion Systems-Modelling & Simulation. The aim of this paper is to present the complete modeling and simulation of wind turbine driven doublyfe induction generator which feeds a power t the utility grid. For that, two pulse width modulated voltage source converters are connected back to back between the rotor terminals and utility grid via common dc link. The grid side converter controls the power flow between the DC bus and the AC side and allows the system to be operated in sub synchronous and super synchronous mode of operation. The complete system is modelled and simulated in the MATLAB Simulink environment in such a way that it can be suited for modelling of all types of induction generator configurations.

27. In January 2011, Alvaro Luna, Francisco Kleber de Araujo Lima, David Santos, Pedro Rodríguez, Edson H. Watanabe, and Santiago Arnaltes presented Simpliûed Modelling of a DFIG for Transient Studies in Wind Power Applications. Improving the fault ride-through (FRT) capability of doubly fed induction generators (DFIGs) in wind power applications is a very important challenge for the wind power industry. The scientific models of such generators empower us to break down their reaction under nonexclusive conditions. In any case, their scientific multifaceted nature does not add to disentangling the examination of the framework under transient conditions and consequently does not help in ûnding clear answers for upgrading their FRT. This paper displays a simpliûed model of the DFIG, which has been extricated from the traditional ûfth-request model, which can precisely appraise the conduct of the framework while signiûcantly diminishing its intricacy.

28. In July 2015, Warren N. White, Fariba Fateh, and Zhichao Yu presented Torsional Resonance Active Damping in Grid Tied Wind Turbines with Gearbox, DFIG, and Power Converters. Two methods for torsional resonance mitigation are tested using the NREL software FAST in the MATLAB/ Simulink environment with a 750 k wind turbine. One mitigation method uses rotor angular acceleration measurements to provide virtual inertia for resonance detuning while the other is an active vibration absorberThe wind turbine representation utilizes a five mass gearbox display, a doubly nourished instigation generator demonstrate, an interface with the force network, and a streamlined recreation of the tower shadow impact. The two moderation strategies are tried by subjecting the wind turbine to a recurrence sweep of wind with a specific end goal to energize the full conditions and afterward to inspect the impact of the alleviation techniques. The vibration safeguard indicates better execution with more prominent shaft wavering lessening than that of the virtual dormancy.

29. In July 2015, Heng Nian, Peng Cheng, and Z. Q. Zhu presented Independent Operation of DFIG-Based WECS Using Resonant Feedback Compensators Under Unbalanced Grid Voltage Conditions. It gives an independent operation of the rotor-side converter (RSC) and grid-side converter (GSC) for a doubly fed induction generator (DFIG)-based wind energy conversion system under unbalanced grid voltage conditions. In this paper, the RSC is controlled to achieve four different control targets, including balanced stator current, sinusoidal rotor current, smooth stator active and reactive powers, and constant DFIG electromagnetic torque. The GSC is told to keep the dc voltage at a consistent

quality. Extra input compensators utilizing thunderous controllers for the RSC are utilized, and the disintegrations of the positive and negative grouping parts and computations of the rotor negative current references can be maintained a strategic distance from. Another comparative compensator is utilized as a part of the GSC to stifle the dc voltage ûuctuates and evacuate the GSC receptive force motions without the stator or rotor power data. The proposed strategy can make the RSC and GSC accessible to a free operation with a basic usage for higher unwavering quality.

30. In August 2010, A. Arulampalam, G. Ramtharan, J.B. Ekanayake, A.P. Tennakoon, S.G. Abeyratne N. Jenkins, Presented Fault Ride Through operation of a DFIG wind farm connected through VSC HVDC. The electromechanical transients during a de loading of a DFIG turbine and the Fault Ride through (FRT) capability of a DFIG wind farm connected through HVDC transmission lines are discussed. The electromechanical oscillations during a de loading operation of a DFIG wind turbine generator are simulated using BLADED software. Then power reduction control during a fault was achieved by reducing the power from the wind farm as a whole and by de loading the individual wind generator. A new power blocking technique applied at the offshore converter station was used to reduce the wind farm power output. Simultaneous control of the wind farm and wind turbine power outputs enabled a smooth power reduction during the fault.

III. CONCLUSION

In this paper, an overview and key issues of different research studies for Dynamic and Transient fault behaviours of DFIG is presented. The doubly fed induction generator has attracted many researchers' attention recently due to its ability to obviate defects caused by improper design of power electronics controlled unit, such as grid fault, over current, dynamic and transient behaviour etc. DFIG should be placed in the suitable power electronics converter design with crowbar circuits in order to provide transient and short circuit fault reduction, current limitations and technical and environmental benefits. It is clear, from the existing literature, that there are different solution methods for finding dynamic and transient fault clearance of DFIG by various objectives and their imposed constraints. To maximize the DFIG fault detection provided helpful information and references for researchers can lead additional studies in this field.

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[16] F. Poitiers, T. Bouaouiche, and M. Machmoum presented advanced control of a doubly-fed induction generator for wind energy conversion.

[17] Johan Morren, and S. joerd W. H. de Haan presented Ridethrough of Wind Turbines with Doubly-Fed Induction Generator During a Voltage Dip.

[18] Jin Yang, John E. Fletcher, and John O'Reilly presented A Series Dynamic Resistor Based Converter Protection Scheme for Doubly-Fed Induction Generator during Various Fault Conditions.

[19] Alejandro Rolan, Alvaro Luna, Gerardo Vazquez, Daniel Aguilar and Gustavo Azevedo presented Modelling of a Variable Speed Wind Turbine with a Permanent Magnet Synchronous Generator.

[20] J. G. Slootweg, S. W. H. de Haan, H. Polinder, and W. L. Kling presented General Model for Representing Variable Speed Wind Turbines in Power System Dynamics Simulations.

[21] Yazhou Lei, Alan Mullane, Gordon Lightbody, and Robert Yacamini presented Modeling of the Wind Turbine with a Doubly Fed Induction Generator for Grid Integration Studies.

[22] Richard Gagnon, Gilbert Sybille, Serge Bernard, Daniel Paré, Silvano Casoria, Christian Larose presented Modeling and Real-Time Simulation of a Doubly-Fed Induction Generator Driven by a Wind Turbine.

[23] A.A. El-Sattar, N.H. Saad, M.Z. Shams El-Dein presented Dynamic response of doubly fed induction generator variable speed wind turbine under fault.

[24] Jun Yao, Hui Li, Yong Liao, and Zhe Chen presented An Improved Control Strategy of Limiting the DC-Link Voltage Fluctuation for a Doubly Fed Induction Wind Generator.

[25] F. Wu, X.-P. Zhang, K. Godfrey and P. Ju presented Small signal stability analysis and optimal control of a wind turbine with doubly fed induction generator.

[26] M.T.V.L. RAVI KUMAR MADA, CH. SRINIVAS, K. SHASHIDHAR REDDY presented Doubly-Fed Induction Generator for Variable Speed Wind Energy Conversion Systems-Modelling & Simulation.

[27] Alvaro Luna, Francisco Kleber de Araujo Lima, David Santos, Pedro Rodríguez, Edson H. Watanabe, and Santiago Arnaltes presented Simpliûed Modelling of a DFIG for Transient Studies in Wind Power Applications.

[28] Warren N. White, Fariba Fateh, and Zhichao Yu presented Torsional Resonance Active Damping in Grid Tied Wind Turbines with Gearbox, DFIG, and Power Converters.

[29] Heng Nian, Peng Cheng, and Z. Q. Zhu presented Independent Operation of DFIG-Based WECS Using Resonant Feedback Compensators Under Unbalanced Grid Voltage Conditions.

[30] A. Arulampalam, G. Ramtharan, J.B. Ekanayake, A.P. Tennakoon, S.G. Abeyratne N. Jenkins, Presented Fault Ride Through operation of a DFIG wind farm connected through VSC HVDC.