POWER QUALITY IMPROVEMENT FOR WIND LARGE SCALE INTEGRATION WITH MULTI FREQUENCY OSCILLATIONS WITH MEASURED

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ABSTRACT: In the Recent Years with Large Portion of the Power is Being Generated with Renewable Energy Sources. The only problem with the wind is that it can't be maintained constant as the wind speed changes with Time with the changing of the wind Pattern Multiple Frequencies Come into Picture which Stabilizes the System Environment. This Paper Analyze the Such Multi Frequency Oscillations as they Cause the Large-scale Wind Power Integration with the Wind Turbines I.E. Shafting Torsional Oscillation, Sub/Super-Synchronous Oscillation and High Frequency Resonance. The State of the Art Is Systematically Summarized from The Aspects of Oscillation Mechanism, Analysis Methods and Mitigation Measures, and the Future Research Directions Are Prospected.

I.INTRODUCTION

In recent years, wind energy technology has advanced swiftly in China due to its mature generation and massive ability for improvement. The cumulative installed ability of wind energy in China has reached 164 GW, and the electricity proportion of wind power is nine.2% of total set up generation capability. Wind power useful resource in China is in particular concentrated in Northwest, Northeast and North China. In Gansu and Ningxia province, renewable electricity along with wind and sun strength is the second one largest strength supply in the nearby strength grid. The mounted potential of renewable electricity has reached 40.7% and 39. Nine% in 2017 in Gansu and Ningxiarespectively.

Wind energy generation is based on the electricity electronics era. With the huge-scale integration of wind strength and giant software of electricity digital devices in transmission, distribution, and intake, the level of modernization of power electronics in electricity devices is growing, which has profoundly modified the grid's dynamic behavior. On the only hand, electricity electronics generation makes the energy delivery more controllable, but alternatively, energy digital devices have the hazards of low-inertia, susceptible to grid disturbance, which carry new stability troubles to the strength machine. One of the most worried problems is the Multi-frequency Oscillation (MFO) issues covering more than one frequency segments, which include wind turbine's Shafting Torsional Oscillation (STO), Sub- synchronous Oscillation (SSO), fantastic-synchronous oscillation, and High Frequency Resonance (HFR). In current years, there have been many MFO activities because of huge- scale wind energy integration occurred in home and overseas projects, which significantly threaten the secure and strong operation of power device and limit the consumption of renewable strength. Some giant problems, such as the mechanism, evaluation techniques, prevention, and

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mitigation measures of MFO, have attracted wide interest from academia to enterprise.

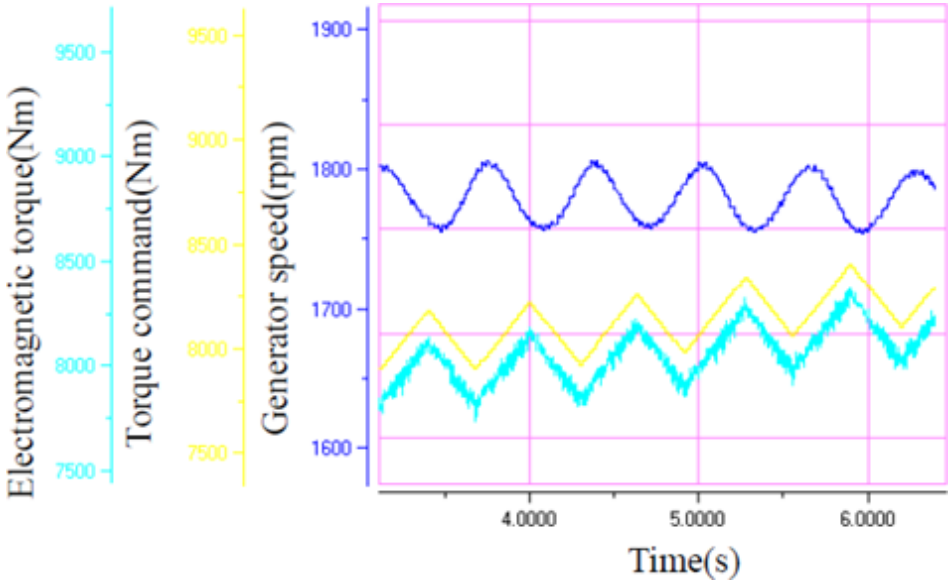
The organization's goal is to research and explain the multi-frequency stability trouble of converter-primarily based modern-day energy systems. Furthermore, some scholars pay attention to the Low-frequency Oscillation (LFO) characteristics in huge-scale included wind strength system, and analyses the machine oscillation mode after wind turbines replacing the identical potential thermal strength units The have an effect on of wind energy on small-sign angular balance is also studied. The construction of _grid-friendly‘ wind farms is the development fashion in the renewable electricity industry. In order to conduct a complete review on the MFO problem due to wind energy integration, this paper first of all elaborates several common MFO incidents in grid operation, and summarizes their characteristics and commonalities. Then, the state of the art of MFO is systematically summarized such as the components of oscillation mechanism, analysis methods, and mitigation measures. Finally, this paper has potentials for destiny research directions.

II.MULTI-FREQUENCY OSCILLATION INCIDENTS IN GRID OPERATION

This section introduces several typical MFO incidents in domestic and foreign grid operation.

A. Shafting Torsional OscillationIncident

The STO of Doubly-fed Induction Generator (DFIG)-based totally wind turbine takes place every now and then in wind farms, oscillation is due to torsional vibration between mass blocks in generators. The detected waveforms of wind turbine are shown in Fig.1, there are approximately 1. Four Hz oscillation components in generator pace, torque command, and electromagnetic torque. The repeated tightening and relaxation of force shaft will reason damage to generators‘ mechanical shaft. Meanwhile, the STO frequency may be very near the LFO frequency in strength gadget. Consequently, the resonation among STO mode and LFO mode can get worse the stability margin of the converter-grid device, even destabilize the device sooner or later.



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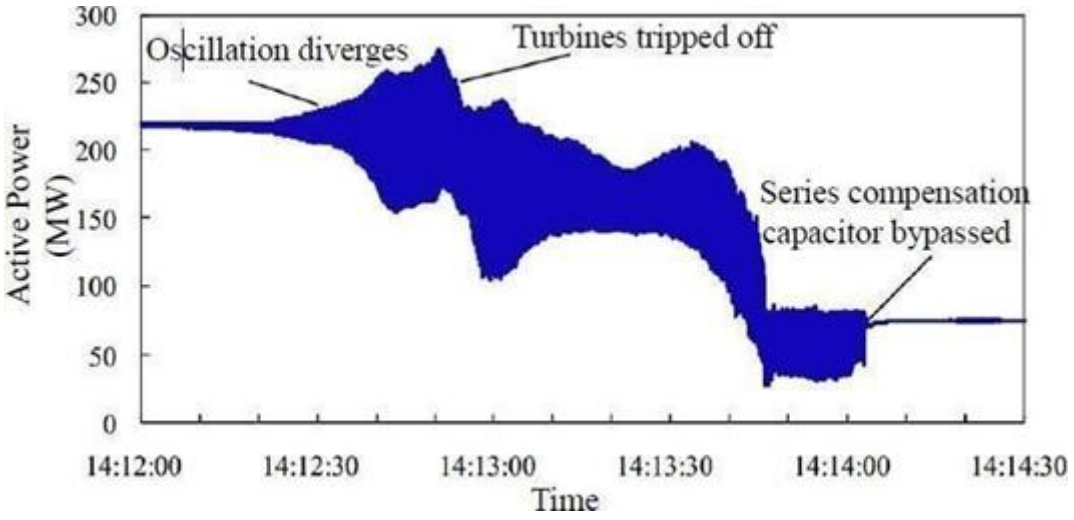
B. Sub-synchronous Oscillation Incidents

The SSO occasion due to wind power first passed off in a DFIG-based wind farm in southern Texas in October 2009 When the wind farm is connected to grid immediately via high reimbursement level line, the interaction between wind generators and series compensated transmission line led to SSO (approximately 20 Hz) in line contemporary and voltage. As the oscillation amplitude persevered to be increasing, it sooner or later leaded to generators‘ trip and damage of crowbar protection circuit. The follow-up research display that this new phenomenon isn't like conventional SSO related to synchronous mills‘ shaft torsional vibration, it's far a new SSO trouble named Sub-synchronous Control Interaction (SSCI) as a result of the interplay among a power digital control tool of wind turbine and a chaincompensated gadget energy Since 2011 masses of SSO (cutting-edge frequency variety from three to ten Hz, and lively frequency range from 40 to forty-seven Hz) occasions have come about in Hubei Guyana wind power machine, which has induced thousands of wind turbines to be reduce-off DFIG-based totally wind farms in Guiana place are radially connected to 220 kV substations, After which the wind energy export via 500 kV series-compensated transmission strains.



III.MECHANISM OF MULTI-FREQUENCYOSCILLATION

MFO brought about by wind power incorporation is another issue that has just showed up lately, the general exploration is as yet in a creating stage. There have been some exploration results concerning the system of MFO, and the accompanying area will give an overall audit of components on STO, sub/super-simultaneous swaying, andHFRissues.

A. Shaft Torsional Oscillation

As of now, DFIG, PMSG, and Squirrel Cage Induction Generator (SCIG) are broadly utilized in wind ranches. The mechanical shaft arrangement of DFIG and SCIG comprises of wind turbine, low/rapid shaft, gearbox and generator. The turbine speed is low, while the generator speed is high, so the gearbox interfacing the two is versatile association and has low comparable solidness. PMSG's mechanical shaft framework just contains three sections: wind turbine, low-speed shaft and generator, yet its multi-post design additionally causes mechanical shaft to have low comparablefirmness.

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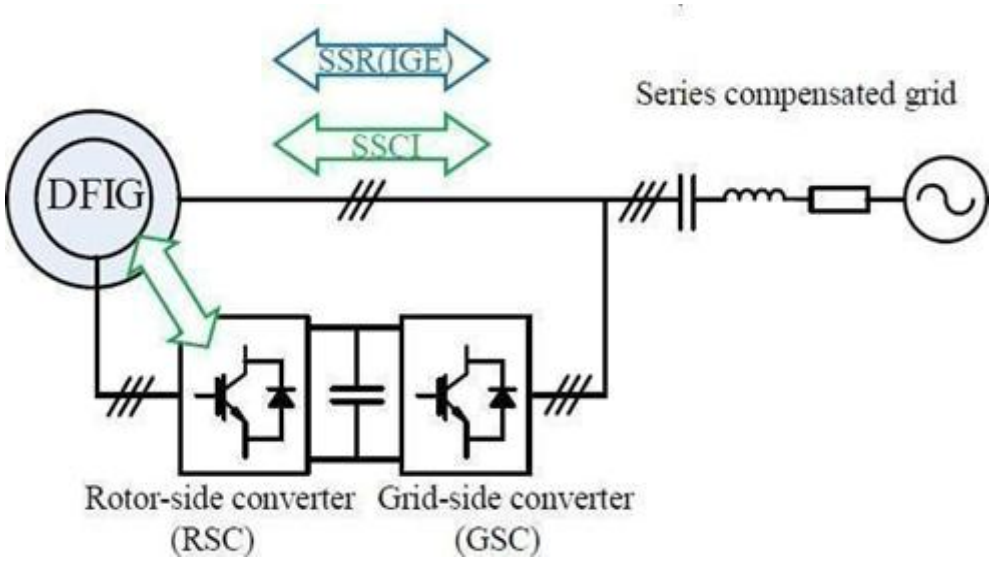
STO alludes to the unusual swaying wonder of adaptable mechanical shaft after unsettling influence. This shaft wavering includes electrical and mechanical parts, which will influence the unique steadiness of wind turbines and cause the swaying of dynamic force yield. Shaft wavering brought about by little aggravation normally has little plentifulness and brief span. At the point when a genuine framework shortcoming happens, huge unsettling influences might make the shaft framework a persistent twist or even flimsiness. The torsional vibration recurrence of wind turbines' mechanical shaft is somewhat low (2 MW DFIG is about 1.67Hz Flow investigates on the system of STO essentially incorporates two perspectives: negative damping impact and constrained swaying brought about by wind shear and pinnacle shadow impact.

B. Sub/super-simultaneous Oscillation

As a rule, ωr is bigger than ωer, subsequently the same opposition of rotor changed over to stator side is negative, which acquaints negative damping with the framework. Upgrading the key control boundaries and control methodologies of wind turbines that influence the wavering can keep the event of SSO from the underlying driver. Reference [58] proposed SSR concealment measure to change the control boundaries of DFIG converters. Reference [8] improves converter control boundaries of PMSG and takes care of the sub- coordinated unsteadiness issue. This methodology is the most financially savvy one as there is no compelling reason to contribute any new equipment, nor adjust existingcontrol block.



IV.ANALYSIS METHODS OF MULTI-FREQUENCY OSCILLATION

This section mainly provides a general introduction about oscillation analysis methods of power system with high wind power penetration.

A. EigenvalueAnalysis Method

Eigenvalue investigation technique is the most broadly utilized strategy for framework solidness examination. By linearizing nonlinear conditions at a given stable working point and tackling the state network, a ton of data like eigenvalues, eigenvectors and cooperation components canbegotten

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The eigenvalue investigation technique is frequently utilized in the investigation of STO and SSO: Oscillation strength can be decided by the genuine piece of eigenvalue, and the recurrence of swaying can be gotten by the fanciful piece of the eigenvalue the key boundaries influencing the swaying mode can be dictated by noticing the development pattern of eigenvaluelocus.

Eigenvalue examination technique has severe hypothesis and furnishes adequate data about swaying mode with high precision. However, utilizing this technique requires building an extremely itemized framework model that can completely reflect mechanical and electrical provisions of entire framework. Another downside is that this strategy requires exact boundaries of force electronic converters and itemized network activity boundaries. Also, in view of the privacy of business wind turbines, it is regularly extremely challenging to acquireThese boundaries or by quantitative examination of eigenvalue affectability and support factors

B. Frequency Scanning Method

Recurrence checking examination technique is an inexact linearization strategy. The recurrence impedance normal for a complicated framework is gotten by persistently infusing various frequencies of current at the generator side to screen out the framework activity mode with potential reverberation dangers Recurrence checking investigation strategy is straightforward and compelling, it is a not unexpected technique to dissecting SSO and is particularly reasonable for acquiring the impedance attributes of a VSC-HVDC framework with complex design In any case, this technique is restricted by the output step and got impedance qualities may not be precise enough at certain frequencies. Accordingly, the recurrence examining examination strategy is regularly joined with different techniques for additional checking.

C. Complex Torque Coefficient Method

Complex force coefficient investigation strategy is a mix technique for eigenvalue examination and recurrence checking investigation. The electrical and mechanical qualities of wind turbines are dissected independently in this strategy, and the electrical and mechanical complex force coefficients can be determined by examining the recurrence.

Complex force coefficient strategy is especially appropriate for the investigation of STO in wind turbines It can used to examine the effect of various boundaries on wavering, and is useful to the plan of damping regulator This strategy is likewise utilized in the examination of SSO The presumptions and improved on conditions in demonstrating measure impact the exactness of set up model.

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V.SIMULATION RESULTS

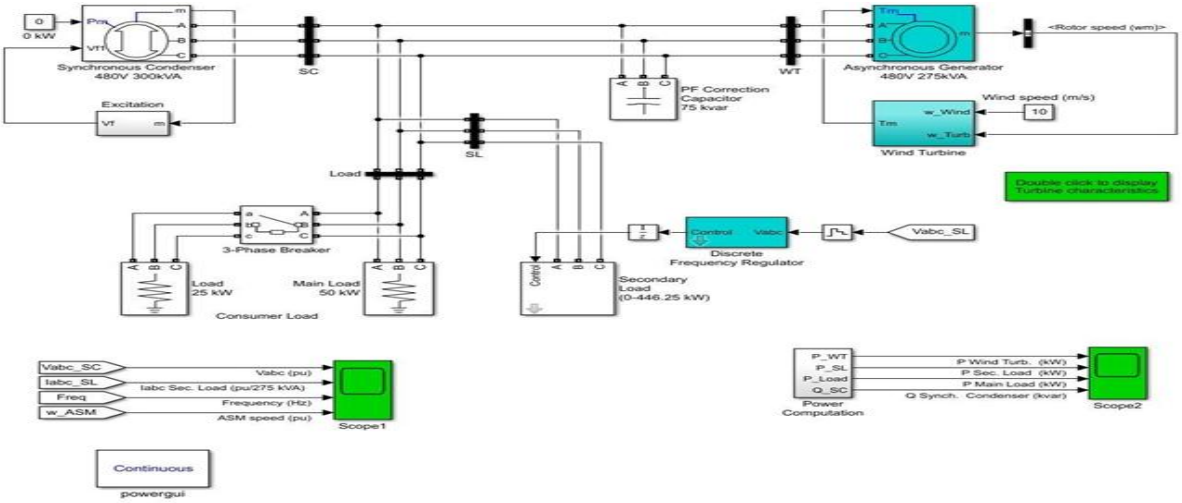

Fig: 1.Proposed Simulation diagram

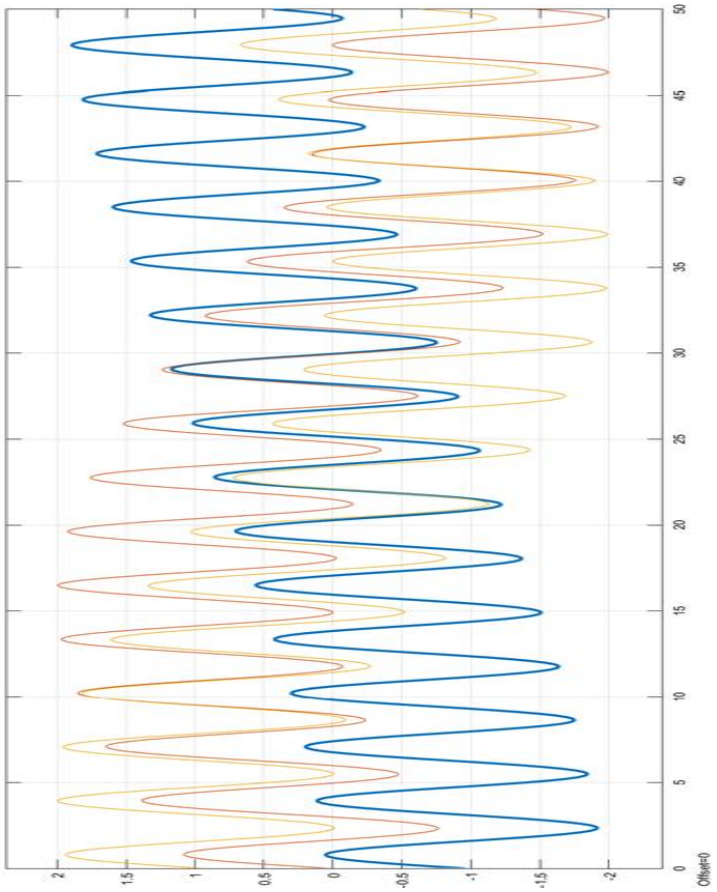

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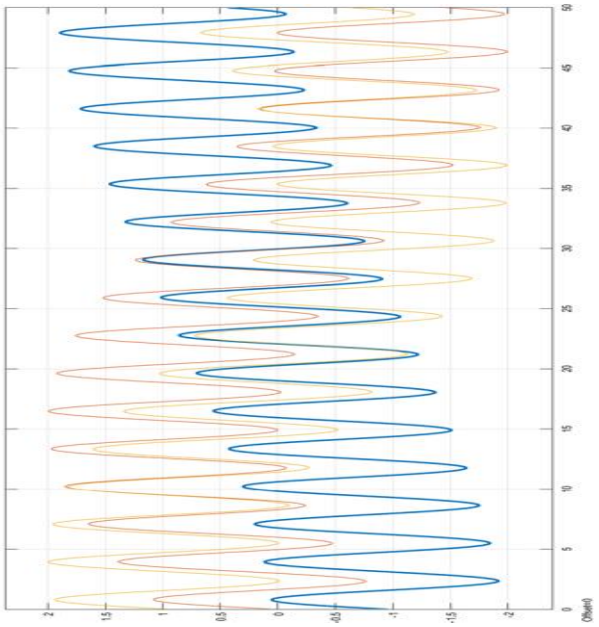
Fig:2. Grid side Converter Wave form



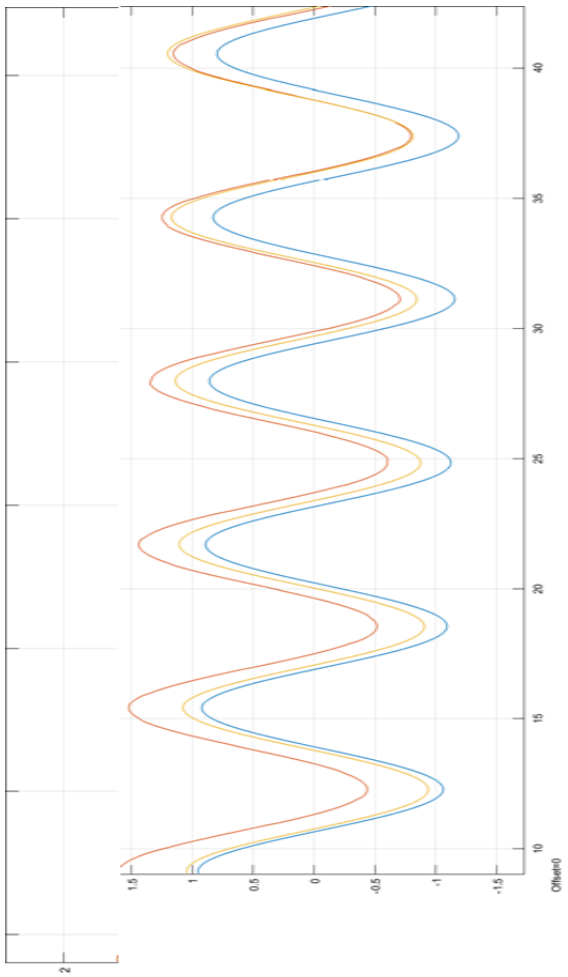


Fig: 3.Router Side converter Wave form

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VI.CONCLUSION: To acquire further bits of knowledge into the MFO issues, future exploration work should be completed in after themes:

1) The incorporation of wind force can prompt various motions in various recurrence data transmission. Regardless of whether different motions will happen at the same time or even communicate with one another should be additionally contemplated andsummed up.

2) In current examinations, the instrument of SSO brought about by the cooperation between PMSG-based breeze turbines and AC frail network and the wide-going proliferation of sub- coordinated parts in lattice has not been concentrated totally, and related issues should be additionallyinvestigated.

3) as of now, there are generally couple of studies on motions in sub-simultaneous and high recurrence range brought about by wind ranch mix through VSC-HVDC framework. The HFR brought about by VSC-HVDC framework actually comes up short on a total instrument clarification.

4) The control of force electronic gadgets has solid nonlinearity, so it is important to track down a suitable examination strategy to concentrate on the unique coupling association between power electronic gadgets and AC/DC crossover complex framework. Time-shifting component as the framework working conditions or boundaries change. It is a significant specialized test to viably recognize and distinguish the swaying and afterward take relating relief measures in latticeactivity.

5) The recurrence of wavering brought about by wind power combination is different, and the swaying recurrence has time-shifting component as the framework working conditions or boundaries change. It is a significant specialized test to viably recognize and distinguish the swaying and afterward take relating relief measures in latticeactivity

REFERENCES

[1]NationalEnergyAdministration.(2018,Feb.). 2017windpowerintegration.Beijing.China. [Online].Available: http://www.nea.gov.cn/2018-02/01/c_136942234.htm

[2] H. Li, H. W. Chen, C. Yang, et al, ―Modal analysis of the low-frequency oscillation of power systems with DFIG-based wind farms,‖ Proceedings of the CSEE, vol. 33, no. 31, pp. 17–24,Oct.2013.

[3] P. He, F. S. Wen, Y. S. Xue, ―Impacts of wind power integration on small signal stability and low frequency oscillation characteristics of interconnected power systems,‖ Automation of Electric Power Systems, vol. 38, no. 22, pp. 1–10,Nov.2014.

[4] W. J. Du, J. T. Bi, H. F. Wang, ―Small-signal angular stability of power system as affected by grid-connected variable speed wind generators—a survey of recent representative works,‖ CSEE Journal of Power and Energy Systems, vol. 3, no. 3, pp. 223–231,Sep.2017.

[5] C. Lawrence, J. P. Gross, ―Sub-synchronous grid conditions: new event, new problem, and new solutions,‖ in Western Protective Relay Conference, Washington, USA, 2010, Oct.19–21, 2010.

[6] J. Adams, C. Carter, S. H. Huang, ―ERCOT experience with sub-synchronous control interaction and proposed remediation,‖ in 2012 IEEE PES Transmission and Distribution Conference and Exposition, Orlando, USA,May.7–10,2012.

[7] M. J. Li, Z. Yu, T. Xu, et al, ―Study of complex oscillation caused by renewable

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ISSN (Online): 2203-1731

energy integration and its solution,‖ Power System Technology, vol. 41, no. 4, pp. 1034–1042, Apr. 2017.

[8] L. Shoal, R. Sharma, S. Prized, et al, ―Eigenvalue-based stability analysis of sub-synchronousoscillationinanoffshorewindpower plant,‖in17thInternationalWorkshopon Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants, Stockholm, Sweden, Oct.16–18, 2018.

[9] J. Lü, P. Dong, G. Shi, et al, ―Sub synchronous oscillation and its mitigation of MMC- based HVDC with large doubly-fed induction generator-based wind farm integration,‖ Proceedings of the CSEE, vol. 35, no. 19, pp. 4852–4860,Oct.2015.

[10] C. Buchanan, C. Rauscher, A. Mensa, et al, ―BorWin1 -first experiences with harmonic interactions in converter dominated grids,‖ in Die Energiewende - Blueprints for the New Energy Age, Bonn, Germany,Nov.17–18,2015.

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