A PROTECTION SCHEME FOR UNBALANCED THREE PHASE CONVERTER BY USING ZERO SEQUENCE CURRENTS

[1]C.Siva Ganga,[2]Y.Sudharshan,[3]N.Siresha
[1]Student,[2]Student,[3]Student
[1]Department of Electrical & Electronics Engineering
[1]Annamacharya Institute of Technology & Sciences, Rajampet,India

Abstract :In power system, the three-phase dc to ac power converters suffer from power oscillation and over current problems in case of the unbalanced ac source voltage that can be caused by grid/generator faults. Existing solutions to handle these problems are properly selecting and controlling the positive and negative-sequence currents. These methods use the typical three-phase three-wire converter structure having four control freedoms for the load current but these seem to be not enough to achieve satisfactory performances under the unbalanced ac source because this method cannot avert power oscillation and overloaded or distorted current. Therefore, more current control freedoms are needed to improve the control performance under the unbalanced ac source conditions.

A new series of zero sequence logic control strategies which utilize the three phase four wire and six wire converter structures with the zero-sequence components, which may enable extra current control freedoms are proposed to enhance the power controllability under this adverse condition to introduce proper zero-sequence current controls and corresponding circuit configurations. The power converter can enable more flexible control targets; these seem to be enough to achieve satisfactory performances under the unbalanced ac source because the power oscillations and over current problems can be eliminated.

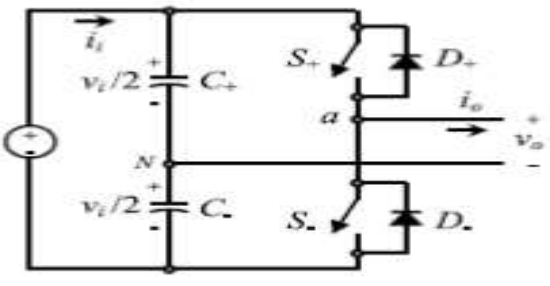
I. INTRODUCTION

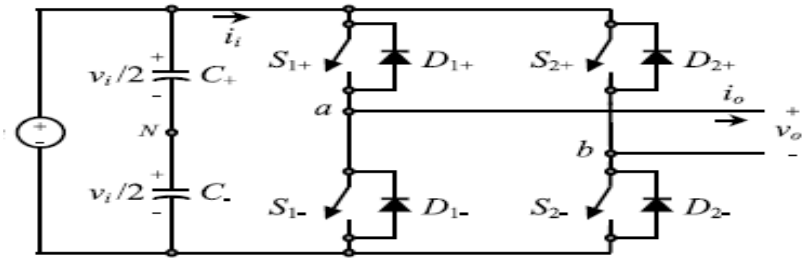
Three-phase dc–ac power converters suffer from power oscillation and over current problems in case of the unbalanced ac source voltage that can be caused by grid/generator faults. Existing solutions to handle these problems are properly selecting and controlling the positive- and negative-sequence currents. In this paper, a new series of control strategies which utilize the zero sequence components are proposed to enhance the power controllability under this adverse condition. It is concluded that by introducing proper zero-sequence current controls and corresponding circuit configurations, the power converter can enable more flexible control targets, achieving better performances in the delivered power and the load current when suffering from the unbalanced voltage. Decoupled control of quick dynamic and receptive forces is then accomplished by managing the deteriorated converter streams utilizing corresponding necessary (PI) controller

II. FAULT TOLERANCE OF CONVERTER

The expanded measure of power from decentralized renewable vitality frameworks, as particularly wind vitality frameworks, requires goal-oriented matrix code prerequisites to keep up a steady and safe operation of the vitality arrange. The framework codes cover rules considering the blame ride-through conduct and in addition the unfaltering state dynamic power and receptive power generation. The genuine framework codes stipulate that wind homesteads ought to add to power framework control like recurrence and voltage control to carry on like ordinary power stations. A definite survey of lattice code specialized prerequisites in regards to the association of twist ranches to the electrical power system [33]. For operation amid framework voltage shortcomings, it turns out to be obvious that matrix codes recommend that wind turbines must remain associated with the lattice and ought to bolster the network by producing receptive energy to bolster and reestablish rapidly the matrix voltage after the blame.

Adaptation to non-critical failure is the property that empowers a framework to keep working legitimately in case of the disappointment of some of its parts. On the off chance that its working quality declines by any means, the lessening is corresponding to the seriousness of the disappointment, when contrasted with a gullibly planned framework in which even a little disappointment can bring about aggregate breakdown. Adaptation to non-critical failure is especially looked for after in high-accessibility.



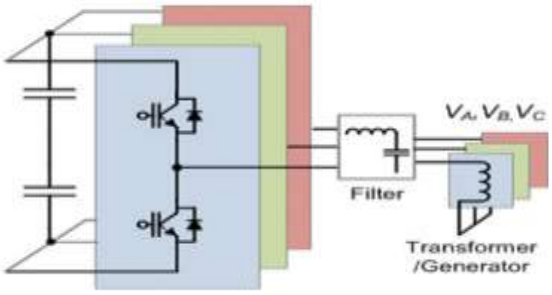


III. MODELING OF CONVERTER SYSTEM

A specific end goal to investigate the controllability and the execution of the power hardware converter under an unfavorable air conditioning source, an extreme unequal air conditioning voltage is initially characterized as a contextual analysis in this paper. Additionally, there are numerous different sorts of voltage shortcomings which have been characterized. As indicated by [2] and [19], any contorted three-stage voltage can be communicated by the whole of segments in the positive arrangement, negative grouping, and zero succession. For straightforwardness of investigation, just the segments with the principal recurrence are considered in this paper, nonetheless, it is likewise conceivable to extend the examination to higher request music. The contorted three-stage air conditioning source voltage can be spoken to by

$$V_S = V^+ + V^- + V^{.0}$$

$$= \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = V^+ \begin{bmatrix} sin(\omega i + \varphi^+) \\ sin(\omega i - 120^0 + \varphi^+) \\ sin(\omega i + 120^0 + \varphi^+) \end{bmatrix} + V^- \begin{bmatrix} sin(\omega i + \varphi^-) \\ sin(\omega i + 120^0 + \varphi^-) \\ sin(\omega i - 120^0 + \varphi^-) \end{bmatrix} + V^0 \begin{bmatrix} sin(\omega i + \varphi^0) \\ sin(\omega i + \varphi^0) \\ sin(\omega i + \varphi^0) \end{bmatrix} \quad (3.1)$$



IV. SIMULATION RESULTS AND DISCUSSIONS

IV.I ELIMINATION OF BOTH ACTIVE AND REACTIVE POWER OSCILLATIONS

The three-phase dc–ac converters are critical components as the power flow interface of dc and ac electrical system.
A dc–ac voltage source converter with a corresponding filter is typically used to convert the energy between the dc bus and the three-phaseshowninfigure4.1.

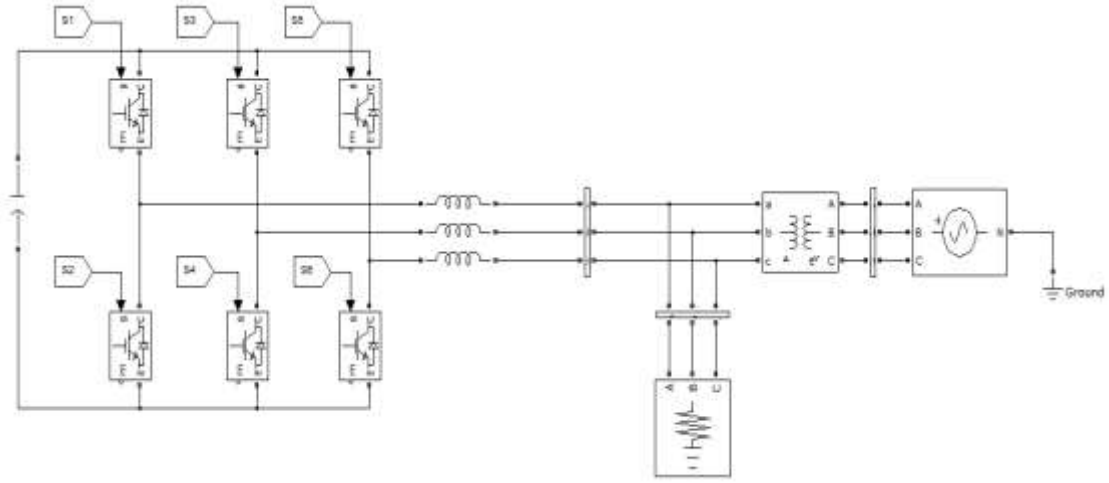


Figure4.1.Simulink model of DC to AC power converter

IV.II CONVENTIONAL PI CONTROLLER

Proportional-Integral (PI) controllers are the most commonly used controllers, especially in the electronic industry.

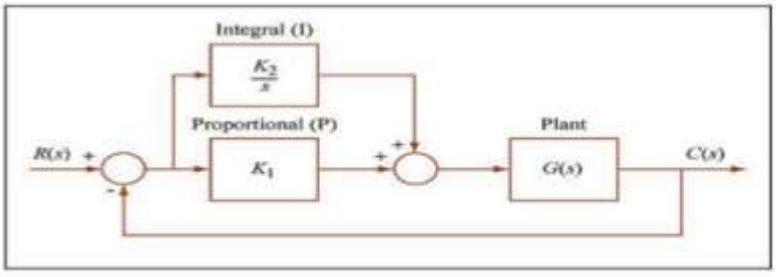
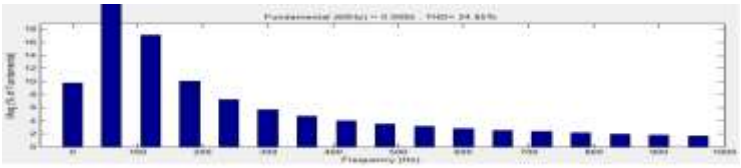


Figure 4.2. Conventional PI controller diagram

IV.III RESULT

Here mainly focused on improvement of power control limits of a typical three-phase dc–ac converter system under the unbalanced ac source using zero sequence logic controller. A new series of control strategies which utilizes the zero-sequence components are then proposed to enhance the power control ability under this adverse condition. The three-phase converter structure having six current control freedoms. The extra two control freedoms coming from the zero-sequence current can be utilized to extend the controllability of the converter and improve the control performance under the unbalanced ac source. By using zero sequence logic control strategies, it is possible to totally cancel the oscillation in both the active and the reactive power, orreduced the oscillation amplitude in the reactive power. Meanwhile, the current amplitude of the faulty phase is significantly relieved without further increasing the current amplitude in the normal phases.



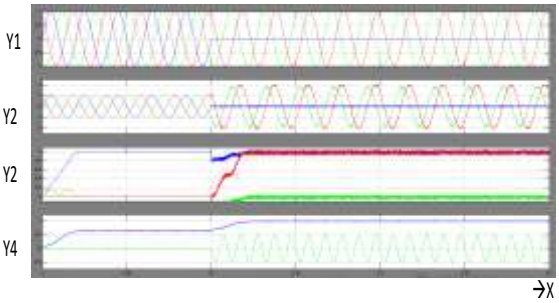


Figure 4.9 : Simulation result of converter system with no P oscillations and negative sequence current using PI controller

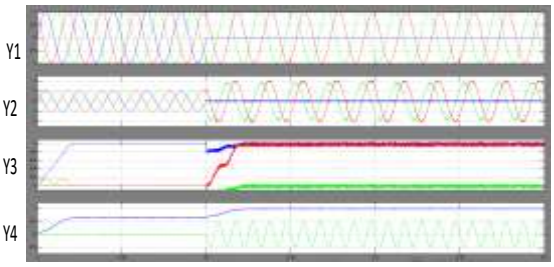


Figure 4.10: Simulation result of converter system with no P oscillations and negative sequence current using ZERO sequence controller

Y1: source voltage (p.u) Y2: load current(p.u) Y3: current ampl.(p.u)
Y4: output power(p.u) X: time(sec)

24

V. FUTURE SCOPE

This project work can be extended further by Control scheme for photovoltaic three-phase converters to minimize peak currents during unbalanced grid-voltage sags. By using the unbalanced voltage sources, the reduction of complexity and total cost of the converter can be achieved.

VI. ACKNOWLEDGMENT

The authors convey deep sense of gratitude to the management of Annamacharya Institute of Technology and Sciences for helping with required facilities to complete this work.

REFERENCES

[1] Han, Y.; Shen, P.; Zhao, X.; Guerrero, J.M. Control Strategies for Islanded Microgrid Using Enhanced Hierarchical Control Structure with Multiple Current-Loop Damping Schemes. IEEE Trans. Smart Grid 2017, 8, 1139–1153.

[2] Baghaee, H.R.; Mirsalim, M.; Gharehpetian, G.B. Three-phase AC/DC power-flow for balanced/unbalanced microgrids including wind/solar, droop-controlled and electronically-coupled distributed energy resources using radial basis function neural networks. IET Power Electron. 2017, 10, 313–328.

[3]Dawoud, S.M.; Lin, X.; Okba, M.I. Hybrid renewable microgrid optimization techniques: A review. Renew. Sustain. Energy Rev. 2018, 82, 2039–2052.

[4] Guerrero, J.M.; Loh, P.C.; Lee, T.L.; Chandorkar, M. Advanced control architectures for intelligentmicrogrids-part II: Power quality, energy storage, and AC/DC microgrids. IEEE Trans. Ind. Electron. 2013, 60, 1263–1270.

[5] Ou, T.C.; Lu, K.H.; Huang, C.J. Improvement of Transient Stability in a Hybrid Power Multi-System Using a Designed NIDC. Energies 2017, 10, 488.

[6] Lin, L.; Ma, H.; Bai, Z. An improved proportional load-sharing strategy for meshed parallel inverters system with complex impedances. IEEE Trans. Power Electron. 2017, 32, 7338–7351.

[7]Marchiano, M.; David, M.J.; Rayworth, E.A. Power Generation Load Sharing Using Droop Control in an Island System. IEEE Trans. Ind. Appl. 2018, 54, 1890–1898.

[8] Zhang, D.; Wang, F.F.; Burgos, R.; Boroyevich, D. Common-mode circulating current control of paralleled interleaved three-phase two-level voltage-source converters with discontinuous space-vector modulation. IEEE Trans. Power Electron. 2011, 26, 3925–3935.

[9] Hosseinzadeh, M.; Farzad, R.S. Robust Optimal Power Management System for a Hybrid AC/DC MicroGrid. IEEE Trans. Sustain. Energy 2015, 6, 675–687.

[10]Hosseinzadeh, M.; Farzad, R.S. Power management of an isolated hybrid AC/DC micro-grid with fuzzy control of battery banks. IET Renew. Power Gener. 2015, 9, 484–493.

[11] Leonardo, R.L.; Fabricio, B.; Calebe, H.O.L.; Marcelo, C.C. Reactive power and current harmonic control using a dual hybrid power filter for unbalanced non-linear loads. Energies 2018, 11, 1392. Energies 2018, 11, 2486 16 of 16

[12] Han, Y.; Shen, P.; Zhao, X.; Josep, M.G. An enhanced power sharing scheme for voltage unbalance and harmonics compensation in an islanded ac microgrid. IEEE Trans. Energy Convers. 2016, 31, 1037–1050.

[13] Mehdi, S.; Alireza, J.; Juan, C.V.; Josep, M.G. Secondary control scheme for voltage unbalance compensation in an islanded droop-controlled microgrid. IEEE Trans. Smart Grid 2012, 3, 797–807.

[14] Mehdi, S.; Alireza, J.; Juan, C.V. Autonomous Voltage Unbalance Compensation in an Islanded DroopControlled Microgrid. IEEE Trans. Ind. Electron. 2013, 60, 1390–1402.

[15] Liu, Q.; Tao, Y.; Liu, X.; Deng, Y.; He, X. Voltage unbalance and harmonics compensation for islanded microgrid inverters. IET Power Electron. 2014, 7, 1055–1063.

[16] Vyawahare, D.; Chandorkar, M. Distributed generation system with hybrid inverter interfaces for unbalanced loads. In Proceedings of the 2015 IEEE 6th International Symposium on Power Electronics for Distributed Generation Systems, Aachen, Germany, 22–25 June 2015.

[17] Quentin, T.; Ionel, V.; Aitor, E. Hybrid Energy Storage System Microgrids Integration for Power Quality Improvement Using Four-Leg Three-Level NPC Inverter and Second-Order Sliding Mode Control. IEEE Trans. Ind. Electron. 2018, 65, 424–435.

[18] Ruben, L.; Juan, M.M.; Antonio, G.E.; Mehdi, S.; Josep, M.G. Grid-forming VSC control in four-wire systems with unbalanced nonlinear loads. Electr. Power Syst. Res. 2017, 152, 249–256.

[19] Ou, T.C. A novel unsymmetrical faults analysis for microgrid distribution systems. Int. J. Electr. Power Energy Syst. 2012, 43, 1017–1024.

[20] Bina, M.T.; Kashefi, A. Three-phase unbalance of distribution systems: Complementary analysis and experimental case study. Int. J. Electr. Power Energy Syst. 2011, 33, 817–826.

[21] Ritwik, M.; Balarko, C.; Arindam, G.; Rajat, M.; Gerard, L.; Firuz, Z. Improvement of stability and load sharing in an autonomous microgrid using supplementary droop control loop. IEEE Trans. Power Syst. 2010, 25, 796–808.

[22] Qobad, S.; Josep, M.G.; Juan, C.V. Distributed secondary control for islanded microgrids-a novel approach. IEEE Trans. Power Electron. 2014, 29, 1018–1031.

[23] Han, Y.; Li, H.; Shen, P.; Ernane, A.A.C.; Josep, M.G. Review of active and reactive power sharing strategies in hierarchical controlled microgrids. IEEE Trans. Power Electron. 2017, 32, 2427–2451.

[24] He, J.; Li, Y.; Frede, B. An enhanced islanding microgrid reactive power, imbalance power, and harmonic power sharing scheme. IEEE Trans. Power Electron. 2015, 30, 3389–3401.