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MODELLING AND SIMULATION OF IMPROVED FUEL CELL CONTECTED TO GRID THROUGH INVERTER

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Abstract:

Fuel cell systems are enhancing due to interest to supply electricity in remote areas as well as distributed power generation especially during the peak loads. Fuel cell generation becomes popular due to cleanliness, portability and suitability for electricity and heat generation. This paper presents the modelling of a fuel cell power plant (FCPP) in terms of fuel cell, dc-dc converter, dc-ac inverter and power system parameters, to interface with loads or grid. The control strategy of this model is hysteresis current controller (HCC). HCC is used to generate inverter switch pulse for the ac grid voltage. MATLAB/SIMULINK is used to validate the modelling and simulation of fuel cell generation and power conditioning unit. The proposed control strategy makes the distribution generation system work properly when the voltage disturbance occurs in the distribution system.

Keywords: ANN, PV, DC voltage, MPPT, High efficiency .

1. INTRODUCTION:

A fuel cell is an electrochemical cell that converts a source fuel into an electrical current. It generates electricity inside a cell through reactions between a fuel and an oxidant, triggered in the presence of an electrolyte. The reactants flow into the cell, and the reaction products flow out of it, while the electrolyte remains within it. Fuel cells can operate continuously as long as the necessary reactant and oxidant flows are maintained. Fuel cells are different from conventional electrochemical cell batteries in that they consume reactant from an external source, which must be replenished[1] – a thermodynamically open system. By contrast, batteries store electrical energy chemically and hence represent a thermodynamically closed system.

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Many combinations of fuels and oxidants are possible. A hydrogen fuel cell uses hydrogen as its fuel and oxygen (usually from air) as its oxidant. Other fuels include hydrocarbons and alcohols. Other oxidants include chlorine and chlorine dioxide Fuel cells come in many varieties; however, they all work in the same general manner.

They are made up of three segments which are sandwiched together: the anode, the electrolyte, and the cathode. Two chemical reactions occur at the interfaces of the three different segments. The net result of the two reactions is that fuel is consumed, water or carbon dioxide is created, and an electrical current is created, which can be used to power electrical devices, normally referred to as the load. At the anode a catalyst oxidizes the fuel, usually hydrogen, turning the fuel into a positively charged ion and a negatively charged electron. The electrolyte is a substance specifically designed so ions can pass through it, but the electrons cannot. The freed electrons travel through a wire creating the electrical current. The ions travel through the electrolyte to the cathode. Once reaching the cathode, the ions are reunited with the electrons and the two react with a third chemical, usually oxygen, to create water or carbon dioxide.

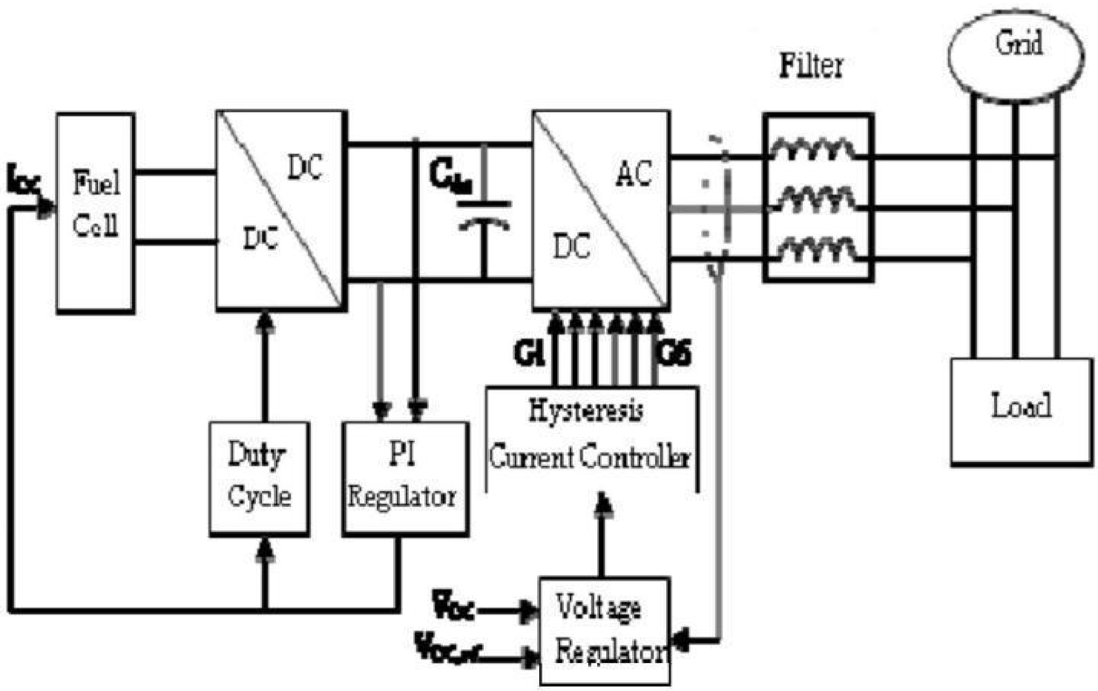

Fig 1 Proposed system configuration

SIMULATION RESULTS

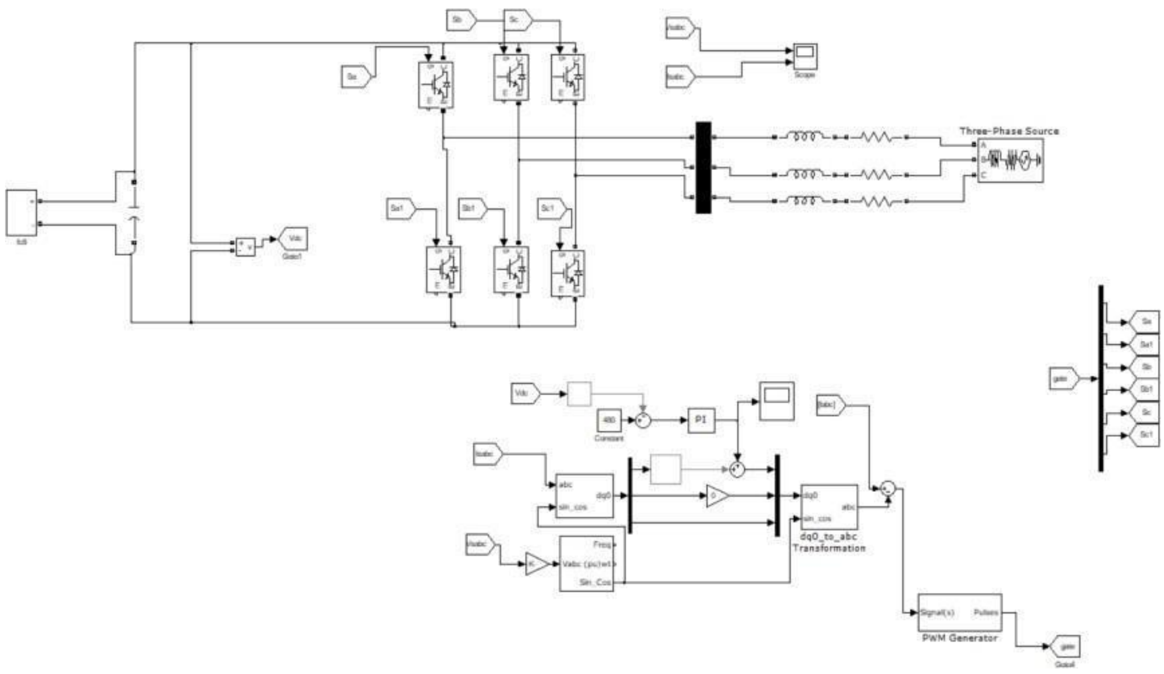

Fig 2 Proposed circuit configuration

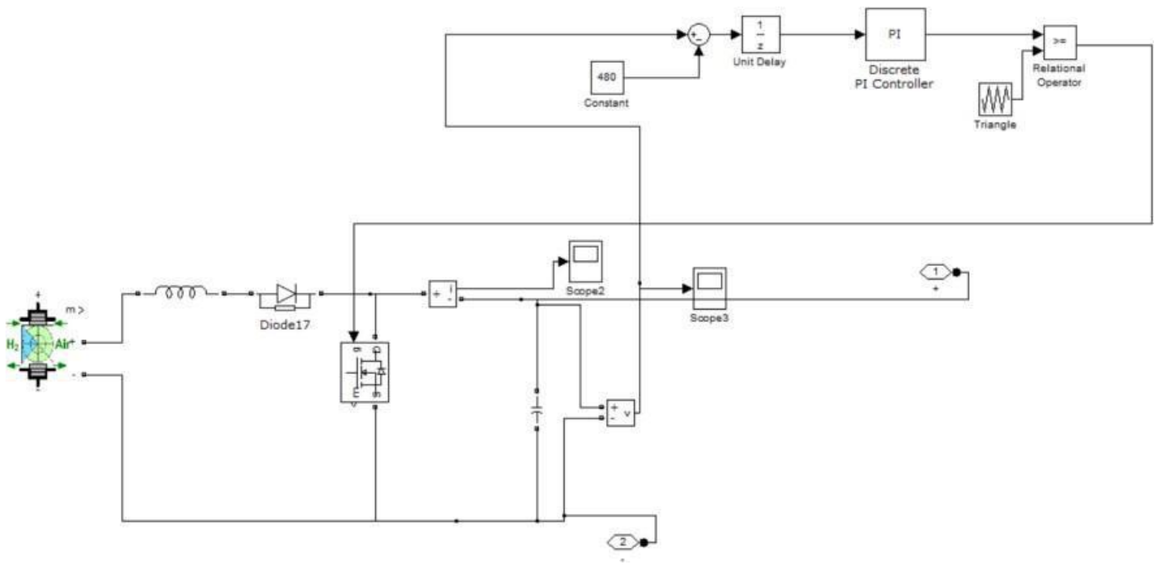

Fig 3 Fuel cell input system

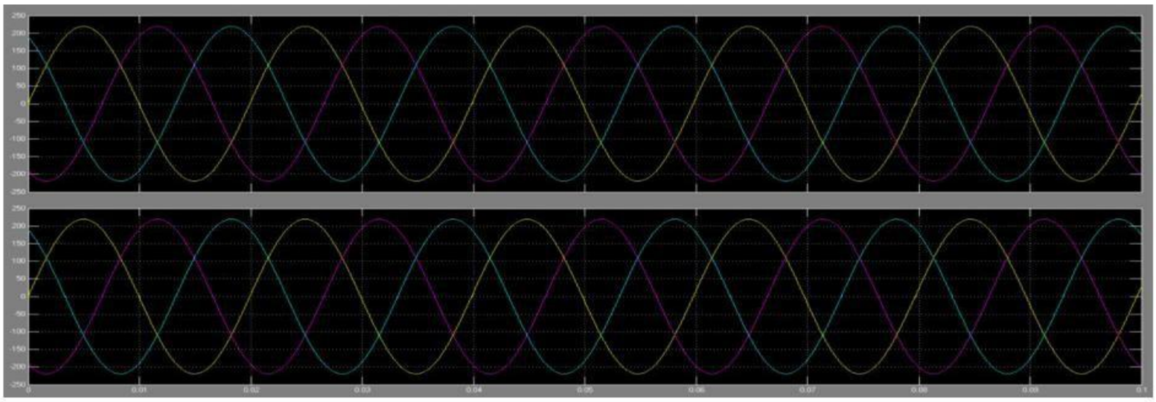

Fig 4 Grid voltage and current

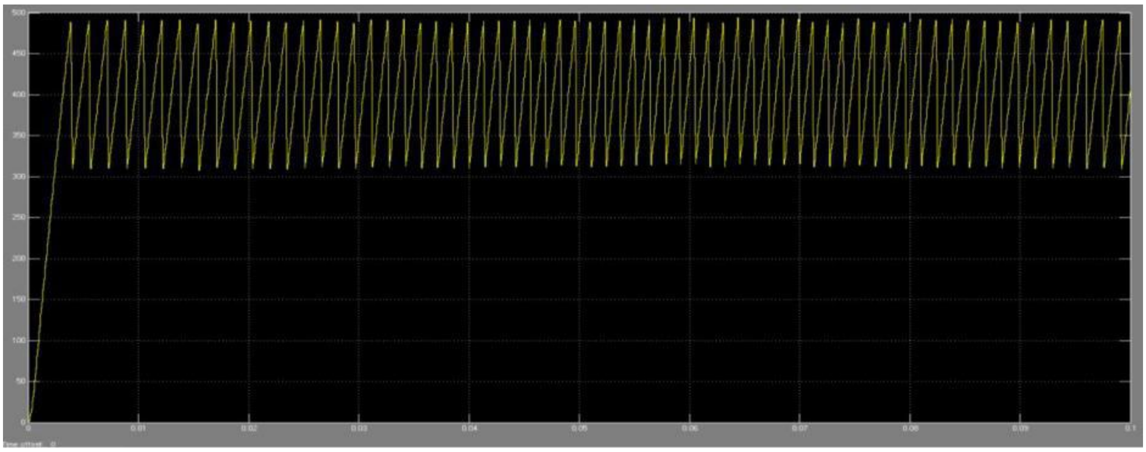

Fig 5 Boost converter voltage

CONCLUSION

This paper presents a three phase DSTATCOM as a voltage regulator and its control strategy, composed of the conventional loops, output voltage and dc bus regulation loops, including the voltage amplitude and the frequency loops. Experimental results demonstrate the voltage regulation capability, supplying three balanced voltages at the PCC, even under nonlinear loads. The proposed amplitude loop was able to reduce the voltage regulator processed apparent power about 51 % with nonlinear load and even more with linear load (80%). The mPPT algorithm tracked the minimum power point within the allowable voltage range when reactive power compensation is not necessary. With grid voltage sag and swell, the amplitude loop meets the grid code. The mPPT can also be implemented in current-controlled DSTATCOMs, achieving similar results. The frequency loop kept the compensation angle within the analog limits, increasing the autonomy of the voltage regulator, and the dc bus voltage regulated at nominal value, thus minimizing the dc bus voltage steady state error. Simultaneous operation of the mPPT and the frequency loop was verified. The proposed voltage regulator is a shunt connected solution, which is tied to low voltage distribution grids without any power interruption to the loads, without any grid voltage and impedance information, and provides balanced and low-THD voltages to the customers.

REFERENCES

[1] ANEEL National Electric Power Distribution System Procedures – PRODIST, Module 8: Energy Quality. Revision 07, 2014.

[2] M. Mishra, A. Ghosh and A. Joshi, "Operation of a DSTATCOM in voltage control mode," IEEE Trans. Power Del., vol. 18, no. 1, pp. 258-264, Jan. 2003.

[3] G. Ledwich and A. Ghosh, "A flexible DSTATCOM operating in voltage or current control mode," IEE Proc.-Gener., Transmiss. Distrib., vol. 149, n. 2, pp. 215-224, Mar. 2002.

[4] T. P. Enderle, G. da Silva, C. Fischer, R. C. Beltrame, L. Schuch, V. F. Montagner and C. Rech, "D-STATCOM applied to single-phase distribution networks: Modeling and control," in Proc. IEEE Ind. Electron. Soc. Annu. Conf., Oct. 2012, pp. 321 - 326.

[5] C. Kumar and M. Mishra, "Energy conservation and power quality improvement with voltage controlled DSTATCOM," in Proc. Annu. IEEE India Conf., Dec. 2013 pp. 1-6.

[6] R. T. Hock, Y. R. De Novaes and A. L. Batschauer, "A voltage regulator based in a voltagecontrolled DSTATCOM with minimum power point tracker," in Proc. IEEE Energy Convers. Congr. Expo., Sep. 2014, pp. 3694-3701.

[7] B. Singh, R. Saha, A. Chandra and K. Al-Haddad, "Static synchronous compensators (STATCOM): a review," IET Power Electron., vol. 2, no. 4, pp. 297-324, Jul. 2009.

[8] C. Kumar and M. Mishra, "A Multifunctional DSTATCOM Operating Under Stiff Source," IEEE Trans. Ind. Electron., vol. 61, no. 7, pp. 3131-3136, Jul. 2014.

[9] C. Kumar and M. Mishra, “A Voltage-Controlled DSTATCOM for Power-Quality Improvement,” IEEE Trans. Power Del., vol. 29, no. 3, pp. 1499-1507, Jun. 2014.

[10] S.-H. Ko, S. Lee, H. Dehbonei and C. Nayar, “Application of voltage- and currentcontrolled voltage source inverters for distributed generation systems,” IEEE Trans. Energy Conv., vol. 21, no. 3, pp. 782-792, Sep. 2006.

[11] R. T. Hock, Y. R. De Novaes and A. L. Batschauer, “Frequency Compensation for Stand Alone Voltage-controlled DSTATCOM,” in Proc. Brazilian Power Electron. Conf. and Southern Power Electron. Conf., Dec. 2015, pp. 1-6.

[12] T. Esram and P. Chapman, “Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques,” IEEE Trans. Energy Conv., vol. 22, no. 2, pp. 439-449, Jun. 2007.

[13] A. Al-Diab e C. Sourkounis, “Multi-tracking single-fed PV inverter,” in Proc. 15th IEEE Mediterranean Electrotech. Conf., Apr. 2010, pp. 1117-1122.

[14] M. de Brito, L. Galotto, L. Sampaio, G. de Azevedo e Melo and C. Canesin “Evaluation of the Main MPPT Techniques for Photovoltaic Applications,” IEEE Trans. Ind. Electron., vol. 60, no. 3, pp. 1156-1167, Mar. 2013.

[15] F. Ansari, A. Iqbal, S. Chatterji and A. Afzal, “Control of MPPT for photovoltaic systems using advanced algorithm EPP,” in Proc. 3rd Int. Conf. Power Syst., Dec. 2009, pp. 1-6.