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A Review Simulation of Fuel Cell in Power System and Study for ElectricVehicles

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Abstract *–Powerdistributionsystems,ideally,havetobecompelledtoprovidetheircustomerswithassociate uninterrupted flow of energy at smooth sinusoidal voltage at the narrowed magnitudelevel and frequency however, in follow of power systems, notably the distribution system, havevaried nonlinearloads, that significantly have a bearing on the standard of power provides. As aresult of the nonlinear loads, the purity of the waveform of provides is lost. These finally end upproducingmany powerquality problems.Fuel cell cars are powered by compressed hydrogen gas that feeds into an onboard fuel cell "stack" that doesn't burn the gas, but instead transforms the fuel's chemical energy into electrical energy. This electricity then powers the car's electric motors.*

Keywords: **Electric Vehicle; Power system of vehicle; Fuel Cell vehicle; Solar Vehicle**

I. INTRODUCTION

In current scenario, industrial devices are mainly based on electronic devices like programmable logic controllers, scada and electronic drives for getting the target. The electronic devices are very sensitive to disturbances and subsided tolerant to power quality problems like voltage sags, swells and harmonics. Voltage dips are thought of to be one in each of the foremost severe disturbances to the industrial equipments [1].

A. Power Quality Problems

Power distribution systems, ideally, have to be compelled to provide their customers with associate uninterrupted flow of energy at smooth sinusoidal voltage at the narrowed magnitude level and required frequency however [2].

The power disturbances occur on all electrical systems, the sensitivity of today's refined electronic devices makes them lots of risk of the quality of power provide. for some sensitive devices, in a brief disturbance can cause disorganized knowledge, interrupted communications, a frozen mouse, system crashes and failure etc. an influence voltage spike can damage valuable components. Power Quality problems embody an outsized vary of disturbances just like voltage sags/swells, flicker, harmonics distortion, impulse transient, and interruptions [3].

II. LITERATURE REVIEW

A. Review Based on STATCOM

Several research papers and publications have addressed the improvement of power quality using DVR. A brief review of the work undertaken so far is as follows:

N.G.Hingorani et al. [2] introduced a technology popularly known as FACTS (flexible Ac transmission system) based on power electronics to enhance the controllability, stability & power transfer capability of ac transmission system. He revolutionized the area of power electronics by discussing in-depth the FACTS controllers including SVC, STATCOM, TCSC, SSSC, UPFC, IPFC plus voltage regulators, phase shifters, and special Controllers with a detailed comparison of their performance attributes. He presented a practical approach to FACTS & their major applications in power industry. Compensating systems also known as the custom power devices (CPD) offer a handful of protection & security to the system under observation. They tend to absorb the various disturbances by injecting appropriate voltage, current or both into the system; thereby relieving the main source from meeting the reactive power demand of the load.

Srivastava et.al [3] has illustrated that both static and dynamic performance of a power system can be amazingly enhanced by various Flexible AC Transmission system (FACTS) controllers. The FACTS controllers have also been reviewed for mitigating the transmission line bottlenecks which could curtail the power system fluctuations at lower frequencies.

Dash et. al. [4] has presented the design of a nonlinear variable-gain fuzzy controller for a flexible ac transmission systems (FACTS) device to enhance the transient stability performance of power systems. STATCOM is a new generation FACTS device with prospective usages.

Kothari et.al [5] proposed the key objective of a STATCOM in a transmission system to increase the transmission capability of an existing network and hence

to defer the necessity of building new transmission lines. In order to improve the functionality of the STATCOM further, its dc side is supported with energy storage system (ESS).

Morris et al. [6] has suggested a variable structure fuzzy PI-genetic control scheme for a voltage source inverter based STATCOM to dampen the rotor angle oscillations of a power system. Further, a Genetic Algorithm (GA) is applied to fine-tune the variables of the fuzzy PI controller for optimal damping performance.

Stella et al. [7-8] proposed a neuro-sliding mode controller for STATCOM for UPFC in order to dampen the electromechanical oscillations in a power system.

Shen Chen et.al [9] shows the dc capacitor in a STATCOM is not a bulk energy storage device; it does not have the real power compensation ability. It affects the real power flow in a roundabout way by controlling the voltage at the point where the STATCOM is connected. It is proved that four-quadrant real and reactive power compensation can be obtained using a linearized model of the STATCOM/ESS and PQ decoupled PI controller.

Yang Zhiping et.al [10] proposed steady state operating range of a STATCOM can be expanded from one dimension to two dimensions by integrating it with an energy storage device (ESD) on its dc side. This integration will make the operation of a STATCOM to be more flexible and efficient. The steady state operating range of a STATCOM can be expanded from one dimension to two dimensions by integrating it with an energy storage device (ESD) on its dc side. This integration will make the operation of a STATCOM to be more flexible and efficient.

Yang Z et.al [11] shows in many applications, the ESS is required to supply power for a short duration and hence, the capacity of the ESD is small. In such cases, the cost of the STATCOM electronic system dominates that of the ESS and therefore, the integrated STATCOM/ESS grabs the attraction of transmission service providers

Muyeen SM et.al [12] proposed size of the dc link capacitor can be cut down immensely in the STATCOM/ESS topology which is a remarkable feature of the STATCOM/ESS. It is possible mainly because, a capacitor of smaller rating is adequate to regulate the battery dc current.

B. Review Based on STATCOM/BESS

Verma Amit et.al [13] show that the STATCOM/BESS could solve the power fluctuation problems besides that it also enhances the stability of the wind farms by supplying the adequate reactive power support to the system.

Chang & Mariesa et.al [14] propose a BESS is integrated into a cascaded converter based STATCOM to regulate both real and reactive power flow using a PQdecoupled PI controller.

Kuiava et al. [15] present a robust control scheme is presented in for enhancing the dynamic oscillation damping and hence to improve the power quality in transmission systems integrated with STATCOM and energy storage system. In order to provide the reactive power control, it has an additional damping controller which has been configured in the form of linear matrix inequalities.

Sverre & Tore et.al. [16] Presents a combined STATCOM and super capacitor energy storage system (SCESS) for compensating the wind power fluctuations as well as grid voltage stabilization in wind farms.

Stella et al. [17] present a new hybrid controller for minimizing the electromechanical fluctuations in a multi-machine power system.

Lenka A et.al.[18] proposed numerous complex control algorithms for STATCOM/BESS and proven to be useful, the BESS has few disadvantages like limited life cycle, voltage and current limitation and environmental hazards.

III. METHOD

A. System Modeling

The whole system is developed with the help of MATLAB software. In this system we are using fuel cell as a STATCOM in power system . Figure 1 shows the Simulink model of 150 km long transmission line with fuel cell. The major component of the model are fuel cell, power grid and three phase load. The main purpose of the fuel cell is to improve the transient response of the system.

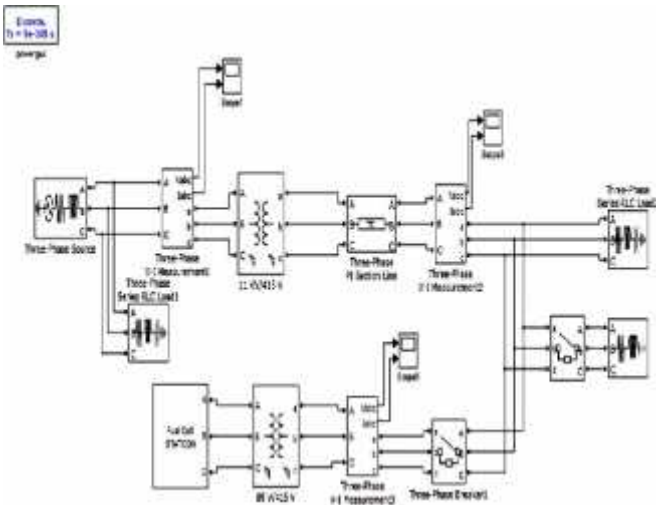

Figure 1: SIMULINK model of Fuel Cell Based STATCOM

B. Modeling of Fuel Cell

For fuel cells, the electrochemical process starts on anode side. At the anode side, flow plate channels gets H2 molecules. Catalyst in anode separates hydrogen on protons H+ through membrane that proton travel to cathode and over external electrical circuit the electrons that travel to cathode. By using of catalyst at the cathode, oxygen is correlate with hydrogen protons and electrons for formation of H2O and heat .

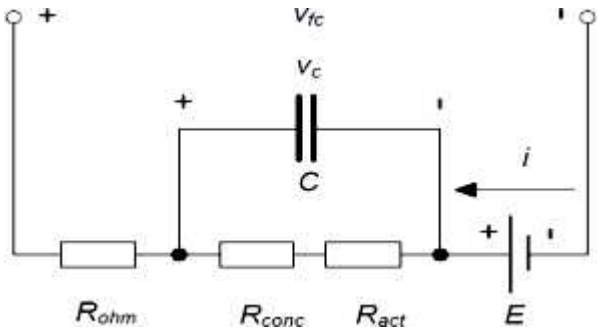

Figure 2: Fuel cell equivalent electrical circuit diagram

IV. CONCLUSION

In this paper review, different authors work on power quality optimization. More than 3 authors are working on the fuel cell for power quality optimization. Some of the authors work in controller methods using MATLAB for Quality optimization.

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