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Performance of Cascade H-Bridge Inverter based on feed-forward Current Vector Controller of Reactive Power Compensation System

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Abstract. FLC-based statcom was suggested in this research to improve PQ in distribution networks. There are several STATCOM setups for reactive compensation in traditional systems, however, they are unable to reduce harmonics for medium power applications. Thus, the most flexible and energy-efficient power inverter is the Multi Level Cascaded H-bridge Inverter (MLCHI) design structure available. A low switching rate and a broad bandwidth control mechanism for MLCHI power are the focus of this investigation. Reactive power or VAR compensation at the Point of Shared Coupling may be controlled using vector control using a specified STATCOM system's controller under balanced loading circumstances (PCC). This is done by transforming dq-coordinates in a STATCOM system in into mathematical equations using Park's transformation. Cascade Pulse Width Modulation (PWM) STATCOM having variable voltage and current ratings may be realized using the controller's gain parameters, whichare generated using the formulae provided for the controller's gain parameters. Finally, MATLAB-Simulink simulation & numerical analysis are used to test the proposed control scheme's performance.

Keywords: Multi Level Cascaded H-bridge Inverter, Pulse Width Modulation, STATCOM, Non linear load, Grid integration

1. Introduction

There have been some extremely difficult consequences in the electricity industry as a result of the continuously growing energy excellent problems that have arisen as a result of the creation of unpredictable weights, such as engine steady speed force structures, Programmable Logic Controller (PLC), rectifiers, digital stabilizers, PCs, etc. [1]. As a side note, effective energy flow controls, such as responsive power payback, may alleviate these concerns. Static VAR Compensators (SVC), a traditional open energy or VAR compensation strategy, shows several burdens in terms of its power score, responsiveness, accuracy, and cost. Flexible Alternate Current Transmission system (FACTS), namely the MCHI-based network related to it, has been made public [2]. STATCOM has a significant edge over its conventional competitors, and it has been thoroughly tested over the last 20 years. The Voltage Source Inverter (VSI) is a vital component of the STATCOM because it initiates a -level inverter, also known as a six-beat inverter, which pulls transfer current from restriction semiconductors in three-segment configurations. Six-beat inverters have indeed been developed since the introduction of staggered inverters, with unique transformer relationships that minimise consonant streams and enhance the STATCOM shape [3]. Some 70% of all device failures may be attributed to these inefficient and long-lasting transformers, which are ineffective and contribute to the polarising usual for the converter and flood overvoltage due to the submersion of transformers in transitory situations [4]. Staggered VSI geometries have become more robust and divergent from the typical VSI to the extent that their applications in FACTS have improved [5]. The MCHI with segregated DC capacitance has been reduced to the maximum practical geology amongst several fresh staggered inverter geologies for putting distinctive attention to varied packages and STATCOM structure requirements. Regardless, using a Proportional Integral (PI) microcontroller for the manipulation device may introduce a goliath weak point as dismal momentary execution. High constant kingdom botch is a common term for this shortcoming, which affects both its dynamic responsiveness and key limit. By leveraging high basic growth at the disadvantage of terrible fresh response and the other way around, a 0 predictable state bungle may be achieved. Regardless, a larger degree or staggered inverter may be achieved by stacking multiple H-bridge inverters to provide higher bandwidth and remarkable symphonious execution [6]. When using the STATCOM structure, both low vital expansion and reduced buying and selling repetition may be applied using MCHI to produce an exceptionally excellent extraordinary response while also reducing the predicted kingdom mistake rate. Aside from that, several issues,i.e, cumbersome, large, and expensive line repetition transformers may be avoided by including MCHI-based STATCOMs in the energy system.Over the last three decades, a great deal of work and testing on various manipulation schemes for MCHI-based STATCOM has been completed [7]. All audits were focused on the STATCOM machine's unique and temporary reactions to compensate VAR. PI-controllers have been deemed the most effective method of controlling an experiment by the public at large of experts in the field. The PI-controllers, on the other hand, can't authoritatively discover the demand values [8] because of limitation assortments and operational centers which activates poor short response and causes STATCOM shape instability [9]. In addition, the essential enlargement limitations are case-dependent and no longer clearly shown [10]. More challenges with imbalanced voltage arise as the number of staggered inverters grows, necessitating a more complex STATCOM specification on top of the existing system configuration [11]. The DSP's computational burden increases dramatically as a result, which reduces the strength and stability of the STATCOM execution during normal operation. Power converters are plays a crucial to improve the performance of the grid-connected renewable energy (RE) sources. Power generations through RE sources are gaining more attention in past decades because of their inherent properties. To produce balanced sinusoidal output voltages from the grid integrated PV systems and cascaded multi-level converters are adopted. The design of various cascaded multi-level converter topologies with different PWM techniques is investigated in this project. Multilevel inverters (MLI) have gained much attention in both academia and industries because of their promising properties providing almost sinusoidal output voltage and currents. Enhanced voltage regulation and efficiency of the overall grid integrated RE sources with MLI converters. MLI converters are the optimal solution for both medium and high power applications.

2. Proposed Test system

Proposed system under performance is depicted in Figure.1. It has a STATCOM for reactive power compensation for dynamic load varying systems. The future controller improves the performance of the proposed system using PI regulators. The implemented MLI STATCOM with five levels existed in this work and enhances the presentation of the suggested controller through different computer simulations.

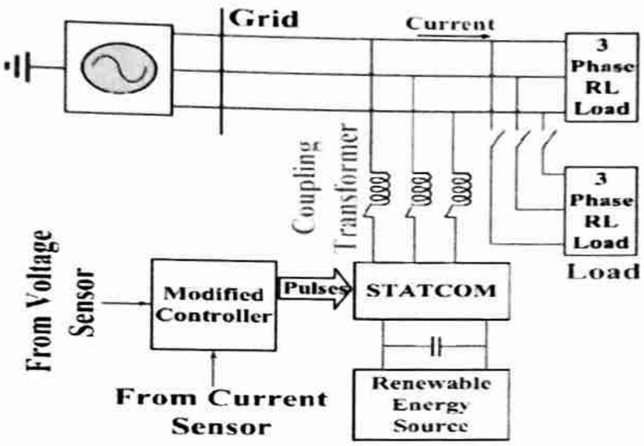


Figure.1: Proposed STATCOM under implementation.

3. Proposed Controller

The proposed STATCOM is implemented with five-level inverters and designed with closed-loop control. The ON/OFF of the suggested link appears based on the recommendation of two series switches for preventing the short circuits by ensuring the DC-link is fully off ahead of switching to the next leg. A park transformations and phase-locked loops are used in this implementation. The STATCOM controller is presented in figure.3.

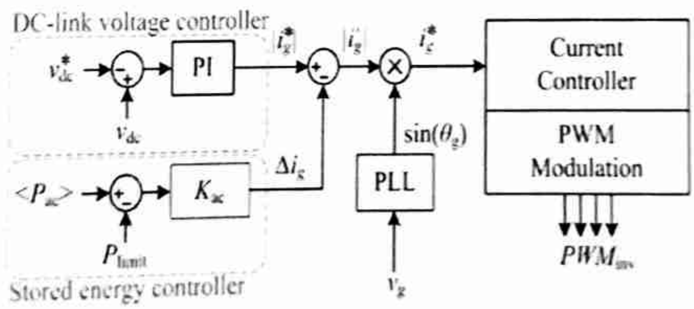


Figure.2: DC link voltage controller

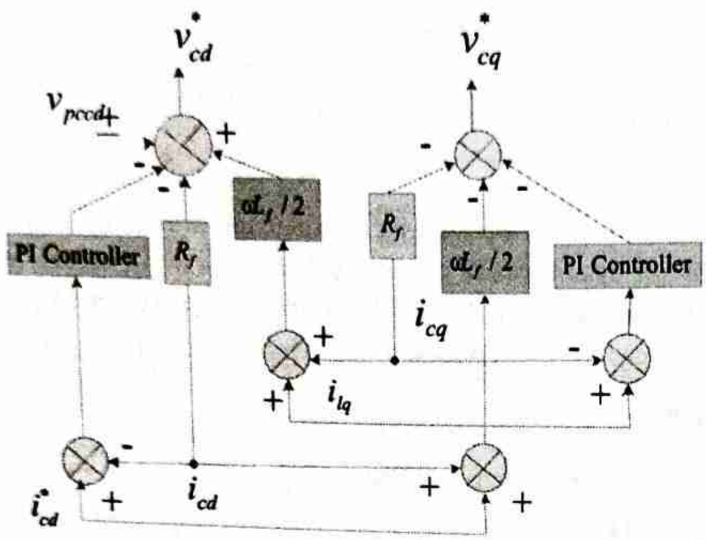
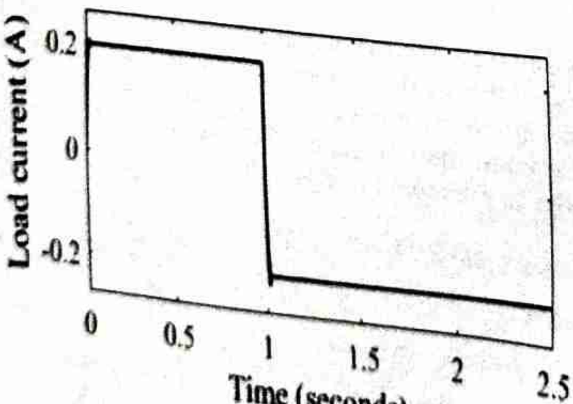


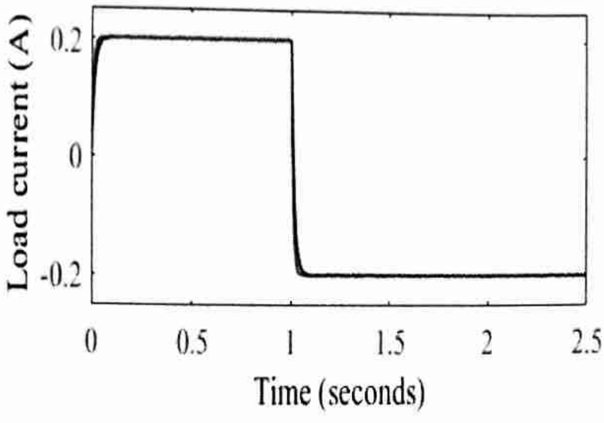
Figure .3: Proposed STATCOM controller

4. Simulation Results and discussion Conclusions

MATLAB/Simulink is used to simulate the future MCHI with STATCOM stable-state & small-signal equivalent circuits, which are derived mathematically from the STATCOM controller parameters. PulseWidth Modulation is use to modify the MCHI using IPD CB-PWM., resulting in minimal and reliable switching losses and reliable power management between the H-bridges. In Table I, you'll find all of that information. For this study, researchers looked at how, at the speed of one second, the PF switches from trailing to leading, causing the RLLL to become the new RLCL. Assuming that the system and the load were in equilibrium, this was done. Because of this, the single-phase result can reflect a three-phase system. Figure 4.2 depicts STATCOM's response to a rapid spike in load. The icq" algorithm-based system offers stronger steady-state and transient responses than the typical STATCOM system, as shown in Figures 4a and 4b, with steady-state error is a zero and better steady-state and transient responses (a).

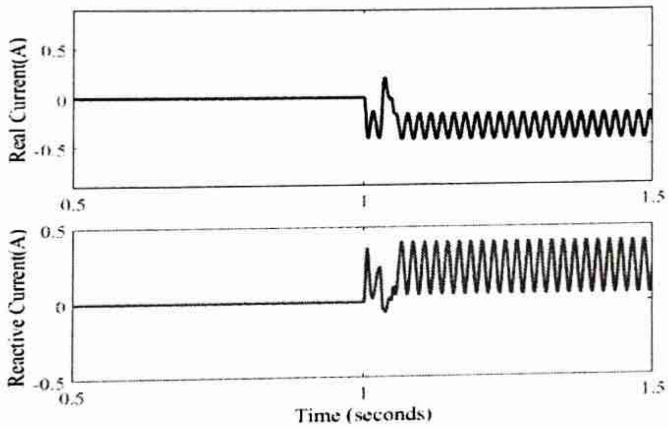


(a)

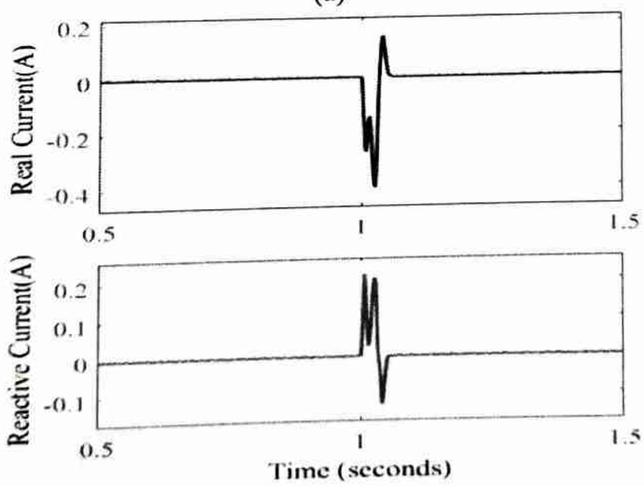


(b)

Figure .4 : (a) with & (b) without step change of load current and designed icq"



(a)



(b)

Figure .5: real and reactive currents(a) without & (b) with design of proposed system

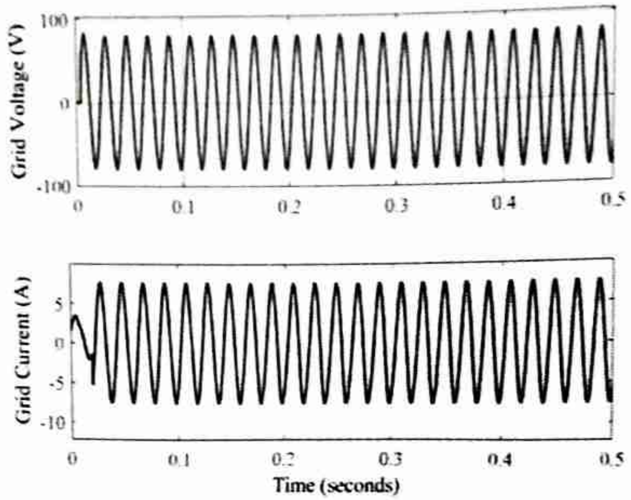


Figure .6: grid voltage & grid current

With the icq" algorithm, Fig. 6 showing the load current changing at time 1s for both the grid of voltage Vs and the grid of current Vs. If the grid current is in phase with Vs, then the p.f is equal to 1 apart from of the load, as shown in Fig.7 (the graph).

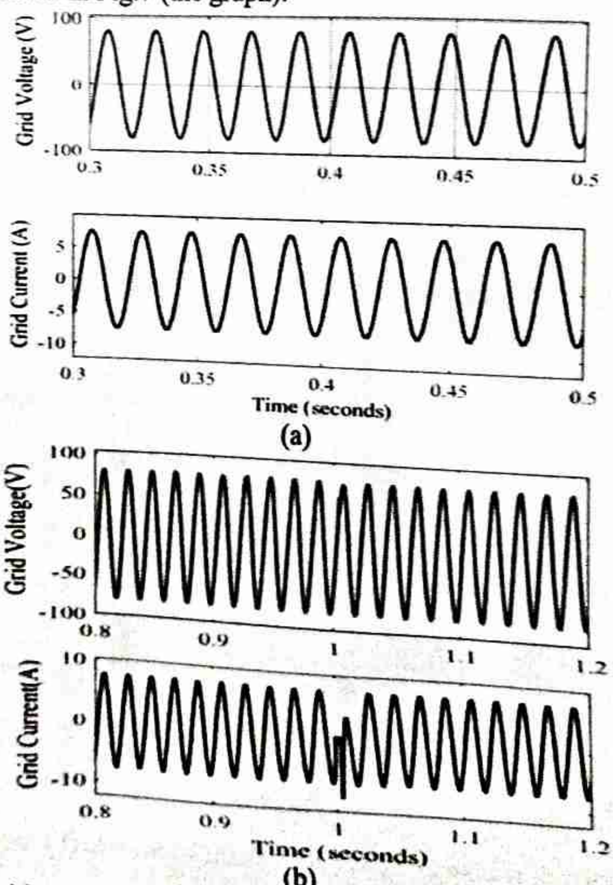


Figure .7: (a) grid current & voltage for STATCOM (b) grid current & voltage for STATCOM with capacitive approach

5. Conclusions

In STATCOM systems, a decoupling feed-forward present vector controller that employs the dq-method may offer VAR correction and PF correction. Pi controllers were used for reactive current correction since they are quick and robust. The statistical formulation of the icq reference of reactive signal "The algorithmic structure has been shown. When working out the Kp and integral Ki gains for the PI-proportional controller, the planned reactive standard current icq was used as a standard. "k total represents the algorithm's overall profit. The suggested STATCOM system has been shown in simulations. Simulation findings show an increase in p.f from 0.67 to 1 under inductive and capacitive loading scenarios. As part of the future development, this controller will need to be tested again

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