

ACTIVE POWER MANAGING WITH HELP OF BATTERY 3-CELL UNIT AND MMC CONVERTER FOR RESIDENTIAL LOADS

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ABSTRACT

Active power management is very important in renewable power source utilization. Nowadays various active power compensation methods using domestic and industrial applications. The active power management improves power plant efficiency and quality of power. Main objective of this paper is describing and summarizing various

active power management from industries. Also, this paper proposed battery energy storage system-based modular multi-level converter model for active power compensation. The battery energy storage system is back-bon of renewable power system. Generally, two control strategies, first one is phase to phase SOC balancing control and inter phase SOC balancing control for effective utilization of three phase line to line voltage. Second one is effectively utilizing battery energy by managing SOC level for all battery to avoid over charging / discharging process. All control strategies and performance of proposed system verified with help of MAT-LAB/SIMULINK platforms and experimental setup.

KEYWORDS: Active-Power, BESS, Boost Converter, SOC, Battery.

1. INTRODUCTION

Currently many nations utilizing more renewable power sources like, solar and wind ,fuel cell etc.. because all renewable power generation methods less harmful to environment and sustainable. Also, renewable power generation have lot of challenges in electricity cycle, solar and wind sources are depending geographical location and weather condition, in such condition solar or wind power output of magnitude will vary with respective to irradiation and wind speed. Even hybrid based (PV-Wind) power generation method also affects because all integrated renewable power sources are weather depended. This will also affect productivity cycle because in India and other nation-based industries working 24/7 concept. So for continuous power supply required for all linear and non linear load with constant power. The hybrid or singleton renewable power sources are sometime nil power generate due to weather, in this scenario all load will affect. There for all manufacturing industries using battery energy storage system (BESS) purpose of electrical energy backup. Generally, Battery based energy storage system store electrical energy in the form of chemical energy during stable weather condition and non-peak load demand time. The battery energy storage system controlled by charge controller because battery may affect over charging and discharging process. Mainly the charge controller will focus level state of charge (SOC) and depth of charge(DOC) because this two factors only desired battery life time. Now days various charge controller designed with help of PID, artificial intelligence applications. The artificial intelligence based controller and power electronics interface play vital role in renewable power source integrated with load because conventional controller will give approximated value in closed loop circuit but artificial controller give accurate results. Also source to load have lot of power quality problems, short time duration and longtime duration issue like sag, swell, transient, DC-offset, Voltage imbalance and harmonics etc.. consequently, this power quality problem affect industries/Domestic sensitive load working performance so for FACTS based many compensator devices installed between source to load. The compensator will compensate power quality issue from transmission and distribution medium. Generally industries and domestic loads or mixed linear, non linear loads. The more power rating non linear load inject more active power from supply that time remaining linear and lower power rating nonlinear machine perform unstable. This will affect life time loads so for active power and reactive power management is very important in utility side. Therefore this paper will describe various active power compensation methods and designing low cost level battery energy storage system based boost converter backup for active power compensation.

2. BACKGROUND ANALYSIS

The active power compensation is improved by using FACTS devices and Artificial controller. The compensation devices operated various control strategies like PWM signal generation for semiconductor switches and voltage and current reference signal sensing, voltage and current level deriving etc. The DC linked PV-Battery -hydro system used for active power management.^[1] Various FACTS devices described for active power management.^[2] Remote area power supply designed with help of DFIG based wind energy conversion and energy storage system, super capacitor used for life span improvement of battery.^[3] Super capacitor and battery combined hybrid system used for active power management also fuzzy combined distributed control system developed purpose of regulating wind-diesel system transient.^[4] Self consumption ratio based active power management is improve low voltage feeder performance and mitigating overvoltage problems.^[5] Grid interfacing shunt active filter for microgrid power quality improvement.^[6] Zero sequence compensated voltage support model mitigating power quality problems.^[7] Hybrid active filter with injection circuit reduce harmonics and improving power factor but low capacity so for combined PWM rectifier for dc voltage control Process.^[8] As per literature survey various conventional and non conventional methods enhancing active power but all those methods have minor barriers,

- DC-Linked PV -Battery -Hydro System is using Two level Conversion.
- Facts Devices based Active Power management is using more switches.
- Super capacitor is less efficient in active power management.

There for this project using single controller loop with Modular Multi level Converter for active power management in residential load.

3. MATERIAL AND METHODOLOGY

In this project contain modular multi-level converter with 45V lithium-ion battery with PIC Microcontroller purpose of PWM signal generation and Controlling Battery charging and discharging process with help of Battery SOC level, actually first MMC unit is connected Phase A group cell unit, similarly second MMC units connected Phase B group cell unit, Third MMC connected with Phase C group cell unit. By using modular multi-level converter reducing battery time comparatively boost converter also Phase A group cell unit charging time remaining two phase group cell units are off stage purpose of reducing switching loss. Show in figure 3.1 typical Modular multi-level converter with battery cell unit. For analysing

active power Modular multi-level converter modelled and result verified MAT-LAB/SIMULINK platform show in figure 3.2

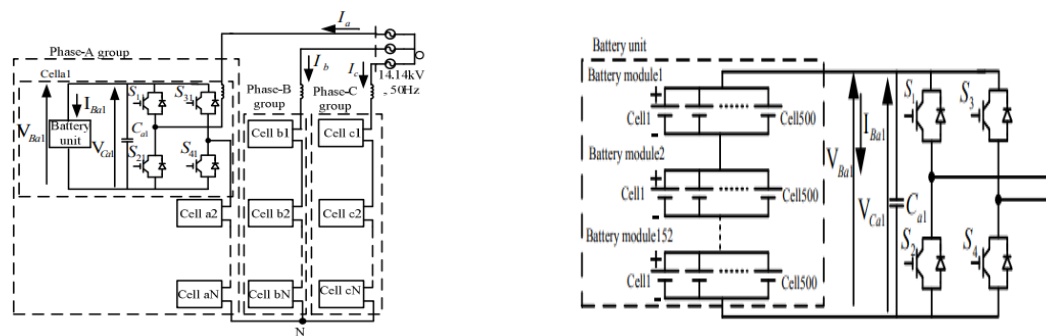


Figure 3.1: Typical MMC with Battery Cell Unit.

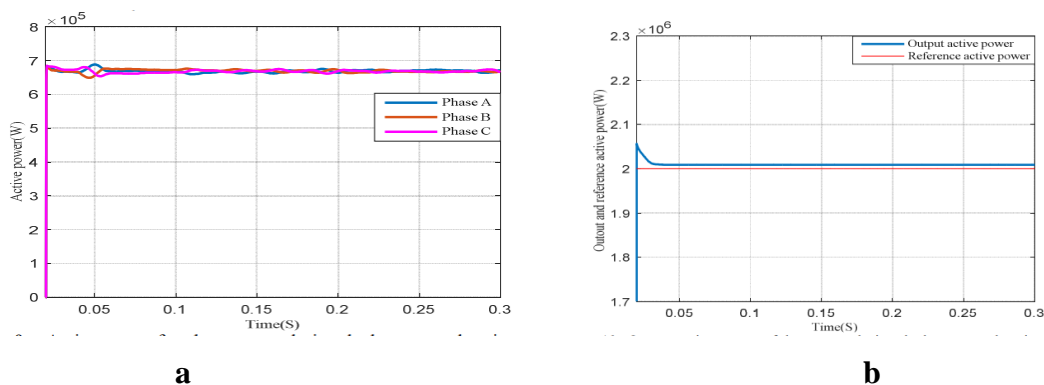


Figure 3.2.a Active power for 3Phase group during battery charging time 3.2.b Output Active power during battery charging time.

4. CONCLUSION

In this paper analyzed various Active power management strategies and designed low-cost single controller unit with modular multi-level converter for battery energy storage system, Each battery cell unit controlled with help of SOC level of battery. Battery energy storage system play the active power compensation when large nonlinear load running same supply, that time load may perform non-proper due to more active power consumption so for battery 3-cell unit will provide appropriate active power to load, so for load will perform properly without any supply disturbances.

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