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Implementation for PV Inverter Novel Based on Half-Bridge Front End Converter

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Abstract-

Half bridge non-isolated dc-dc converter introduced for battery storage and Controller is implemented based on BESS (battery energy storage system) for high power grid distribution proposed in secondary of transformer. Multi-port dc-dc isolated converter has emerged recently as very important in the case of PV based storage and distribution application. A new front end converter is introduced for efficient PV generation and Common solid state transformer to improve the converter operating speed. Front end converter (FEC) plays a major role and its switching operation is per-formed by MPPT based pulse generations. The overall converter performance is verified through MATLAB (Simulink).

Recent days the growth in peak demand for the increasing of distributed and deregulated energy systems require an optimized grid control unit. The advances in computing and communication technologies forming the traditional power network into a smart grid, capable of real-time remote monitoring and control. Mart is particularly well- suited for renewable energy sources; power is utilized, depending upon the availability of natural resources.

Keywords: BESS, FEC, MPPT, FACTS, CSC

I. INTRODUCTION

Power systems are complicated networks with hundreds of generating stations and load centers being interconnected through power transmission lines. An electric power system can be separated into four stages: i) generation, ii) transmission iii) distribution and iv) utilization. The basic structure of a power system is as shown in Fig.1. It is composed of generating plants, a transmission system and distribution system. These subsystems are interconnected through transformers T1, T2 and T3.

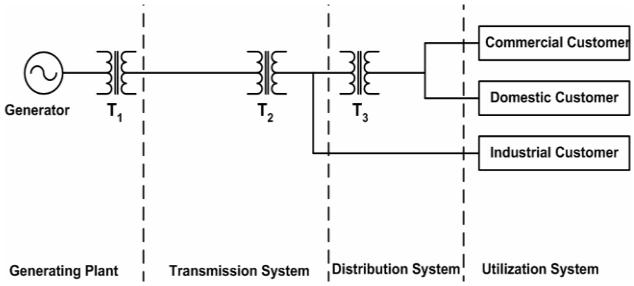


Figure 1. Power system

1.1 Power Quality Concept

Even a few years back, the main concern of consumers in power system was the reliability of supply which is defined as the continuity of electricity. It is however not only the reliability that consumers want these days, quality of electricity supply is also very important for consumers. The term, electric power quality, broadly refers to maintaining a nearly sinusoidal bus voltage at rated magnitude and frequency in an uninterrupted manner from the reliability point of view. For a well-designed generating plant which generates voltages almost perfectly sinusoidal at rated magnitude and frequency, power quality problems start with transmission system and stay valid until end users in distribution system. In [1,2], the terms, characterizing the power quality in the power system have been defined and are summarized as follows:

− **Transients:** are defined as the change in a system variable that disappears during transition from one steady-state operating condition to another and can be classified as impulsive transients and oscillatory transients. Impulse transients are mainly caused by the impact of lightning strikes to the power system. The typical causes of oscillatory transients are capacitor or transformer energization and converter switching. While impulsive transient is a sudden and has non-power frequency change in voltage and current with a fast rise and decaying time, oscillatory transient has one or more sinusoidal components with frequencies in the range from power frequency to 500 kHz and decays in time.

FACTS Controllers

The IEEE Power Engineering Society (PES) Task Force of the FACTS Working Group has defined FACTS and FACTS Controller as given below [3].

Flexible AC Transmission System (FACTS): Alternating current transmission systems incorporating power electronic-based and other static controllers to enhance controllability and increase power transfer capability

II. SYSTEM DESCRIPTION AND OPERATING PRINCIPLES

In the most general case, a shunt connected compensator in a distribution system can also filter out load harmonics and balance the unbalanced load currents in addition to the correction of load power factor. Each additional capability obviously increases initial cost of the implemented system. However, for the balanced clean loads although their reactive power demand varies rapidly the shunt connected compensator is required only for power factor correction.

The three phase CSC based STATCOM is a shunt connected compensator, which injects nearly sinusoidal three phase balanced currents with adjustable magnitudes and leading or lagging the corresponding line voltages by nearly 90°. Therefore, the three phase CSC based STATCOM can compensate for the balanced loads having rapidly fluctuating reactive power demands of harmonic less loads, such as synchronous or asynchronous motors in Ward-Leonard drives. In this chapter, the system description and operating principles of three phase Current Source Converter (CSC) based STATCOM will be presented in order to meet following objectives:

• Harmonic content of the nearly sinusoidal current produced by STATCOM should comply with IEEE 512 Std 1992 and limits imposed by the Energy Market Regulatory Authority of Turkey,

• The magnitude of the reactive current component produced by STATCOM should be controllable between zero and pre-specified value,

III. DESIGN OF CURRENT SOURCE CONVERTER

The system description and operating principles of three phase Current Source Converter (CSC) based STATCOM have been presented in previous chapter. It has been illustrated that three phase CSC based STATCOM should meet following objectives

• Nearly sinusoidal currents should be produced,

• Magnitude of these currents should be fully controlled,

• The phases of the produced current should be fully controlled with respect to supply voltages in order to permit the flow of desired amount of active and reactive powers in the desired direction.

In this chapter, the design and implementation of a high power prototype for three phases CSC based STATCOM satisfying the above objectives will be presented. Design of the prototype system will be accomplished in view of reactive power compensation requirements of an actual sample application that is load compensation of coal mining excavators.

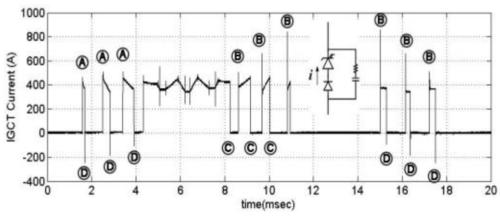
The design methodology used in this work is based on analysis, simulation and experimental work. The simulation of CSC based STATCOM has been carried out by using PSCAD/EMDTC simulation tool. The modulation techniques and control methods of the prototype system has been exercised with this model. The ratings of power semiconductors, input filter components, dc-link reactor, and snubber components have all been determined by using this simulation model. The details of this simulation model can be found in Appendix C. Analysis such as the effects of snubber components in snubber design has been carried out by MATLAB/Simulink.

− Tektronix TDS5054 Digital Phosphor Oscilloscope
− LeCroy WaveJet 324 Oscilloscope
− Pintek DP100 High Voltage Differential Probe (100MHz)
− Tektronix P5210 High Voltage Differential Probe (50MHz)
− Tektronix P5050 Passive Voltage Probe (500MHz)
− LEM LT 1005 S Hall-Effect Closed Loop Current Transducer
− Powertek, Rogowski Current Waveform Transducers:
CWT 15B, 2mV/A, and CWT 6B, 5mV/A
− Data Acquisition System:
National Instruments DAQ 6062 E Data Acquisition System
National Instruments SC2040 Sample and Hold Card
Fluke 80i-110S AC/DC Current Probe

IV. TEST RESULTS

Current and Voltage Waveforms of Power Semiconductors

Current and voltage waveforms of IGCT and DIODE have been recorded by the use of Rogowski coils and DP100 high voltage differential probes in the field. Two sample records, one for 650kVAr capacitive and the other for 500kVAr inductive reactive power generation of overall STATCOM are given in Fig.2(a) and 2(b) respectively for one supply cycle (20msec).



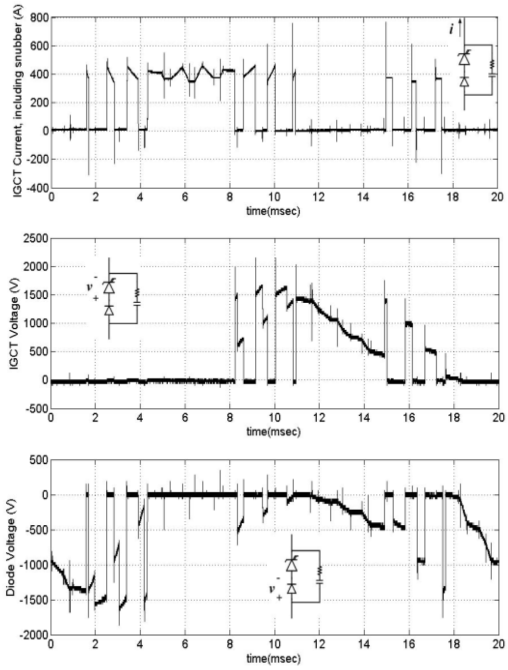


Figure 2(a,b,c) Typical voltage and current waveforms of IGCT and Diode, recorded for 650kVAr capacitive reactive power generation of STATCOM (sampling rate= 25MS/sec)

V. CONCLUSION

Half bridge non-isolated dc-dc converter introduced for battery storage and Controller is implemented based on BESS (battery energy storage system) for high power grid distribution proposed in secondary of transformer. Front end converter (FEC) plays a major role and its switching operation is per-formed by MPPT based pulse generations. The overall converter performance is verified through MATLAB (Simulink).

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