

SUPERCAPACITOR SUPPORTED DSTATCOM FOR REDUCED HARMONICS AND IMPROVED POWER FACTOR

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Abstract: Distributed Static Compensator (DSTATCOM) is a widely used custom power device in distributed network to achieve the power quality enhancement tasks like harmonics drop, power factor correction and maintain constant dc bus voltage. It investigates a novel topology based on a Distributed Static Compensator (DSTATCOM) coupled with a supercapacitor for power quality enhancement. The proposed topology comprises of a voltage source converter (VSC) supported DSTATCOM, a DC-DC bidirectional chopper and a supercapacitor. The supercapacitor is used to organize the abridged dc-bus voltage. The accepted instantaneous symmetrical component theory (ISCT) control approach will be used to produce the switching pulses for scheming the IGBTs of the VSC. Simulations of the proposed system would be conceded out in MATLAB/SIMULINK environment to demonstrate its effectiveness over conventional DSTATCOM for power quality issues.

Keywords: DSTATCOM; Supercapacitor; power factor correction (PFC); Current harmonic reduction

1. Introduction

Habitually, static capacitors and passive were working to improve power quality (PQ) in a distribution system. There can be problems like predetermined compensation, system-parameter-dependent performance and achievable resonance through line reactance. To overcome these drawbacks, a distribution static compensator (DSTATCOM) has been proposed. It balances both harmonic content cum reactive component of load currents towards the source balanced current and in phase with the source voltages.

To produce the reference control signals for the DSTATCOM, various control schemes have been examined such as immediate reactive power theory (p-q theory), synchronous reference frame (SRF) system theory, power balance theory, SVPWM, etc., Instantaneous symmetrical component theory (ISCT) control technique is finest control technique used for producing switching signals for a three phase VSC of the DSTATCOM in the distribution system. This ISCT novel DSTATCOM control strategy is projected here as an alternative techniques for the harmonic reduction and power factor improvement. This method is based on the concept of reference source current calculation.

Super capacitor is coupled with a DSTATCOM to reform the power temper issues. The ultra capacitor is an electrical potency supply opinion that abundance the electrical energy in its electrostatic field from the source during the off-py hours and communicate back to the magnetize during pry hours. The stored energy of the ultra capacitor is utility to govern the voltage across DClink condenser of a VSC-DSTATCOM very rapidly.

2. System Topology

This distribution system consists of a three phase supply and a three phase non-linear load. The proposed compensator is connected at the point of common coupling (PCC) through an interfacing impedance as shown in Fig.1. The compensator consists of an IGBT based VSC with a dc bus capacitor, a bidirectional chopper and a super capacitor block. The super capacitor block includes an internal series resistance (R_s), parallel resistance (R_p) due to flow of leakage current and a super capacitor

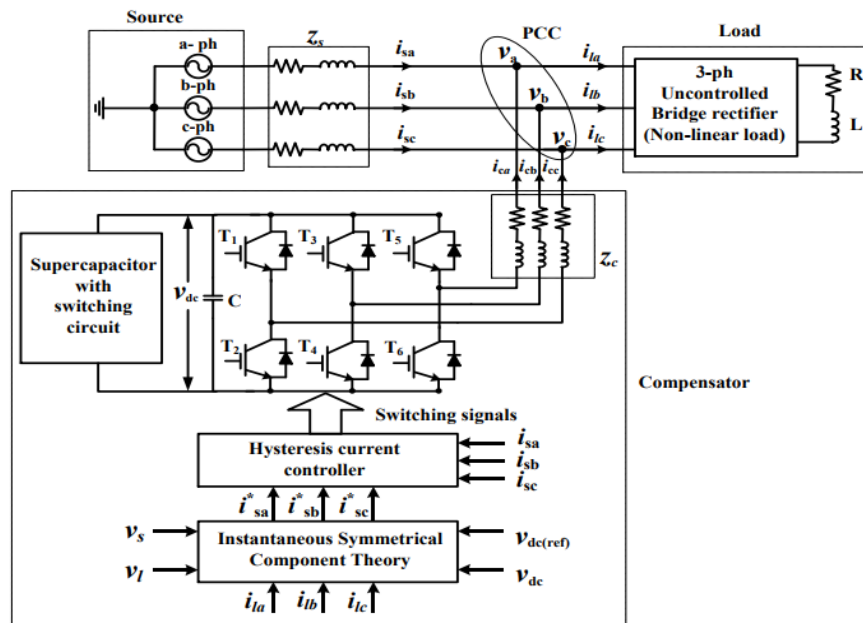


Figure1. Proposed Topology Based DSTATCOM for Distribution System

2.1 Super capacitor

A super capacitor is constant to a DSTATCOM through a bi-directional prick. The knob execute a essential party in impeach/dismiss of energy to/from the ultra capacitor. Stored spirit in the super capacitor is utility to defend the voltage across DC bus bar capacitor during satisfaction of different power temper problems. Thus the ultra capacitor involves two trading operations,

(i)Charging exercise

Current relation during command period of the super electrical condenser (C_{sc}) is given by

$$I_{cell} = I_p + I_{sc}$$

Equivalent voltage appeared across supercapacitor circuit is given by

$$V_{cell} = I_{sc}R_s + I_{sc}R_p [1 - \exp(-t/RC)]$$

(ii) Discharging operation

Current relation during discharging period is specified by

$$I_{sc} = I_p + I_{cell}$$

Total voltage emerged across super capacitor circuit is given by

$$V_{sc} = V_{sc}^r - (V_{sc}^r + I_{sc}R_p) [1 - \exp(-t/R_p C_{sc})]$$

2.2 DSTATCOM without supercapacitor

The distribution system with DSTATCOM under unbiased condition which embraces the supply voltage (v_s) and supply current (i_s) and load current (i_l) filter

currents (i_{ca} , i_{cb} and i_{cc}) and dc link voltage (v_{dc}) [from top to bottom]. %THD of source current is 2.76% and load current is found 20.72%. It is experimental that the dc-link voltage is 691.3V

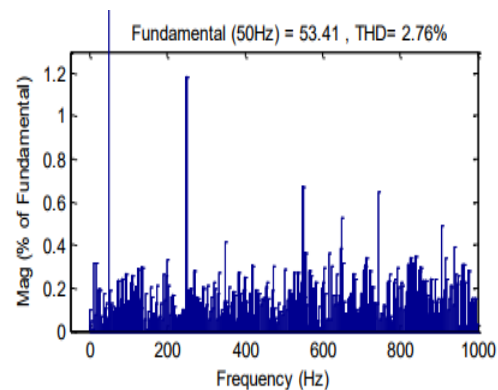


Figure 2. THD of load current Without Super capacitor supported DSTATCOM

2.3 With Super capacitor supported DSTATCOM

Different wave forms are attained from the distribution system with the supercapacitor sustained DSTATCOM under balance load condition such as DC-link voltage (v_{dc}), filter currents (i_{ca} , i_{cb} and i_{cc}), load current (i_l), supply current (i_s) and supply voltage (v_s) [from bottom to top]. It is established that the dc-link voltage is 670.6V

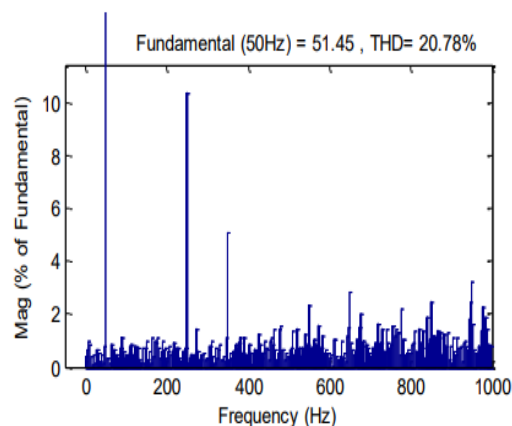


Figure 3. THD of load current Without Super capacitor supported DSTATCOM

3. Simulation Result

Simulation actions of the proposed scheme is executed in MATLAB/Simulink to detect the performance of the system beneath various conditions like without DSTATCOM and with DSTATCOM.

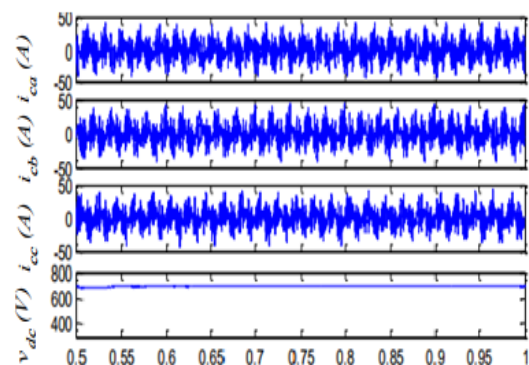


Figure 4. Simulation output Without DSTATCOM

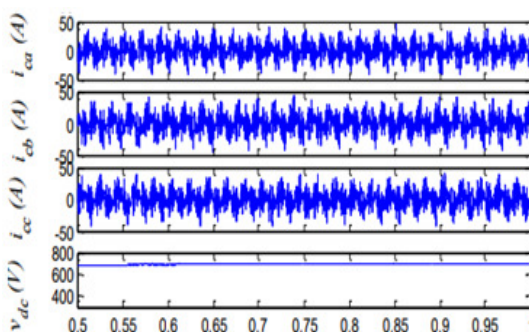


Figure 5. Simulation output with supported DSTATCOM

4. Conclusion

The modeling and action of an ISCT based super electrical condenser supported DSTATCOM analysis situs is crest to compensate overtones of ascent incidental and to improve input command constituent of the system also provides reduced dc bus voltage. Furthermore, DC bus bar voltage of the DSTATCOM is regulated by the super capacitor at a immovable rate than that of a classic DSTATCOM analysis situs. This exceptional feature of the proposed analysis topology serve symbol reduction in cost, command cost and size of the analysis module. The action and simulation of the DSTATCOM have been examined by worn MATLAB/Simulink successfully under balanced load arrangement.

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