The Grid Impedance Adaptation Dual Mode Control Strategy in Weak Grid

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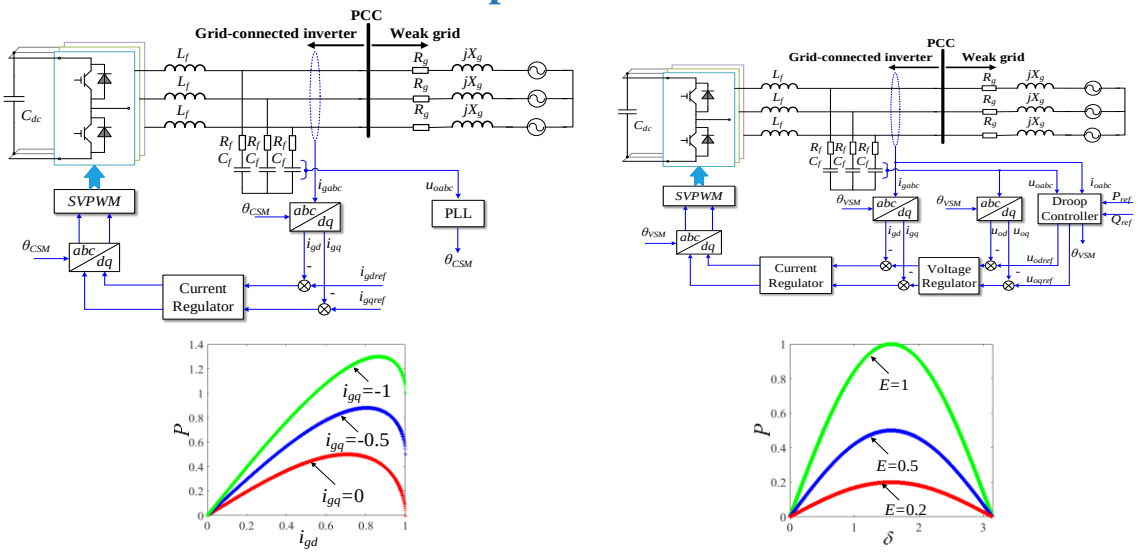
I. Introduction

With the increasing penetration of distributed energy resources and the wide distribution of access point, the power grid is becoming more and more weak. For the two main stability control strategies in weak grid, namely the current source grid connected mode (CSM) and the voltage source grid connected mode (VSM).

The grid impedance adaptation dual mode control strategy in weak grid is: When the grid impedance is small, the inverter operates at CSM, and when the grid impedance is large, the inverter operates at VSM.

II. The Proposed Control Scheme



(a) CSM (b) VSM

Fig. 1. The control strategy schematic and power coupling characteristics of the grid connected inverter operating at CSM and VSM.

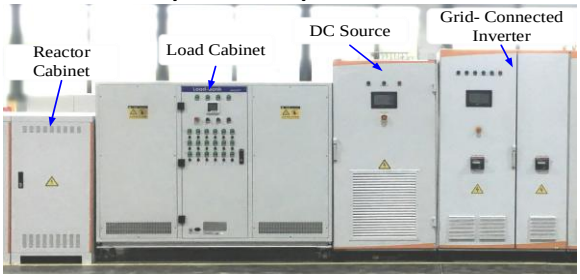
The power coupling characteristics of CSM and VSM are analyzed, respectively: With the increase of the grid impedance, the coupling degree between active power *P* and current i_{gq} is enhanced when inverters operate at CSM, while the coupling degree between active power *P* and voltage *E* is attenuated when inverters operate at VSM. Therefore, it is more suitable for inverter operates at VSM in extremely weak grid with larger grid impedance than operates at CSM.

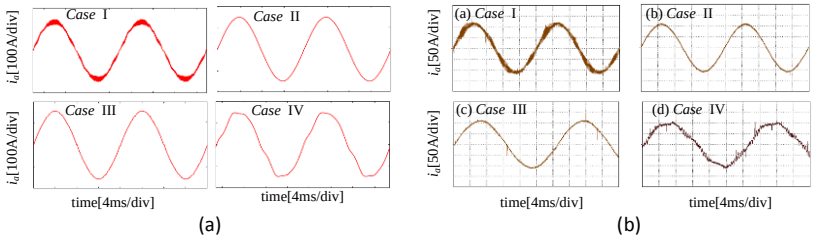
Furthermore, through small signal modeling and analysis of the inverter operating at VSM, the stability and dynamic performance are improved when the grid impedance increases. It is concluded that the inverter is more suitable for operating at VSM in the larger grid impedance occasions.

Table I Description of Four Cases

Case I	*Inverter operates at VSM with very small impedance*
Case II	*Inverter operates at VSM with very large impedance*
Case III	*Inverter operates at CSM with very small impedance*
Case IV	*Inverter operates at CSM with very large impedance*

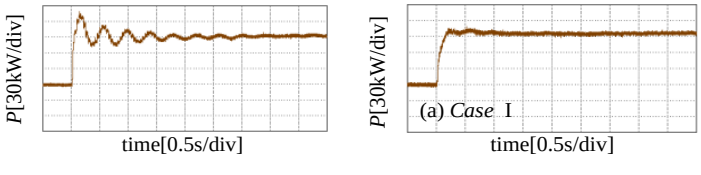
Experimental platform





(a) (b)

Fig. 2. The steady state waveform of grid current under four different operating cases: (a) Simulation results. (b) Experimental results.



(a) (b)

Fig. 3. The experimental waveform of the active power amplitude step from 0 to the rated value under the two operating cases: (a) ***Case* I.** (b)***Case* II**.

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