Simulation of a-Si PV System Grid Connected by Boost and Inverter

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Abstract-This paper is about a PV system connected to the electric grid by power electronic converters, using classical PI controller. The modelling for the converters emulates the association of a DC-DC boost with a two-level power inverter (TwLI) or three-level power inverter (ThLI) in order to follow the performance of a testing experimental system. Pulse width modulation (PWMo) by sliding mode control (SMCo) associated with space vector modulation (SVMo) is applied to the boost and the inverter. The PV system is described by the five parameters equivalent circuit. Parameter identification and simulation studies are performed for comparison with the testing experimental system.

Keywords: Photovoltaic energy, MPPT, modelling, power electronics, simulation, experimental results.

1. Introduction

Electricity market restructuring offers more flexibility at both points of production and utilization [1]. Similarly, with the reform in the power system sector (PSSe), the progresses in distributed power generation systems (PGSys) generated new opportunities for the electric sector [2]. Distributed PGSys include, for example, photovoltaic power, wave power, wind power, small hydropower or geothermal power. A summary of the hardware for some distributed PGSys is given in [3] and a review of management and electric grid (EGr) integration for distributed PGSys is given in [4].

The growth of photovoltaic PGSys is significant in the current years. Even foreseen as able to compete with the fossil-fuelled thermal PGSys, particularly, taken into consideration the environmental safeguarding value [5,6]. Climate changes and the environmental policy are becoming progressively important for the PSSe as pollution regulations are stricter and client perception of environmental effects is greater than ever. Nowadays, deceleration of greenhouse is acknowledged to be possible only if CO2 anthropogenic emissions are reduced [7]. The European Commission committed European Union (EUn) to become an economy energy-efficient with low-carbon emissions, endorsing the climate and energy package with plans to generate a new Energy Policy for the EUn. The proposals are intended for: reducing the anthropogenic emissions by 20% by 2020 and 50% until 2050; and increasing the quota of EUn energy consumption from renewable energies. In the future, solar energy is expected to be a significant part of the European Energy Policy.

Also, the European Commission considers that smart grids marks a new advance towards: a more active consumer role, improved integration of renewable energies into the EGr, increasing energetic efficiency with a significant impact on reducing the anthropogenic emissions, job creation and technological development in the EUn. In Portugal, the renewable energy reached a total installed capacity of 11 446 MW in September 2014, of which photovoltaic generation capacity is responsible for 346 MW.

A PV system (PVsy) converts the solar energy into electricity using solar cells. These cells may be assembled into panels and arrays. A PV array can be comprised by several panels connected in parallel or series in order to create larger systems with or without tracking systems, used to meet higher