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Operational properties of a photovoltaic system with three single phase inverters

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Abstract. In the recent years the number of photovoltaic systems which are connected to the distribution networks is increasing all over the world. It is to expect further increase in the future. This work focuses on analysis of a photovoltaic system with three single-phase inverters connected to the electric grid. Photovoltaic systems often use single-phase inverters. The disadvantage of such systems is asymmetrical unbalanced delivery of electricity to the distribution network. This means that the currents in individual lines are unbalanced which leads to the unbalanced three-phase power generation.

Key words

Single phase inverters, Photovoltaic system, Analysis, Renewable energy,

1. Introduction

In the case study, this work focuses on analysis of a photovoltaic system with three single-phase inverters connected to the electric grid. Three single-phase inverters connected to the grid were tested during the day. Throughout the test, the inverter's input current and input voltage as well as output current and output voltage were measured. They were used to calculate the inverter's input and output power, power factor PF and efficiency η. The total harmonic distortion THD is determined by applying Fourier analysis of current and voltage. This photovoltaic system is connected to the strong electric grid with low impedance.

2. Photovoltaic system

Fig. 1 shows the photovoltaic (PV) system installed at University of Maribor, Faculty of Electrical Engineering and Computer Science. The PV system is structured into three subsystems. The total power of the PV system is 7.5 kWp (power of each sub array is 2.5 kWp).

3. Analysis

On the inverters' input side the DC voltage u_{DC} and current i_{DC} were measured while on the output side the AC voltage u_{AC} and current i_{AC} were measured. Input voltage and current as well as output voltage and current were sampled with sampling frequency 10 kHz in 1 s long time window.

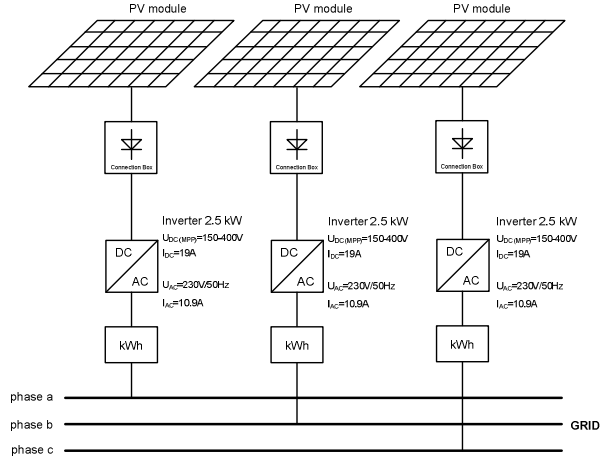

Fig. 1. System block diagram of a photovoltaic system 7,5 kWp installed at University of Maribor.

4. Results

Fig. 2 shows active input P_{DC} and output P_{AC} of all inverters, given as functions of time t.

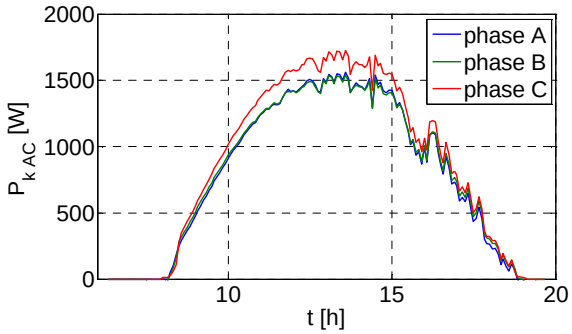

Fig. 2. Input P_{DC} and output P_{AC} power, given as functions of time t.

5. Conclusion

Analysis of single-phase inverters for photovoltaic system is performed in the paper. It is shown that the main problem of photovoltaic systems with three single-phase inverters connected to the grid is in the asymmetrical distribution of power. The results clearly show that the sub-array which is connected to the phase C produces more energy.