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Issues about Monitoring the Energy Performance of a PV Plants Constellation

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Abstract. After setting PhotoVoltaic (PV) plant up, it needs to monitor its energy performance in order to verify the correct or incorrect operation. For this aim, PV plants can be equipped with simple dataloggers or SCADA systems. When several PV plants have to be monitored, a unique supervision centre is implemented, even if each PV plant is independent from the others. From the point of view of storing and transferring data, they constitute a *constellation* of PV plants. This structure, based on the client-server configuration, allows to concentrate the information on a unique supervision centre, but PV plants have to be monitored one at a time. If several analyses have to be run for each PV plant, the total time for monitoring the whole constellation can be very long. The paper deals with these issues.

Keywords

PV plant, Constellation, Monitoring, Statistics.

1. Introduction

Italian PV market is very attractive for new grid-connected PV plants installations as well as for Operation and Maintenance (O&M) enterprises, thanks to the government feed-in tariff. O&M enterprises (usually related to the EPC contractors) can have a lot of PV plants to be monitored. Lately, PV plants was equipped with simple dataloggers, sometimes including ports to link directly the environmental sensors (radiance level, temperature and so on). Nowadays, large PV plants can be equipped with *Supervisory Control And Data Acquisition* (SCADA) systems. These systems implement not only the functions of the simple dataloggers but also other supervision functions. In fact, SCADA systems for PV plant can: a) reveal anomalies related to the breakers; b) measure the reactive power at the Point of Common Coupling (PCC); c) verify if connection pins of PV modules have been changed; d) other functions chosen by the end user, adding I/O ports. Some times SCADA system for monitoring PV plants are based on KNX standard in order to uniform the information acquired by different sensors. These complex systems allows to verify the total daily/monthly/yearly produced energy as well as the voltage and current waveform in both AC and DC sides. Nevertheless, sometimes operation anomalies are little and no warning is generated from the supervision system; even the evaluation of some standard benchmarks [1] can be ineffective. These hidden anomalies cause two problems: a) produced energy is less than the expected one, then economic revenue is reduced; b) anomalies become failures sooner or later. Paper [2] proposes a methodology to monitor the efficiency of a PV plant and to extract information about its operation. It allows to highlight anomalies also when standard benchmarks (defined in [1]) fail. Descriptive and inferential statistical tools are used in [2]. Also [3] consider statistics for assessing PV plants.

Moreover, when several PV plants have to be monitored, O&M enterprises prefer to implement a unique supervision centre, directly linked to each PV plant. Each of them is analyzed one after the other. If few PV plants with small rated power have to be monitored, the whole monitoring system is effective and does not require too time, but when each PV plant has great rated power (≥ 100 kWp), the amount of the data explodes and the processing time grows exponentially. The paper presents these issues in Sec. 2 and proposes possible solutions for an effective and efficient monitoring of a PV plants constellation in Sec 3. Results are reported in Sec. 4.

2. Data to be monitored in a PV plants constellation

This section deals with the issue of the great amount of data to be monitored for a PV plants constellation.

Fig. 1 reports the standard client-server configuration of several PV plants from the point of view of storing and transferring data. Obviously each PV plant has its own data acquisition system and they are independent each other from the electrical point of view. Server box is placed in a remote control room, while the data-logger (or SCADA system) of each PV plant is located near the plant. Sever box is linked to each data-logger by means of an Internet connection.

In order to implement an effective and efficient monitoring, data processing procedures have to be implemented. Even if the server box can manage sequentially the data of different plants, the whole