OUTDOOR TESTING OF THE ECOSOLE

HCPV MODULE WITH SINGLE MODULE INVERTER

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1. Introduction

BECAR, the Beghelli group's R&D company, is leading, ECOSOLE (Elevated COncentration SOlar Energy), one of the largest European Demonstration projects in solar photovoltaic. ECOSOLE, started in 2012, is focused on the study, design, and realization of an innovative HCPV generator made of new high efficiency PV modules equipped with SoG (Silicone on Glass) fresnel lenses and III-V solar cells, and a low cost matched solar tracker with distributed inverters approach. The project also regards the study and demonstration of new high throughput methods for the industrial large scale productions, at very low manufacturing costs. This work reports the description of the field testing of the single module with inverter and the new tracker's functionalities.

Applicable topic: 4.2

2. ECOSOLE System description

It has been designed a SoG Fresnel based module (Fig. 1) with geometric concentration of 1080X, the single lens size being 92x92mm. The lenses parquet is organized as a 6x12 matrix and is held by an aluminum enclosure which hosts the solar receivers on its inside bottom layer. The 72 HCPV receivers are attached to the bottom metal sheet..

Each module's output is connected to a dedicated complete inverter with MPPT tracker. Each inverter allows the maximum possible energy yield of the HCPV generator, since every single module is independent from the others and there is no problem of module shadowing, mismatching or misalignment. Any aging effect of the system which could eventually lead to mismatching conditions is completely eliminated, since each module will always inject into the grid its maximum available power in any condition. The inverters are connected to three phase junction box for the connection of the HCPV generator to the 400V grid.

The tracker (Fig. 2) is composed of several smaller frames assembled on a big frame which is mounted on the top of a pole and has a large area carrying as many modules as possible to minimize the overall cost and the installation efforts. Each smaller frame, called "maxi-module" has 8 HCPV modules mounted on it. The pre-assembly process of each maxi-module is carried out in the factory, before delivering it to the customer with an automatic alignment calibration of the HCPV modules. The tracker is driven by brushless motors and has self-alignment capability. The tracker carries 144 HCPV modules. It will have about 25kW AC power output @ maximum irradiation level of 1000W/sqm DNI. The tracker is able to turn upside-down to facilitate the module cleaning operations and to better protect the modules' glass from the environment during the night.

3. Module outdoor testing

The modules and inverters have been tested both indoor and outdoor and their performance has been evaluated. The self-scanning capabilities have been assessed.

4. Main results and conclusions

The new ECOSOLE modules and inverter have been tested in outdoor condition and the results collected during several months period. The results are compliant with the forecasted performances. The single module inverters show good conversion efficiency and prove their powerful diagnostic capability and flexibility, allowing the periodic I-V scanning of each single module. A special software has been developed which enables to record the tracker's power acceptance by scanning the whole tracker's performance within a set of angles around the optimal sun alignment.

The ECOSOLE activities will continue up to the beginning of 2016 to complete the full validation of the HCPV generator. During the second half of 2015 the testing of three prototype systems will go on in three concentrating Plants installed at ENEA Research Center in Portici (Italy), at Ben Gurion University (Israel) and at Becar's premises in Bologna (Italy) for a complete performance characterization campaign.
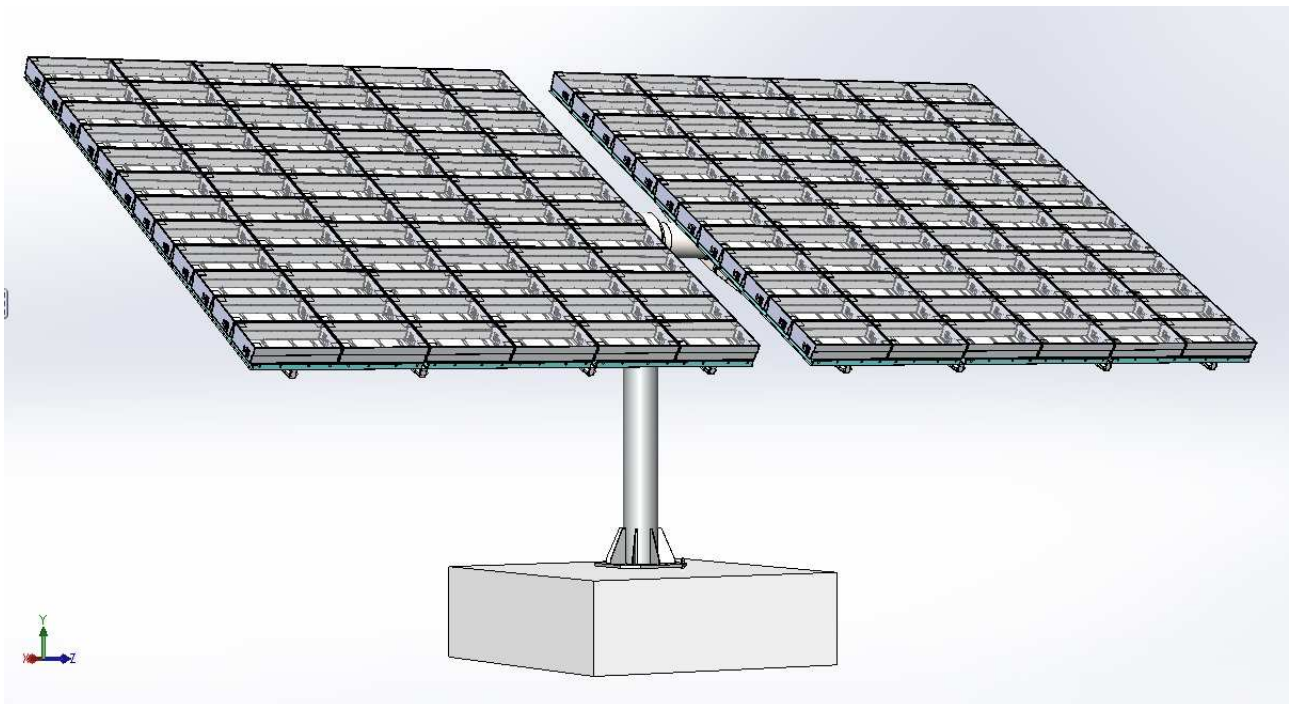
Fig. 1, The ECOSOLE module

Fig. 2, The ECOSOLE tracker