An original design and implementation of a stand used to test the power efficiency of two-axis tracking structures in photovoltaics

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Abstract **The work presents the design and the physical construction of a test stand consisting of a two-axis tracking installation with astronomical positioning and a fixed structure with the specific surface inclination angle (determined through the power efficiency optimization process) and the azimuth angle. On the basis of the analyses as well as the model tests performed, the control type and the components, such as: the power inverter, monitoring devices, and external radiation power density sensors were selected. The system makes it possible to perform measurements of electric energy generation throughout the year and to estimate the efficiency of the tracking structures used in the conditions specific to the city of Poznań in Wielkopolska.**

Keywords **tracker, fixed system, power gain, radiation power density**

I. Introduction

There is strong dependency between the energy of solar radiation that can be obtained from its receiver and the geographical location of the receiver, time parameters and weather conditions. This influence can be partially mitigated through the optimal positioning of the receiver which guarantees that the radiation falls on the receiver surface at the right angle (maximum energy gain). This requires, however, constant adjustment of the receiver position to the current conditions [1,2]. Such adjustments can be implemented as orientation modifications along one or two axes, where the most advantageous results are obtained for controlled tracking systems.

The positioning of the PV receiver can be performed in an open system or in a closed system. An example of the first solution is clock positioning, whose important advantage is the lack of sensitivity to external disturbance. In the second solution, the control is implemented on the basis of signals coming from external sensors (e.g. photosensitive elements). Its disadvantage is, however, increased energy consumption for the operation of the system [3].

II. Operation systems selected for the tests

A fixed system and a tracking system with the astronomical positioning control type were selected for the tests. The roof of the Faculty of Electrical Engineering building of the Poznań University of Technology was selected as the place of system installation.

The fixed structure was implemented with the use of an especially designed frame on which a polycrystalline photovoltaic module manufactured by the Yohkon company with the power of 210 Wp was placed. The inclination angle β in relation to the horizontal plane is 40° and the module itself is directed towards the south. Such positioning was selected after year-long optimization calculations and selected tests on a mechanically controlled tracker were performed. Electrical parameters are monitored with the use of micro-inverters with MPPT and a communication gateway assigned to them.

Fig.1. presents the two-axis tracking system and the fixed system.

Fig.1. The tracking system and the fixed system with the polycrystalline modules with the power of 210 Wp, micro-inverters and the controller installed on the roof of the Faculty of Electrical Engineering building

III. Conclusion

The work presents the design of a stand used to evaluate the reasonableness of using tracking solutions for the climate conditions in Wielkopolska. The performance of complex year-long tests will be possible thanks to the use of the systems that monitor electric energy generation, dedicated software, and radiation power density meters installed in both units. The tests performed involve estimating the amount of energy generated with the use of both systems, including its consumption on the operation of the controlling system itself, and performing the energy balance with the aim to establish the return on investment rate and the potential energy gain.

IV. References

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