

FACULTAD DE INGENIERÍA

Escuela Académico Profesional de Ingeniería Ambiental

Tesis

**Performance Analysis of a Photovoltaic System Using
Factorial Design in the Sector La Ribera, Huancayo,
June 2022**

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Performance Analysis of a Photovoltaic System Using Factorial Design in the Sector La Ribera, Huancayo, June 2022

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Abstract—The objective of the work was to evaluate the performance of the 265W solar photovoltaic system that was installed in a house in La Ribera, Huancayo. The type of research used is technological, experimental level, and the research design was factorial design 32. The results were obtained through the use of the multimeter. The analysis of residuals could prove that all the experimental data collected were consistent, since the variation of residuals is between +2 and -2, and the p-values of the variance analysis are less than the reliability coefficient. The main conclusion of the factorial design 32, is that it guides us to perform the experimental work with nine scenarios or combinations, of which the first scenario where it is located at 22° and positioned to the north and generates 40.7 volts, which is the highest performance of all combinations.

Keywords—Solar panel, voltage, solar energy, photovoltaic system.

I. INTRODUCTION

Solar photovoltaic energy is currently considered one of the most promising renewable energy sources due to its wide availability worldwide and the absence of polluting effects [1]. Renewable energies are increasingly becoming a power generation option for many governments. More than two-thirds of new power generation facilities are based on renewable energy [2]. The production and use of renewable energy currently do not exceed 20% worldwide, at the same time, the demand for energy has increased dramatically due to population growth and industrial development [3].

Compared to other renewable energy sources, solar energy has advanced by leaps and bounds. Studies made by Solar Energy Industries Association (2015). Solar photovoltaic panels and concentrated solar panels reported the highest growth rates compared to other renewable energy sources [4]. Currently, social and economic development is associated with an increase in energy demand. All societies require energy services to meet basic human needs [5]. Finite resources such as fossil fuels are not considered renewable energy. Producing energy from these resources causes negative impacts to the environment, so it should be taken as something of vital importance. In Peru, approximately 48% of energy generation is based on diesel and gas combustion [6]. Likewise, the Peruvian government is

developing a framework of norms to help promote investments in renewable energies. In this way, the goal is for 15% of the energy matrix to come from renewable sources [7]. In the long term, photovoltaic energy becomes profitable and environmentally friendly, and the investment in a PV system can be recovered with the amount saved by not using conventional electricity [8]. An example of the above is seen in the study conducted by the authors of the scientific article "Methodology for the Design of a Hybrid Energy System with a Didactic Approach: Case Study "Centro Educativo Luis López de Mesa". This study shows many benefits after the installation of a PVS in a site. Where previously expenses were made to obtain conventional energy, an amount that could later finance the installation of the PVS [9]. The objective of a factorial design is to study the effect of several factors on one or several responses, when there is equal interest in all the factors. For example, one of the most important particular objectives of a factorial design is sometimes to determine a combination of factor levels at which process performance is best [10]. "Fig.1" shows the structure and operation of the installed PVS. The solar radiation enters the system to be received by the energy generator, which in this case is the solar panel. Subsequently, the energy goes to the charge controller and is directed to the accumulator. Finally, the energy passes through the inverter and the alternating current is obtained.

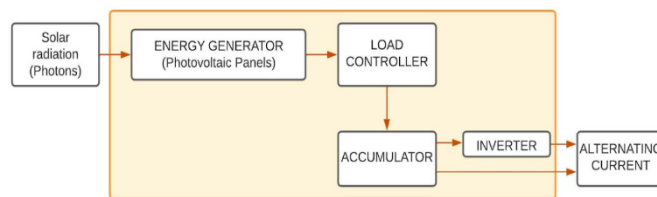


Fig. 1. Structure and operation of the PSV.

II. MATERIALS AND METHODS

The following photovoltaic system was carried out in a house located in the La Ribera sector, Huancayo. The location was chosen to receive the maximum irradiation of the sun in most of the time in most of the solar panel, this place is located in the highest part of the house. Also, it was corroborated that there are no trees, buildings, constructions, panoramic, since