

Optimization of Maintenance of PV Module Arrays Based on Asset Management Strategies: Case of Study

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Abstract : This paper presents a methodology to optimize the maintenance of grid-connected photovoltaic systems, considering the cleaning and module replacement periods based on an asset management strategy. The methodology is based on the analysis of the energy production of the PV plant, the energy feed-in tariff, and the cost of cleaning and replacement of the PV modules, with the overall revenue received being the optimization variable. The methodology is evaluated as a case study of a 5.6 kWp solar PV plant located on the Bogotá campus of the Universidad Nacional de Colombia. The asset management strategy implemented consists of assessing the PV modules through visual inspection, energy performance analysis, pollution, and degradation. Within the visual inspection of the plant, the general condition of the modules and the structure is assessed, identifying dust deposition, visible fractures, and water accumulation on the bottom. The energy performance analysis is performed with the energy production reported by the monitoring systems and compared with the values estimated in the simulation. The pollution analysis is performed using the soiling rate due to dust accumulation, which can be modelled by a black box with an exponential function dependent on historical pollution values. The pollution rate is calculated with data collected from the energy generated during two years in a photovoltaic plant on the campus of the National University of Colombia. Additionally, the alternative of assessing the temperature degradation of the PV modules is evaluated by estimating the cell temperature with parameters such as ambient temperature and wind speed. The medium-term energy decrease of the PV modules is assessed with the asset management strategy by calculating the health index to determine the replacement period of the modules due to degradation. This study proposes a tool for decision making related to the maintenance of photovoltaic systems. The above, projecting the increase in the installation of solar photovoltaic systems in power systems associated with the commitments made in the Paris Agreement for the reduction of CO₂ emissions. In the Colombian context, it is estimated that by 2030, 12% of the installed power capacity will be solar PV.

Keywords : asset management, PV module, optimization, maintenance

Conference Title : ICEPE 2024 : International Conference on Electrical and Power Engineering

Conference Location : Amsterdam, Netherlands

Conference Dates : November 04-05, 2024