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Editorial

Maintenance Management in Solar Energy Systems

Fausto Pedro García Márquez

Ingenium Research Group, Universidad Castilla-La Mancha, 13071 Ciudad Real, Spain; faustopedro.garcia@uclm.es; Tel.: +34-926-295300

1. Introduction

The energy industry is employing new reliable and efficient renewable energy sources because of government and environment restrictions [1]. The renewable energies available around the world are growing rapidly, and it is anticipated that their contribution to global energy will be more than 20% in the next few years.

Solar energy is one of the most-used renewable energies today; however, despite the technical and economic advantages of concentrated solar energy, this industry needs development and improvement in the technologies employed, better maintenance policies, increased efficiency and sustainability, a better energy distribution, etc., to reach competitive levels.

Maintenance is a critical variable in the industry when it comes to reaching competitiveness—in fact, together with operations, it is the most important factor in the energy industry [2]. Therefore, correct management of the corrective, predictive, and preventive politics in any energy industry is required [3]. Maintenance management considers the main concepts, state of the art, advances, and case studies in this topic.

This Special Issue considers original studies that share content complementary to other subdisciplines, such as economics, finance, marketing, decision and risk analysis, and engineering, in maintenance management.

The Special Issue also highlights real case studies, with the main topics being failure detection and diagnosis, fault trees, and subdisciplines (e.g., FMECA, FMEA) [4]. It is essential to link these topics with finance, scheduling, resources, downtimes, etc. in order to increase productivity, profitability, maintainability, reliability, safety, availability, and reduce costs, downtimes, etc. in the energy industry [5].

Advances in mathematics, models, computational techniques, dynamic analysis, etc., are employed in maintenance management [6], and are particularly important for this issue [7].

Finally, we present computational techniques, dynamic analysis, probabilistic methods, and mathematical optimization techniques that are expertly blended to support analysis of multicriteria decision-making problems with defined constraints and requirements.

2. Advanced Analytics in Renewable Energy

The maintenance of solar tower power plants (STPP) is very important to ensure production continuity. However, random and non-optimal maintenance can increase the intervention cost. In paper [8], a new procedure, based on criticality analysis, was proposed to improve the maintenance of STPP. This procedure is the combination of three methods, which are failure mode effects and criticality analysis (FMECA), Bayesian network and artificial intelligence. The FMECA is used to estimate the criticality index of the different elements of STPP. Moreover, corrections and improvements were introduced on the criticality index values based on the expert advice method. The modeling and simulation of the FMECA estimations incorporating the expert-advice-method corrections were performed using the Bayesian network. The artificial neural network is used to predicate the criticality index of the STPP, exploiting the database obtained from the

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Bayesian network simulations. The results showed a good agreement comparing predicted and actual criticality index values. In order to reduce the criticality index value of the critical elements of STPP, some maintenance recommendations were suggested.

Photovoltaic (PV) technology allows for large-scale investments in a renewable power-generating system at a competitive levelized cost of electricity (LCOE) and with a low environmental impact. Large-scale PV installations operate in a highly competitive market environment, where even small performance losses have a high impact on profit margins. Therefore, operation at maximum performance is the key for long-term profitability. This can be achieved by advanced performance monitoring and instant or gradual failure-detection methodologies. One study [9] presents a combined approach on model-based fault detection by means of physical and statistical models and failure diagnosis based on the physics of failure. Both approaches contribute to optimized PV plant operation and maintenance based on typically available supervisory control and data acquisition (SCADA) data. The failure detection and diagnosis capabilities were demonstrated in a case study based on six years of SCADA data from a PV plant in Slovenia. In this case study, underperforming values of the inverters of the PV plant were reliably detected and possible root causes were identified. This research has led to the conclusion that the combined approach can contribute to an efficient and long-term operation of photovoltaic power plants with a maximum energy yield, and can be applied to the monitoring of photovoltaic plants.

Paper [10] is intended to investigate and analyze the operational performances of Conventional Tubular Solar Still (CTSS), Tubular Solar Still with Phase Change Material (TSS-PCM) and Tubular Solar Still with Nano Phase Change Material (TSS-NPCM). Paraffin wax and graphene plus paraffin wax were used in CTSS to obtain the modified solar still models. Experimental studies were carried out in the three stills to observe the operational parameters at a water depth of 1 cm. The experiment revealed that TSS-NPCM showed the best performance and the highest yield in comparison to other stills. The distillate yield from the CTSS, TSS-PCM and TSS-NPCM was noted to be 4.3, 6.0 and 7.9 kg, respectively, the daily energy efficiency of the stills was observed to be 31%, 46% and 59%, respectively, and the daily exergy efficiency of the stills was recorded to be 1.67%, 2.20% and 3.75%, respectively. As the performance of the TSS-NPCM was enhanced, the cost of freshwater yield obtained was also low in contrast to the other two types of stills.

3. Future Works

Despite the closure of this Special Issue, a thorough investigation of the issues related to maintenance management in solar energy systems is expected in the near future. Thereby, achievements relating to advances in maintenance management in solar energy systems pose ongoing challenges to the research community.

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