Agenda 2030 per lo Sviluppo Sostenibile Sustainable Development Goals, SDGs

Obiettivo 7: Assicurare a tutti l'accesso a **sistemi di energia** economici, **affidabili**, sostenibili e moderni - **Pubblicazioni:**

Catelani, M., Ciani, L., Galar, D., Patrizi, G.
Risk assessment of a wind turbine: A New FMECA-Based tool with RPN threshold estimation
(2020) IEEE Access, 8, art. no. 8966244, pp. 20181-20190.

Abstract: A wind turbine is a complex system used to convert the kinetic energy of the wind into electrical energy. During the turbine design phase, a risk assessment is mandatory to reduce the machine downtime and the Operation Maintenance cost and to ensure service continuity. This paper proposes a procedure based on Failure Modes, Effects, and Criticality Analysis to take into account every possible criticality that could lead to a turbine shutdown. Currently, a standard procedure to be applied for evaluation of the risk priority number threshold is still not available. Trying to fill this need, this paper proposes a new approach for the Risk Priority Number (RPN) prioritization based on a statistical analysis and compares the proposed method with the only three quantitative prioritization techniques found in literature. The proposed procedure was applied to the electrical and electronic components included in a Spanish 2 MW on-shore wind turbine.

González-González, A., Jimenez Cortadi, A., Galar, D., Ciani, L.
Condition monitoring of wind turbine pitch controller: A maintenance approach
(2018) Measurement: Journal of the International Measurement Confederation, 123, pp. 80-93.

Abstract: With the increase of wind power capacity worldwide, researchers are focusing their attention on the operation and maintenance of wind turbines. A proper pitch controller must be designed to extend the life cycle of a wind turbine's blades and tower. The pitch control system has two primaries, but conflicting, objectives: to maximize the wind energy captured and converted into electrical energy and to minimize fatigue and mechanical load. Four metrics have been proposed to balance these two objectives. Also, diverse pitch controller strategies are proposed in this paper to evaluate these objectives. This paper proposes a novel metrics approach to achieve the conflicting objectives with a maintenance focus. It uses a 100 kW wind turbine as a case study to simulate the proposed pitch control strategies and evaluate with the metrics proposed. The results are shown in two tables due to two different wind models are used.

Bruzzi, M., Baldi, A., Carnevale, E.A., Catelani, M., Ciani, L.
Conversion efficiency of Si-InGaAs and GaAsP-Si-Ge lateral beam splitting photovoltaic devices
(2018) Measurement: Journal of the International Measurement Confederation, 119, pp. 102-107.

Abstract: This paper deals with the development and characterization of two photovoltaic systems based on the lateral beam splitting principle, with components able to convert different spectral bands of the solar radiation. One is based on a Si cell and a InGaAs photodiode coupled through a long-pass dichroic filter with 950 nm cut-off. A second system is working with a Si photodiode coupled with Ge and a GaAsP photodiodes and two long-pass dichroic filters of 600 nm and 950 nm cut-off in cascade. The systems have been tested under illumination with a Sun simulator and under direct solar radiation in various two-terminal configurations. The performance of the two systems have been compared in same illumination conditions. Both systems, as compared with the Si component alone, proved to significantly increase the photovoltaic performance, achieving at best a conversion efficiency of 20%, so almost doubling its efficiency in best cases.

Reatti, A., Kazimierczuk, M.K., Catelani, M., Ciani, L.
Monitoring and field data acquisition system for hybrid static concentrator plant
(2017) Measurement: Journal of the International Measurement Confederation, 98, pp. 384-392.

Abstract: After the past Fukushima nuclear crisis, the renewable energy industry has been growing remarkably over the last years and has given a further incentive worldwide. In this context, the solar energy is one of the more accessible and cheaper energy resources. For this reason, the solar energy industry has seen a rapid expansion in the last ten years with the result that the share of electricity produced by this technology increases continuously. In order to optimize the photovoltaic energy costs, many solutions have been proposed. In particular, solar concentrating systems have been introduced with the scope of the reduction of silicon needed when compared to the traditional linear photovoltaic modules. This paper is focused on the development of a monitoring system for a hybrid (photovoltaic and thermal – PV/T) static concentrator plant that is able to monitor both electrical and thermal characteristics acquired from the solar and thermal plant. The monitoring of plant parameters is a very important task that can be achieved by means of a well-designed monitoring of system parameters. This approach allows for improving complex system maintenance policies and, at the same time, to achieve a reduction of unexpected failure occurrences in the most critical components, reducing the operating cost.

Cappelletti, A., Catelani, M., Ciani, L., Kazimierczuk, M.K., Reatti, A.
Practical Issues and Characterization of a Photovoltaic/Thermal Linear Focus 20× Solar Concentrator
(2016) IEEE Transactions on Instrumentation and Measurement, 65 (11), art. no. 7518644, pp. 2464-2475.

Abstract: This paper presents some practical issues and experience acquired in the design and experimental verification of a small-sized solar concentrator producing both electrical and thermal power. The device is a low-concentration photovoltaic/thermal solar system with a 20 suns (20×) concentrator factor and is suitable for integration on building roofs. It consists of four small-sized (1930 × 250 × 166 L × W × H mm) linear focus semiparabolic mirrors mechanically linked and driven by a stepper motor and tracking the sun along a single axis. The sunrays are concentrated on strings of monocrystalline cells with conversion efficiency of about 18%. One of the main features of this device is that the parabola mirrors are designed to have their focus inside the mirror profile so that the solar receiver is installed inside the parabolic concentrator. As a result, each single concentrator height is as low as 166 mm. The solar energy that is not converted into electricity by the solar cells is recovered by a cooling medium flowing in an aluminum structure on which the PV cells are mounted. This paper presents an overall description of the device, an electrical layout of the bypass diodes of the solar receiver utilized to reduce the end losses, a method based on voltage measurement to derive the solar cell temperature inside the receiver, and a set of results derived from experimental validations performed on a device prototype. This paper also describes the monitoring system utilized for measurements on the solar concentrator and derives an overall efficiency of solar energy conversion in both electric and thermal generation as high as 61.5%. The predicted values were in good agreement with the experimental test results.