A Demonstratif Overview of Photovoltaic Systems Faults

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***Abstract*—The faults occurring in any industrial systems affects its performance. Moreover, the knowing of the photovoltaic systems faults is a key task for insuring the PV system reliability and good operation, this paper reviews the different defects of the components of photovoltaic (PV) systems (stand-alone, grid-connected). Focusing on the photovoltaic modules defects presentation which are the sensitive component in this chain.**

Keywords— Photovoltaic systems; faults; reliability; PV modules defects.

I. INTRODUCTION

Energy remains a key factor for socio-economic development of a society. It is becoming more and more problematic with increasing price of oil on the one hand and the negative environmental effects induced by the utilization of fossil resources [1], [2]. Now today, the different forms of renewable energies under like solar, wind power, hydroelectricity, biomass offer great flexibility and reliability to mitigate the energy deficit due to increasing of energy demand [3], [4]. It is in this context that the photovoltaic energy sector is a suitable solution of the problematic of the energy. As in any other technical range, the constant increase in the potential for solar energy performance is a fundamental factor in ensuring their competitiveness. In this paper, provides a demonstrative overview of photovoltaic systems faults like EVA discoloration, delamination, busbar oxidation and corrosion, antireflection coating damage ,glass breakage ,bypass and blocking diodes failure, junction box damage , failures of electronic components, snail tracks, hot spot, arc fault Line-to-line fault, ground fault, partial shading and dust accumulation [5], [6].

II. CLASSIFICATION OF SOLAR PV SYSTEMS

The general classification of solar PV systems is given in Figure 1:

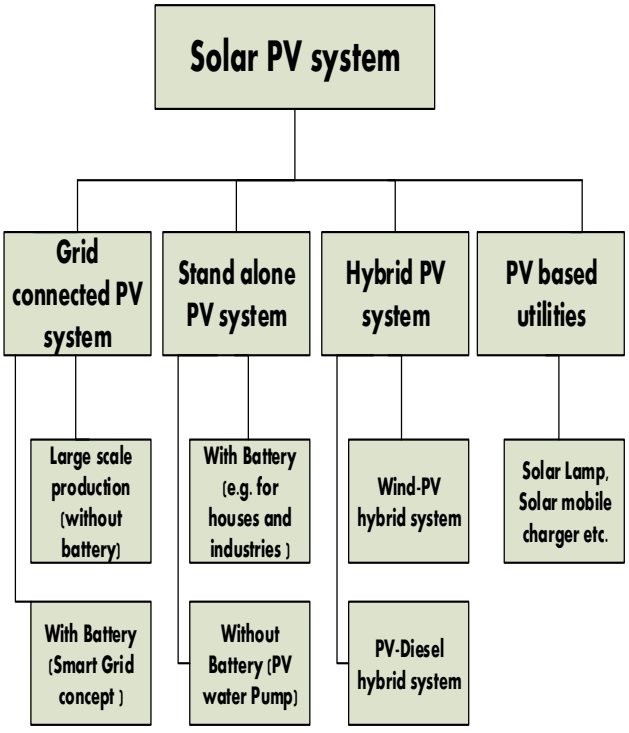

Fig.1. Classification of PV system [7].

III. PHOTOVOLTAIQUES FAULTS

The presence of any faults that occur in photovoltaic systems leads to reduce efficiency, safety risks, it can also stop the required production of the system. The failures of photovoltaic systems can classify into two main categories: permanent and temporary [8], [9] :

- Module EVA discoloration
- Delamination and bubbles
- Busbar oxidation and corrosion
- Antireflection coating damage
- Glass breakage
- Bypass and blocking diodes failure
- Junction box damage
- Failures of electronic components
- Snail tracks
- Hot spot
- Arc fault
- Line-to-line fault
- Ground fault
- Partial shading
- Dust accumulation (soiling)

The permanent failures can be removed by replacing the faulty modules or components, while the temporary faults can occur due to partial shading, soiling and snow on the PV module. These faults can be eliminated by a human operator [8]. Some photographs of PV systems failures are presented below:

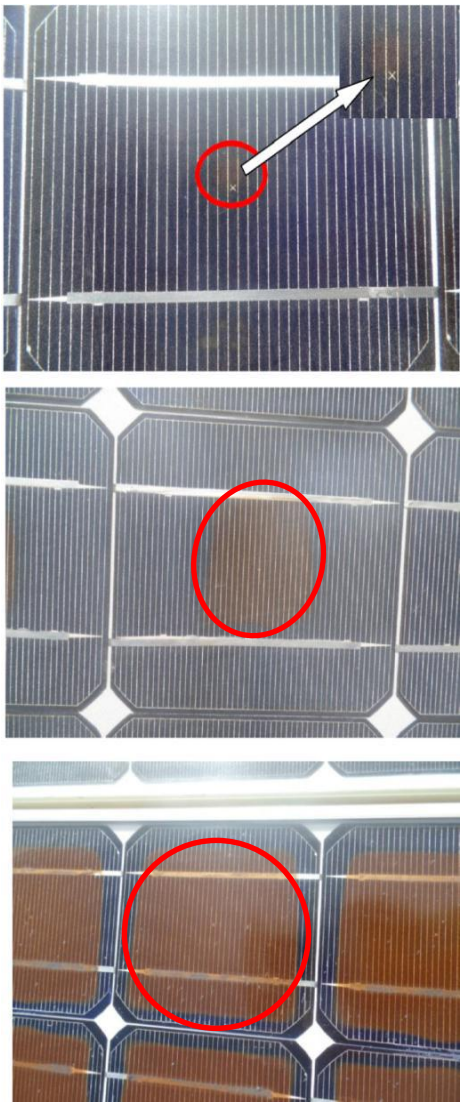

Fig.2. EVA discoloration [5].

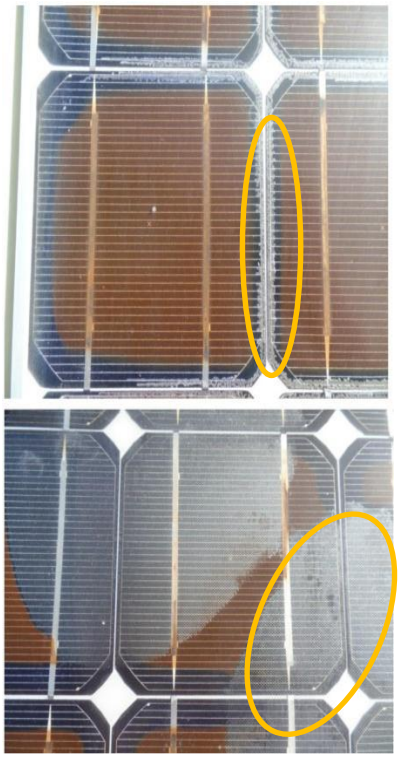

Fig.3. Delamination [5].

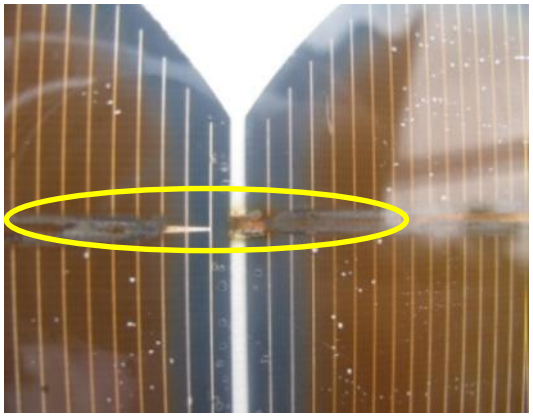

Fig.4. Busbar corrosion [10]

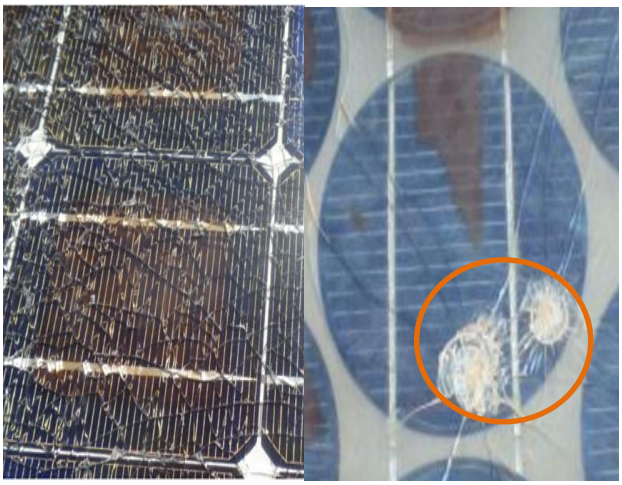

Fig.5. Glass breakage

Fig.5. Antireflection coating damage

Fig.6. Snail tracks (black color) [9]

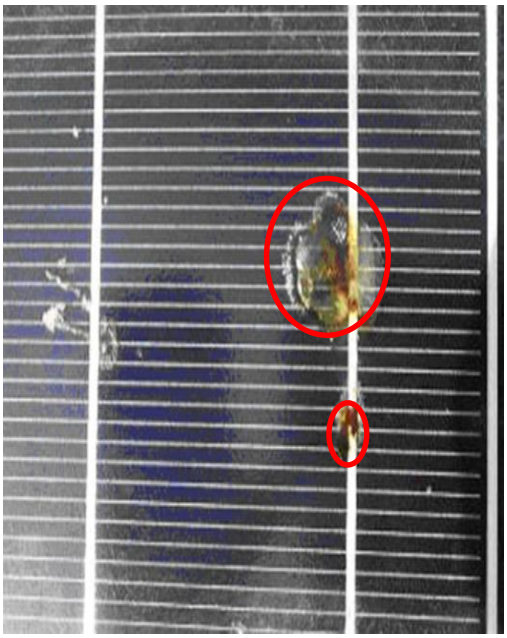

Fig.7. Hot spot [11]

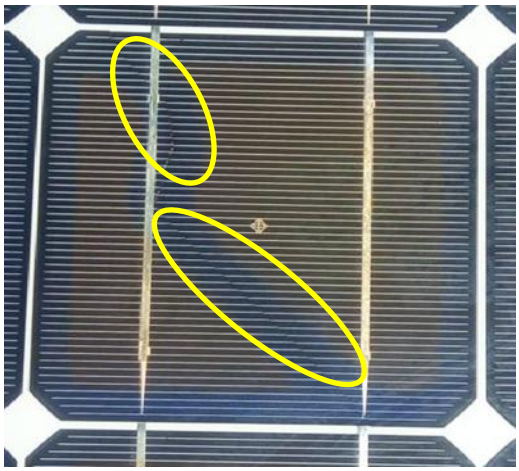

Fig.8. Cracks in solar cell

Fig.9. Junction box damage (back side of PV module)

Fig.10. Dust accumulation on PV modules surface.

Fig. 11. Partial shading caused by trees.

The arc fault can divide into:

- In-line :series arcing (resulting from damage in cell)
- Line-line: parallel and grounding arcing

III. CONCLISION

In this paper, a demonstrative overview of photovoltaic systems faults like EVA discoloration, delamination, busbar oxidation and corrosion, antireflection coating damage ,glass breakage ,bypass and blocking diodes failure, junction box damage , failures of electronic components, snail tracks, hot spot, arc fault Line-to-line fault, ground fault, partial shading and dust accumulation (soiling) are provided in order to give useful information and data for researchers and industrials about this field that it forms a basic platform.

References

[1] R. Dabou *et al.*, "Monitoring and performance analysis of grid connected photovoltaic under different climatic conditions in south Algeria," *Energy Convers. Manag.*, vol. 130, pp. 200–206, 2016.

[2] M. Mostefaoui, A. Ziane, A. Bouraiou, and S. Khelifi, "Effect of sand dust accumulation on photovoltaic performance in the Saharan environment: southern Algeria (Adrar)," *Environ. Sci. Pollut. Res.*, vol. 26, no. 1, pp. 259–268, 2019.

[3] A. Bouraiou *et al.*, "Analysis and evaluation of the impact of climatic conditions on the photovoltaic modules performance in the desert environment," *Energy Convers. Manag.*, vol. 106, pp. 1345–1355, 2015.

[4] A. Necaibia *et al.*, "Analytical assessment of the outdoor performance and efficiency of grid-tied photovoltaic system under hot dry climate in the south of Algeria," *Energy Convers. Manag.*, vol. 171, no. June, pp. 778–786, 2018.

[5] A. Bouraiou *et al.*, "Experimental evaluation of the performance and degradation of single crystalline silicon photovoltaic modules in the Saharan environment," *Energy*, vol. 132, pp. 22–30, 2017.

[6] S. R. Madeti and S. N. Singh, "A comprehensive study on different types of faults and detection techniques for solar photovoltaic system," *Solar Energy*, vol. 158. pp. 161–185, 2017.

[7] S. R. Madeti and S. N. Singh, "Monitoring system for photovoltaic plants: A review," *Renewable and Sustainable Energy Reviews*, vol. 67. pp. 1180–1207, 2017.

[8] A. Mellit, G. M. Tina, and S. A. Kalogirou, "Fault detection and diagnosis methods for photovoltaic systems: A review," *Renewable and Sustainable Energy Reviews*, vol. 91. pp. 1–17, 2018.

[9] A. Bouraiou *et al.*, "Experimental investigation of observed defects in crystalline silicon PV modules under outdoor hot dry climatic conditions in Algeria," *Sol. Energy*, vol. 159, 2018.

[10] E. Kaplani, "Degradation effects in sc-Si PV modules subjected to natural and induced ageing after several years of field operation," *J. Eng. Sci. Technol. Rev.*, vol. 5, no. 4, pp. 18–23, 2012.

[11] M. A. Munoz, M. C. Alonso-García, N. Vela, and F. Chenlo, "Early degradation of silicon PV modules and guaranty conditions," *Sol. Energy*, vol. 85, no. 9, pp. 2264–2274, 2011.