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DEVELOPMENT OF MULTITEST SYSTEM FOR SOLAR PV

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Abstract - *Now-a-days, solar panels are soaring, which helps to reduce co2 emissions at electricity plants. Overtime, solar panels may develop defects which can be easily fixed. In some instances, noticeable changes in visual appearance of the cells occur, such as the 'micro cracks or discolouration '. These defects can cause a severe drop in energy production. In this paper, the defects of the solar cells are determined by analyzing the thermal images. Defect are classified using MATLAB software. For this purpose, an algorithm was designed to perform IR image analysis. We have analyze the quality types (Bus Strength, Glass Quality, Cell Quality, TPT Materials). Finally to predict the Percentage defect, panel quality and age of a solar PV panels.*

Key Words: MATLAB Software, Percentage Defect, Percentage Quality, Efficiency and Age, Solar PV.

1. INTRODUCTION

The solar energy is the energy obtained by capturing heat and light from the sun. The method of obtaining electricity from sunlight is referred to as the referred to as the photovoltaic method. This is achieved using a semiconductor material.

Photo voltaic cells or PV cells convert sunlight directly into DC electrical energy. The performance of the solar panel is determined by the cell type and characteristics of the silicon used, with the two main types being mono crystalline and polycrystalline silicon.

Solar photovoltaic or 'PV' panels are made using the 6 main components described below and assembled in advanced manufacturing facilities with extreme accuracy. In this article we will focus on panels made using silicon crystalline solar cells which are by far the most common and highest performing solar technology available today. There are other solar PV technologies available such as thin film and screen printed cells but we will not be discussing these as they have limited use or are still in development.

In this paper we make the following contribution. We proposed and developed an algorithm to find the Percentage Defect, Percentage Quality, Age and Efficiency.

2. BLOCK DIAGRAM

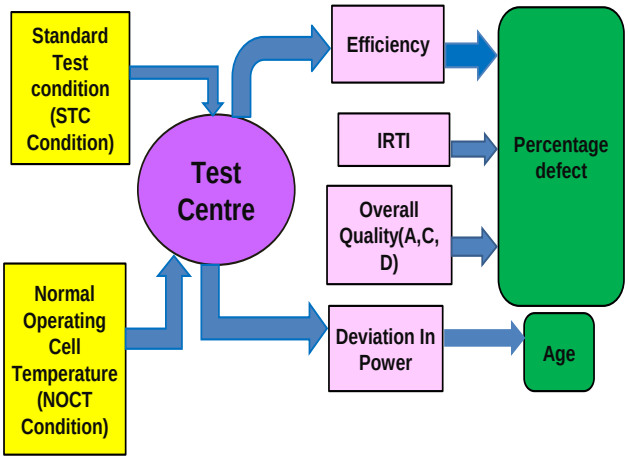

Fig – 1: Block Diagram of Multi test System

3. BLOCK DIAGRAM DESCRIPTION

The above block diagram we using a test center (Solar panel). The test center consists of two inputs like STC condition and NTOC condition. From these STC and NTOC conditions, the Isc , Voc, Vmp, Imp and Pmax of the panel is found out using these test center. Efficiency and Deviation in power is calculated by using these parameters. The IRTI value of the solar PV panel is determined by MATLAB software. We have undergone three process the first one regards the acquisition of an IR image of a well-working PV module. The second case regards the acquisition of an IR image of a bad working PV module. The third one regards the acquisition of an IR image, about the health of PV module.Over all quality is assumed by the different ranges from the solar panel. Finally, we calculate the age and percentage defect of the solar PV panel.

4. STC CONDITION

In a dark room, the 1000W light(2) is focused in a panel and we take the readings such as Maximum Power (Pmax), Open

circuit voltage (Voc), Short circuit current (Isc), Maximum power output voltage (Vmp), Maximum Power output current (Imp) and efficiency depends upon the area of the panel. This readings are taken at this time irradiation (1000W/m^2) and Cell tampertaure (25^0c) is constant.

Fig – 2: STC SETUP

Compare the original specification and STC condition. We taken the readings are high STC and Low STC condition and we found the parameters like Panel Quality, Percentage defect, Efficiency and age.

Table -1: Comparison at various STC conditions

Parameter	Original panel specification	High STC Condition	Low STC Condition
Maximum Power	10	9.34	5.55
Panel quality (%)	100	99.2	95
Percentage defect (%)	0.8%/year	0.8	4
Efficiency (%)	16	15.26	9.27
Age (years)	-	1	5

5. NTOC CONDITION

Sunlight is focused in polycrystalline solar panel tested in NTOC condition. The panels are focused at an angle 30^0 facing south. The Panel are connected in series then observe the short circuit current for these panel using clamp meter and find out for open circuit voltage. By using pyranometer we find out the Irradiation value. Thermal image camera is used to find out the temperature of these panels. compare the original specification and STC condition. We taken the readings are high NTOC and Low NTOC condition and we found the parameters like Panel Quality, Percentage defect, Efficiency and age.

Table -1: Comparison at various NTOC conditions

Parameter	Original specification for NTOC	High NTOC Condition	Low NTOC condition
Maximum Power (Pmax)	10	7.41	3.09
IRTI value	-	82.45	51.81
Panel Quality (%)	100	62	22
Percentage Defect (%)	0.8%/year	37	78
Efficiency (%)	16	12.44	5.44
Age (years)	-	3	8

Fig – 3: NTOC SETUP

5.1 Formula

We can write a formula to find out the percentage defect and age of the solar PV panel

$$\%Defect = \left(1 - \frac{actual\ efficiency}{Ideal\ efficiency}\left(\frac{(4 * IRTI) + A + B + C + D}{8 * 100}\right)\right)100$$

$$Percentage\ Quality = 100 - Percentage\ Defect$$

$$Percentage\ Deviation = \frac{Deviation\ in\ power}{ideal\ power}$$

$$Age = \frac{Percentage\ Deviation}{0.8}$$

$$Deviation\ in\ power = \frac{(Percentage\ ideal\ power - percentage\ actual\ power)}{Ideal\ power}$$

5.2 Advantages

The following are the advantages of the proposed method,

(1) Low Cost: The overall cost for testing the solar panel is low. This makes it much economical. Therefore, this helps to user to conduct frequent test of the panel.

(2) Easy calculation of age: The age of the solar panel can be calculated easily. This would help the user to find whether the given panel is a new or an old one.

(3) Easy calculation of degradation: The degradation of the solar panel can be calculated easily. Generally, the panel will deviate by 1% each year. The reasons are degradation of panel are heavy winds, snow loads and other extreme climates.

(4) % Defect: The %detect of the solar panel can be easily found out. The various defects may be broken solar panel, glass scratches, misplaced alignment of string on the solar panel, solar modules with some external particles etc.

5.3 Limitation

The cost of the equipment such as Thermal image camera, Pyronometer which are used for testing the panel is high. Careful handling of equipment is required.

6. RESULT AND CONCLUSION

Solar power is a cost-sensitive market. This work promotes the easy detection of faults and further, aids are the rectification of faults. As a result of this, the efficiency of solar panel will retain o its manufacturer specifications and assists the customer satisfaction. This paper has presented a thermography based analysis of faults and the proposed methodology was validated by both simulation and experimental test results. Compared with existing methods which detect only separate faults, this work has been made the detection and classification of various combined faults. Then calculate the Percentage Defect, Percentage Quality, Age and Efficiency.

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