

Night time power loss of grid tie inverters

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As mentioned in¹⁷, the previous research publications discussed the inverter RCA from the laboratory stage as initiating some faults such as open circuit faults or short circuit faults. The other previous publications discussed the technical investigation by the visual inspection defects, then deduce some failure causes that may be correct or not correct as there is no verification or validation model. Then a new methodology is investigated to find the failure case analysis of the PV grid-tie inverter.

The inverter components are classified into three sections as shown in Figure 2. The first type belongs to the DC part such as the DC link capacitor and the DC circuit breakers. The second section belongs to the AC part such as the harmonic filter, AC circuit breakers, and cooling fans. The third section is the transition part that converts the DC power to AC power. It consists of power electronic switches and multi-function PCBs that are used to control, protect, and monitor the inverter operation¹⁹. In this case, the MPPT is considered in the inverter control system.

As mentioned in^{20,21,22}, the power losses of three-level inverters are greater than that for the two-level inverters due to the larger number of power electronics switches and capacitors of the DC link. Hereby, the inverter efficiency is higher for two-level inverters than for three-level inverters.

As in the Mega-scale PV power plants, the grid requirement for the THD is very low and shall not exceed 5%, also the power losses due to the power electronic switches are minor or very low compared with the total rating capacity of the PV grid-tie inverter which is rated in Mega-watt. The real case which is investigated in this paper is a three-level NPC inverter. The inverter power circuit consists of three legs as shown in Fig. 3²⁴. The control system for that inverter is shown in Fig. 4, it consists of two closed loops as follows^{25,26,27}:

A brainstorming session was conducted with the O& M team to collect more information about the inverter incident that may be helpful for this analysis. The session outcomes are as the following:

The site technician observed fire and smoke emitted from the inverter container, as well as successive popping sounds due to exploding DC bus capacitors. Therefore, a short circuit path is created on the terminals of the DC bus capacitors. It is required to find the cause of this short circuit fault.



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