# An overview of islanding detection scheme for grid connected pv system

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***Abstract*—** The issue of unintentional islanding in pv grid interconnection still remains as a challenge in grid connected pv system. Anti-islanding methods generally can be classified into four major groups, which include passive methods, active methods, hybrid methods and communication based methods. This study conclude that the setup and operation cost is the vital factor for anti-islanding method selection in order to achieve minimal compromising between cost and system quality. It is difficult to pinpoint generic methods for a specific application.

Keywords—Active method, hybrid method, islanding detection, *Passive method, photovoltaic (PV), utility method*

## I. INTRODUCTION (*HEADING 1*)

This has made PV one of the most promising renewable energy resources in distribution generation(DG).[1]In addition, solar energy is free and pollution free.[2] In grid –connected PV systems particularly, the connection of PV array and balance of system to the utility grid has to be fulfill the technical requirement of interconnection from the utility grid.

There are two types of islanding modes, namely the intentional (planned) and the unintentional (unplanned) islanding. Typically intentional islanding is harmless to the power system because the problem can be solved during or after the grid disconnection. Islanding mode of operation causes the utility grid to be disconnected from the DG in order to prevent any damage in the system. Under this condition, the grid is no longer servicing as a solid voltage and frequency reference. During islanding mode, the utility circuit breaker is opened while the DG is still injecting power to supply the local load (the section between utility circuit breaker and the point of common coupling, PCC) [3,4].This phenomenon occurs when utility suffers from unpredictable interruption of abnormality, such as voltage shut-down, short-circuit or equipment failure. However; unintentional islanding can create severe impact to the power system stability due to the loss of Grid synchronization. According to the information gathered from literature review, none of the islanding detection methods is perfect. Some limitations may include:

i. presence of non-detected zone (NDZ) causing possible Anti-islanding detection failure,
ii. Degradation of power quality and system stability,
iii. False operation in multiple DG,
iv. Requirement of additional circuitry or equipment,
v. high implementation cost.

## II.ISLANDING DETECTION METHOD

For better understanding of islanding phenomena, two key features have to be highlighted. The first feature is the non detected zone (NDZ) and the second is the quality factor (Q factor). Both features have been extensively used as the criteria to evaluate the effectiveness of islanding detection methods. The NDZ represents the interval of islanding failed to be detected by the DG once islanding occurred. This region relates to the power mismatch between DG generating power and local load consuming power, therefore creating a real power variation (ΔP) and reactive power variation (ΔQ).

Many islanding detection methods have been developed for grid-connected PV systems; these methods can be divided into four categories.

*1)* Passive inverter-resident methods, which are based on the monitoring of the voltage at the point of common coupling (PCC) and the detection of its disturbances;
*2)* Active inverter-resident methods, which deliberately Cause a disturbance on the PCC voltage;
*3)* Active methods not resident in the inverter, which work Similar to the previous methods but the perturbation is produced from the utility side of the PCC.
*4)* Communication-based methods which involve the Transmission of data between the inverter and the grid.

### *(a) Passive Methods*

Passive islanding detection methods relies on the measurement of system parameters (such as the variation in the voltage, frequency, harmonic distortion or the power) that causes the inverter to control the output power in order to meet specific conditions during islanding mode of operation. The parameters vary greatly at the point of the PCC when the system is islanded. The difference between abnormal grid-connected condition and an islanding condition is based on the threshold setting of the system parameters. Passive method is the basic requirement of grid connected because this method is economical and practical. In addition, passive methods cause no degradation to power quality and are easily implemented. The drawbacks of passive methods are the large NDZ and difficulties of threshold setting. Moreover, passive method is not guaranteed for all load conditions, especially in load-source balance condition. Active methods are developed to reduce NDZ of passive methods, thus most of the active methods have very small NDZ (even eliminated) compared to passive methods, excepting cases of high Q factor loads. But the concept behind the active

methods is to drive the operation point of the system towards UFP/OFP and UVP/OVP trip limits, by destabilizing the system.

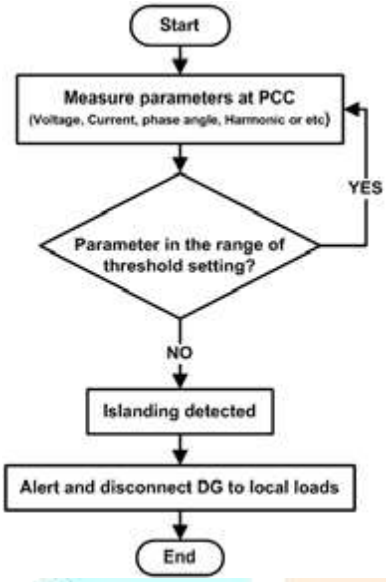


**Fig 1: The flow chart of passive islanding detection procedure**

***(b)Active Methods***

Active islanding detection method is based on the injection Of a small disturbance signal to certain parameters at the PCC the concept of this method is that small disturbance Signal will become significant upon entering the islanding Mode of operation in order to help the inverter to cease power Conversion. Hence, the values of system parameter will during the cessation of power conversion, and by measuring the corresponding system parameters, islanding condition can be detected. Active methods involve feedback control technique that detects changes in the parameters such as frequency or voltage at the PCC. In the case when the PV inverter behaves as current source.

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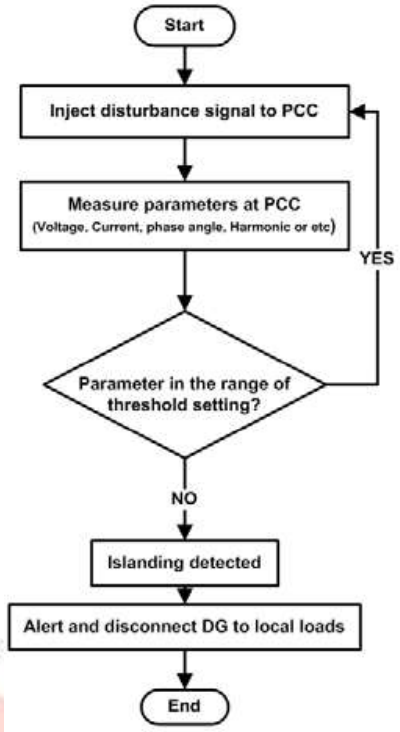


**Fig 2:The flow chart of active islanding detection procedure**

**(C).Hybrid Methods**

Hybrid method is evolved from the combination of both active and passive detection methods [15, 28]. The hybrid methods involves two stages of detecting procedures to overcome the problems of passive method and active method, in order to achieve higher effectiveness [34]. During the detecting procedure passive detection method is used as primary protection, then the active detection method is implemented when the islanding is suspected by the passive method. Fig. 8 shows the basic operation flow for hybrid islanding detection procedures.

***(d)Communication Base Methods***

Communication base methods are based on communication Between utilities and DG. Islanding is detected when the Status of utility circuit breaker and the information was send to DGs. These methods require telecommunication system to be Equipped to alert DG when islanding occurs, then DG will take action to trip from local load. These techniques are more accurate and have better reliability than local islanding detection techniques, but the need for communication equipment which are expensive, make these methods uneconomical to implement.

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*A. Ciccuit diagram*

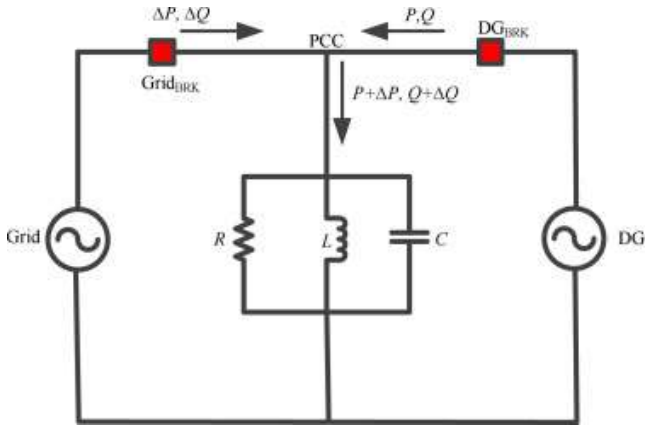


**Fig. 2. Islanding detection test circuit**

A resonant RLC parallel load is considered by the standard;however a resistive local load has been used in this paper.IEEE Std. 929-2000 requires that a grid-connected PV invertertrips when islanding occurs within:

*1)* Ten cycles when there is at least 50% mismatch in activepower (that is $P_{load}$ is < 50% or >150% of $_{inv}P$ ) or theislanded-load power factor is < 0.95 (lead or lag);

*2)* 2*s* when the active power mismatch is <50% (that is $_{inv\ load\ inv}$ $50\%P < P < 150\%P$ ) and the islanded-load power factoris > 0.95 (lead or lag).

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## Conclusion

The overview of several possible islanding detection methods suitable for PV grid-connected system have been discussed and analyzed. As a conclusion, it is difficult to define a generic method for a specific application, because most of the methods discussed are governed by the nature of application and system dependent elements. in addition, the setup and operation cost is always the vital factor for ant islanding method. Hence, careful selection has to be made based on the understanding of the actual history of islanding probability occurrence in a particular system. This is ensuring that the control system is reliable as well as achieving minimal compromising between cost, system quality and safety risks. in fact , the choice of anti-islanding methods is dependent on national electrical rules and regulations, because every country has its own guideline of DG of the actual history of islanding probability occurrence in a particular system. This is to ensure that the control system is reliable as well as achieving minimal compromising between cost, system quality and safety risks. In fact, the choice of anti-islanding methods is dependent on national electrical rules and regulations, because every country has its own guidelines of DG.

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