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PV Connected grid and islanding detection method problems

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***Abstract*— Islanding refers to a condition of a distributed generator (DG) in that it continues to power a location even though power from the grid is no longer present. This condition can bedangerous to grid workers who may not realize that the load isstill powered even though there is no power from the grid. Adverseeffects of islanding are low power quality, grid-protection interference, equipment damage, and personnel safety hazards. For these reasons, DG systems must detect an islanding condition and immediately stop producing power; this is referred to as anti-islanding.Islanding detection methods can be categorized into two major approaches: the passive and active methods. The passive methods are based on measurement of the natural effects of islanding. The active methods use intentional transients or harmonic effects.When the power generated by the DG matches the load power consumption, passive methods fail due to the small natural effectsof islanding. Therefore, the passive methods have a non detectionzone (NDZ). The active methods can reduce the NDZ size. However,these methods reduce the grid power quality. This paper offers an overview of anti-islanding method (AIM) for A single-phase DG conneted in low votage grid.**

***Keywords*—** Islanding, distributed generator, power quality, nondetection zone, anti-islanding method

I. INTRODUCTION

Recently, due to environmental pollution and the immanent exhaustion of fossil fuel, distributed generation systems using renewable energy sources, including wind power,microhydro, solar photovoltaic, and landfill gas, have become one of the main power generation points of interest. The main distributed generator (DG) requirements are high power quality, highly efficient operation, and safety. An islanding condition occurs when a DG and the local loads are disconnected from the grid of DGs supplying power into the local loads [1]. There are two types of islanding modes, namely the intentional (planned) and the unintentional (unplanned) islanding [2, 3]. The purpose of intentional islanding is to sectionalize the utility system in order to create a power 'island' during an occurrence of disturbance. This is a common scenario especially for maintenance purposes. The local load in the created island will be supplied constantly by DG through a well-planned energy management until the utility is ready to be synchronized with the DG. Typically, intentional islanding is harmless to the power system because the problem can be solved during or after the grid disconnection [3].However, unintentional islanding can create a severe impact to the power system stability due to the loss of grid synchronization. Consequently, this causes the DG to be out of the voltage and frequency references. This may damage the electrical devices and systems equipment in the islanded section. Another issue persists in the islanding mode whereby the technical workers may be placed under safety hazards as they may not be aware that the section is continuously powered by the DG. For this reason, anti-islanding control is essential in order to detect the islanding operation immediately subsequently, control signal should be sent to alert the entire system to perform disconnection of DG from the local load [4].

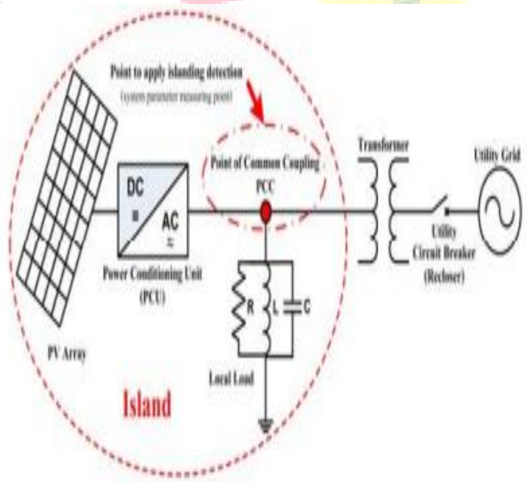


Fig. 1 An overview of islanding mode in a grid connected PV system

II. NETWORK MODÉLISATION

It is a low-voltage network of urban type with individual connection with a transformer, two departures BT, Four BT four branches serving customers. The earthing system is of the earthed neutral by resistance of 40 Ohms (every junction accessory, every 20 m).

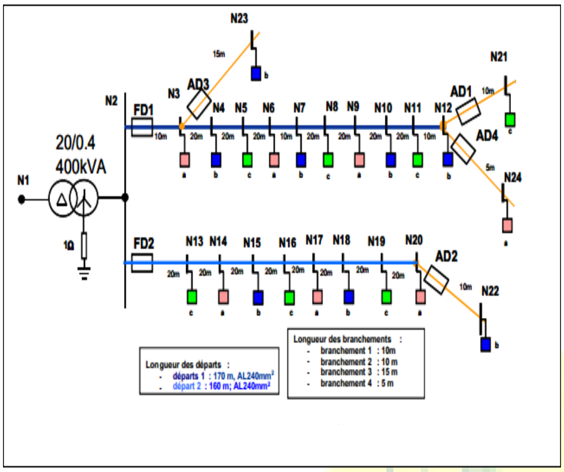


Fig. 2 Studied Networks [5]

A. lines Parameters

The network was modeled with two types of lines: two starts underground cable 240mm² and four branches of 35mm². The cable models were used with the following parameters :

TABLE I
STUDIED URBAN NETWORK

Parameter of the line	240mm² cable Parameter	35mm² cable Parameter
Rd (Ohms/km)	0.1113	0.856
Ro (Ohms/km)	0.954	2.61
Xd (Ohms/km)	0.085	0.145
Xo (Ohms/km)	0.382	1.72
Co (µF/km)	0.3	0.005

We proposed a new method to model correctly lines or cables of 4 or 5 conductor (3 conductors, neutral and screens) using the matrix of line parameters (or cable). The conductors, the neutral and the screen are modeled by a matrix with the values and mutual resistance and inductance. The capacitance are modeled by the lumped parameter in π or in Γ.

B. the source station Structure

The upstream network was modelled by three-phase voltage source with parameter: Rs=0.015 Ohms and Ls=0.25Mh

C. Loads Modeling

All residential loads are modeled by PQ single-phase loads (RL series circuit) varying from tens of kW tgφ= 0.4

D. MV / LV transformer Parameters

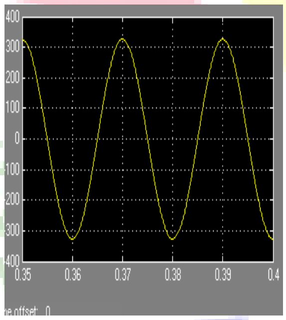
- Coupling : D-yn
- Power : 400kVA
- primary winding Parameters (50% Zt) :

U= 20kV ; R1 = 17.25 Ω ; L1 = 183 mH

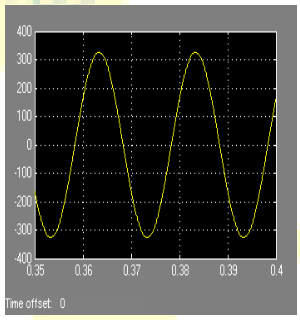
- secondary winding Parameters:

U = 0.4kV ; R2 = 0.0023 Ω ; L2 = 0.024 mH ;
Rmag = 143 kΩ ; Lmag = 1.3691*106(H)

III. VOLTAGES AND CURRENTS IN SOME NETWORK NODES BEFORE CONNECTING TO THE PV SOURCE

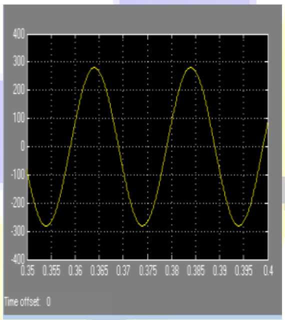


The voltage at node 02

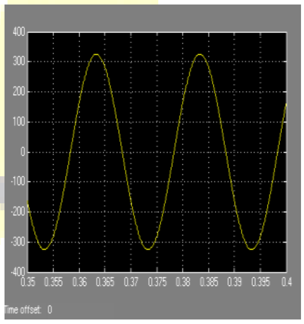


The voltage at node 23

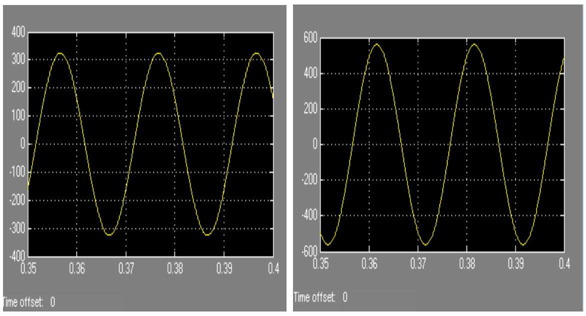
T



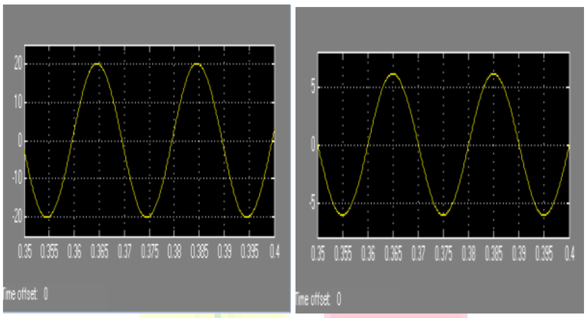
The voltage at node 21



The voltage at node 14



The voltage at node 2 — The compound voltage N :11



The current at node 4 — The current at node 12

Fig.3 Voltages and Currents before PV connecting

IV. The " Subsystem " of PV system used for simulation

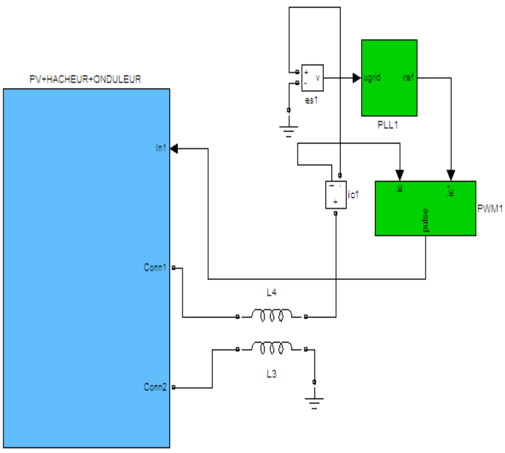


Fig.4. PV system subsystem in simulink

IV.1 The different characteristics of a PV module (Ipv-Vpv), (Ppv-Vpv) following the external factor (G & T) and internal parameters (Rs, Rp, n)

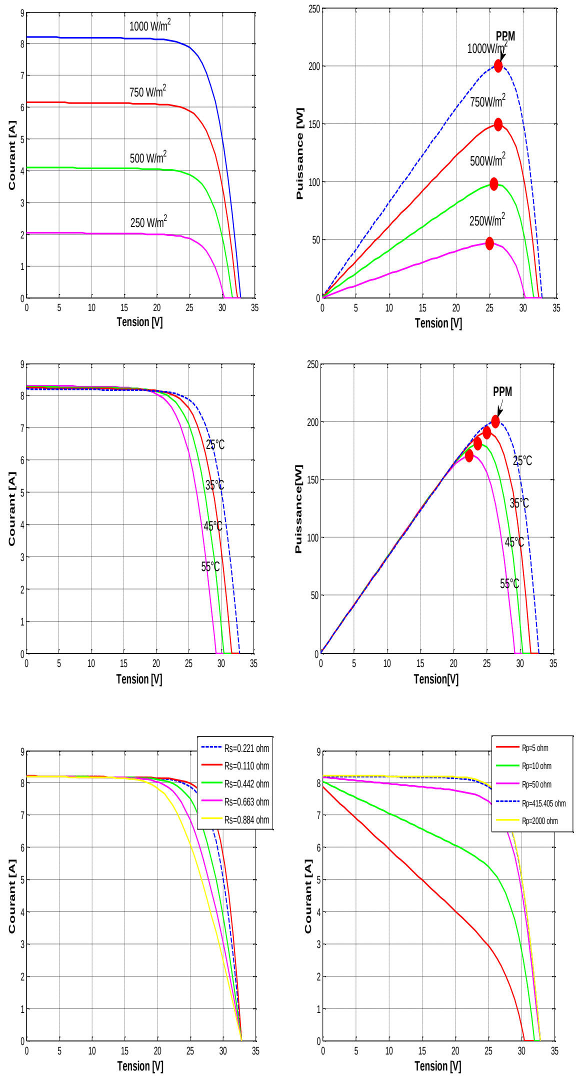


Fig.5: I-V and PV characteristics

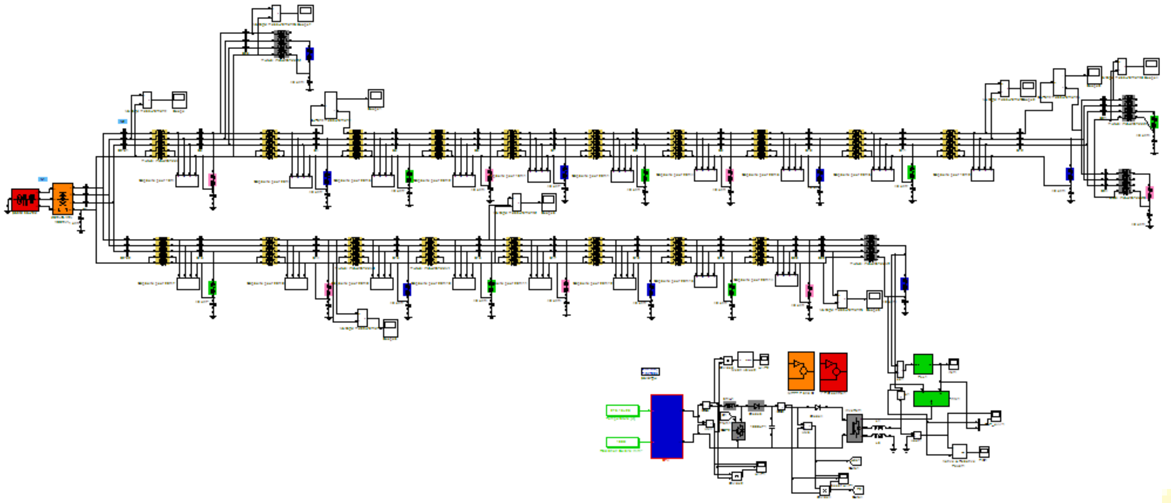


Fig.6. global patterns of PV system connected to the network in simulink

V. ANTI ISLANDING DÉTECTION METHODS [AIM]

To prevent islanding phenomenon, many anti-islanding methods have been studied until now. Fig.7 shows the total number of anti-islanding research papers per year for the DG among IEEE published papers since 1980. As the world DG demand has increased for the last decade, the number of anti-islanding papers has grown rapidly due to the safety issue for the DG.

Various anti-islanding algorithms and detection methods have been developed [6]: The methods can briefly be classified into two families, namely local islanding detection techniques and remote islanding detection techniques. The former method relies on the measurement of system parameters at the DG while the latter is based on the communication between the utility grid and the DG. The other control techniques under the two main families are summarized in Fig.8 which shows the hierarchy of anti-islanding detection [2, 7, 8]. According to the information gathered from literature review, none of the islanding detection methods is perfect. Some limitations may include:

- ✓ presence of non-detected zone (NDZ) causing possible anti-islanding detection failure,(Passive methods),
- ✓ degradation of power quality and system stability,(Actives methods),
- ✓ false operation in multiple DG,
- ✓ requirement of additional circuitry or equipment,
- ✓ High implementation cost [9].

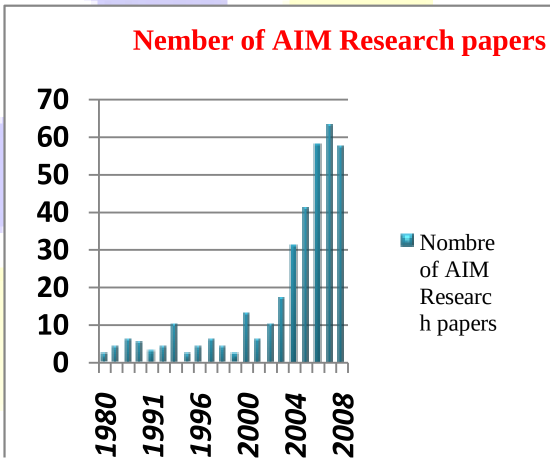


Fig.7. Total number of anti-islanding papers per year, since 1980

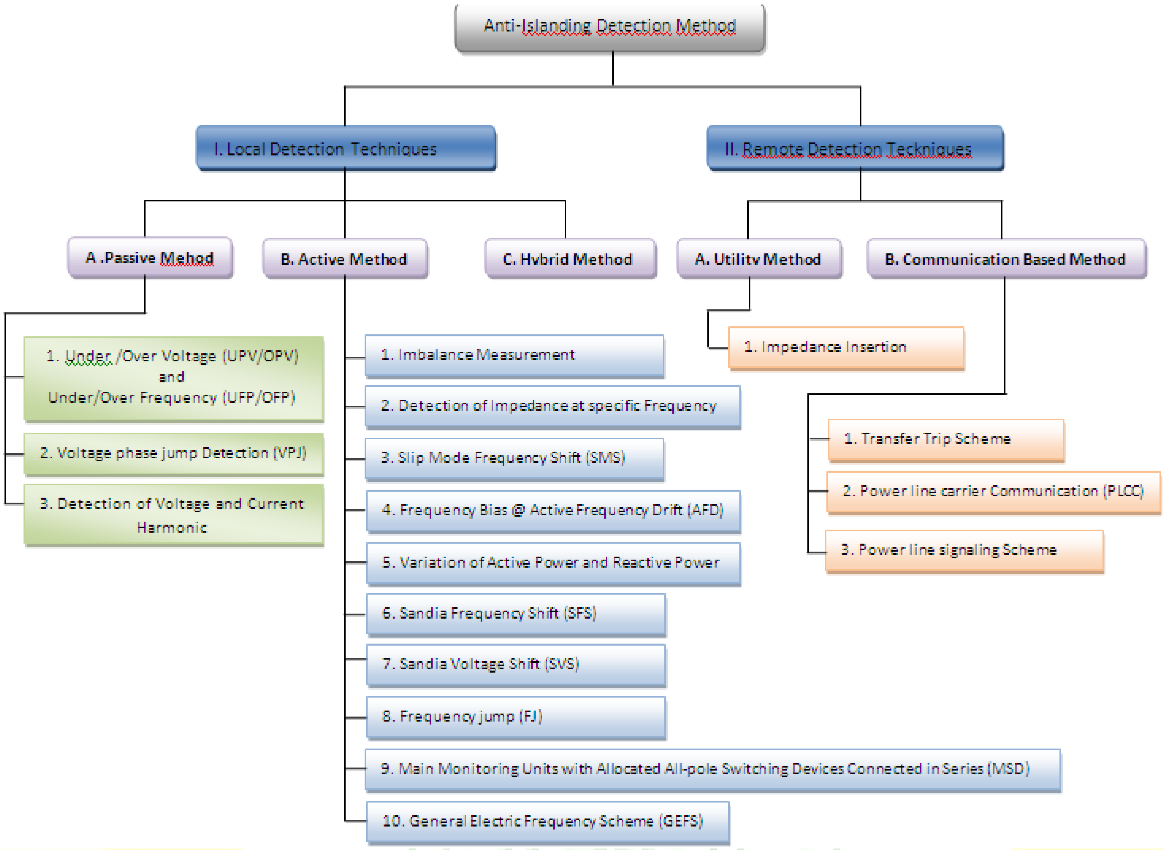


Fig.8. The classification of anti-islanding detection techniques

OBJECTIF:

The aim of this summary is to study various effective anti-islanding detection method in order to determine the most appropriate and effective way to identify islanding problem and that of saluting the speed and accuracy of detection in addition to the quality of energy that concern us greatly in our study and snapped the economic factor of course in every way we will use.

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 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 interconnection requirements.

VI. CONCLUSIONS

The overview of several possible islanding detection methods suitable for PV grid-connected system have been Presented and discussed. 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 anti-islanding method.

REFERENCES

[1] J.H. Kim, J.G. Kim, Y. Ji, Y.Ch. Jung, and C.Y. Won, ‘’An Islanding Detection Method for a Grid-ConnectedSystem Based on the Goertzel Algorithm’’IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 26, NO. 4, APRIL 2011

[2] IEEE, IEEE Application Guide for IEEE Std 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.IEEE Std 1547.2-2008, 2009: p. 1-207.

[3] IEEE, IEEE Standard for Interconnecting Distributed Resources With Electric Power Systems.IEEE Std 1547-2003, 2003: p. 0_1-16.

[4] Funabashi, T., K. Koyanagi, and R. Yokoyama. A review of islanding detection methods for distributed resources. in Power Tech Conference Proceedings, 2003 IEEE Bologna. 2003

[5] C. Le Thi Minh "Couplage Onduleurs Photovoltaïques et Réseau, aspects contrôle/commande et rejet de perturbations "Thèse de doctorat, Laboratoire de Génie Electrique de Grenoble (G2ELAB), Université de Grenoble, 2012.

[6] Singam, B. and L.Y. Hui. Assessing SMS and PJD Schemes of Anti Islanding with Varying Quality Factor. in Power and Energy Conference, 2006. PECon '06. IEEE International. 2006.

[7] Velasco, D., et al., Review of anti-islanding techniques in distributed generators.Renewable and Sustainable Energy Reviews, 2010. 14(6): p. 1608-1614..

[8] Noor, F., R. Arumugam, and M.Y. Vaziri. Unintentional islanding and comparison of prevention techniques. in Power Symposium, 2005. Proceedings of the 37th Annual North American. 2005.

[9] Wilsun Xu, Konrad Mauch, and Sylvain Martel, An Assessment of Distributed Generation Islanding Detection Methods and Issues for Canada.report # CETC-Varennes 2004-074 (TR), CANMET Energy Technology Centre – Varennes, Natural Resources Canada, July 2004, 53 pp., 2004.