Simulation of Auto ground System for Anti-islanding Protection of Distributed Generation with Renewable Application

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***Abstract*—Due to the variety of distribution generation (DG) sizes and technologies connecting to distribution networks, and the concerns associated with out-of phase reclosing, anti- islanding continues to be an issue where no clear solution exists. This paper presents an auto ground approach that was proposed in the context of an IEEE working group on best practices for DG protection. A prototype system was constructed using standard distribution apparatus and a recloser controller, and it was tested on the utility's distribution test line. Results show that the anti-islanding detection time is approximately a cycle longer than the delay associated with application of the auto ground. Once the auto ground was applied, the DG was disconnected within 1 cycle on over current protection. The solution is inherently scalable, applicable to all DG types, is configurable to various reclosing practices and does not require additional equipment or settings changes at the producer's site. Using this anti-islanding protection scheme, a renewable Application is presented for better distributed generation.**

***Index Terms*—Distributed generation, distribution relaying, renewable energy.**

I. INTRODUCTION

THE fast acting of distributed generator has grown over the past decade and some utilities have reached very high penetration levels. Despite this experience the debate between utilities and private producers rages on a number of technical issues. Possibly the most contentious is that of anti-islanding protection, a reliable high speed communication based transfer-trip scheme and a local passive approach methods, that relies only on the measurements of the voltage wave form is represent islanding respectively, the most conservative and modern approaches. The anti- islanding system and line protection are the two fundamental protection requirements that need to be met by all distributed generation (DG) installations, as detailed in the DG interconnection standards Line protection consists of being able to detect all faults on the distribution feeder to which the DG is connected, while not disconnecting for faults on an adjacent feeder. Generally over current relaying is sufficient to meet this requirement, although in power electronic based generators, other strategies may be necessary due to the limited contribution to short circuits by these installations.

Anti-islanding has been the subject of a number of studies these approaches can be typically divided into the following two Classifications: passive approaches using the local measurements of voltage and current, and variables derived from using these quantities, to delineate between islanding and grid connected operation and active approaches where By the DG perturbs the grid voltage or frequency, an approach intended to be benign while the grid is present, and to destabilize the system when the substation is open. A third approach is in fact a variant on communication based approaches, whereby using thyristor valves connected to ground, a disturbance is periodically injected at the substation-its presence at the DG's location indicates a normal condition, whereas its absence is indicative of an islanded grid have also suggested these thyristor based devices for fault identification in. Similar to active islanding techniques, this approach could be criticized alone on the impact on power quality. Additionally, in noisy grids or feeders that are particularly long, the issue of nuisance tripping is an issue.

II. THEORY AND METHODOLGY

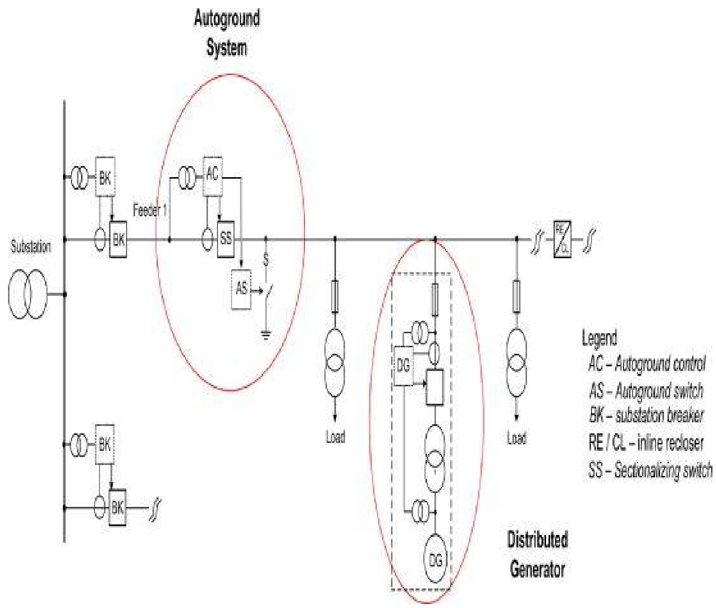

Fig.1. Illustration of the proposed auto grounding system

A DG set owner may decide to connect his DG to the local Electricity Grid supply (ie) the DG will be synchronized to the grid. The main objective here is to feed the plant load will both by the grid as well as the DG set. Whenever a DG is connected to the local grid, there can be two modes of operation as shown in DG is shown connected in parallel to EB power. Plant load is connected to the same bus where both DG and EB are present.

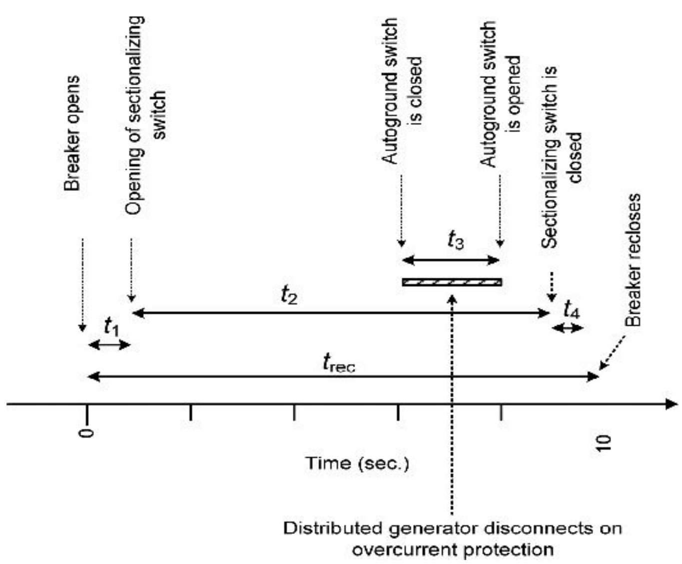

Fig.2. Sequence of events in the Operation of the auto ground.

The first case is a result of the inadvertent opening of the substation feeder breaker/recloses are one of the protection devices further down the feeder. This could be done in error or as a planned operation where the utility personnel do not realize that there is a DG present on the line. Eventually the line is re- energized and the risk of out-of-phase reclosing exists, if the DG remains online. The second, even less likely situation would be a temporary fault that leads to operation of the utility protection device, but the DG‘s protection does not operate before the self- clearing fault extinguishes, creating the temporary island. For example a tree branch might touch the line and it is clear at the moment the vacuum bottle interrupter of a Recloser operates. Although less likely, the latter of the two cases is generally used to define the anti-islanding requirements, which links the requirement to first period relaxing time of the local utility typical first operation releasing time off, although some are as fast as 0.5 s. This defines the speed at which the DG‘s anti- islanding protection must detect the island. Provides a comparison of the different types of anti-islanding approaches and the implications in terms of equipment, the installation site, relative cost, and pros and cons of each. The solution proposed in the present work, termed an auto ground, is seen as a compromise in terms of cost and performance between the transfer-trip and local passive measurements. Presents the auto ground concept, where the auto ground system is installed just down the line of the utility protection device (substation breaker or inline Recloser). In this configuration, following the opening of the utility breaker, the auto ground opens the substation side device, denoted sectionalizing switch (SS) and closes the auto grounding switch (AS) effectively applying a three phase to ground fault.

All DGs that have not already disconnected based on their anti- islanding protection will be forced to disconnect based online protection. Here it is assumed that the DG‘s line protection has been properly configured in order to detect all faults, as required by In the case of inverter based DG, over current protection alone may not be sufficient and more advanced functions such as over current with voltage restraint may be required. However, the focus of the present work is on the validation of the concept. Following application of the auto ground for the predefined time, it then flips states, opening AS following by closing of its SS. The utility breaker then re-energizes the system, without a risk of out-of-phase reclosing. The auto ground system consists of three main components: the sectionalizing switch the auto ground switch, and the controller, which can be implemented using a variety recloser or breaker controls. The parameters of the synchronous generator and the over current protection are provided in the Appendix. Switches on feeders 2 and 3 were opened in order to feed them both from feeder 1.The testing consisted of first synchronizing the generator, balancing its output power with the 150 kW load and then initiate opening of the *SS* for three different configurations of the auto ground with all three fuses in service; with one fuse removed; and with two of the three fuses removed.

SYNCHRONOUS GENERATOR PARAMETERS

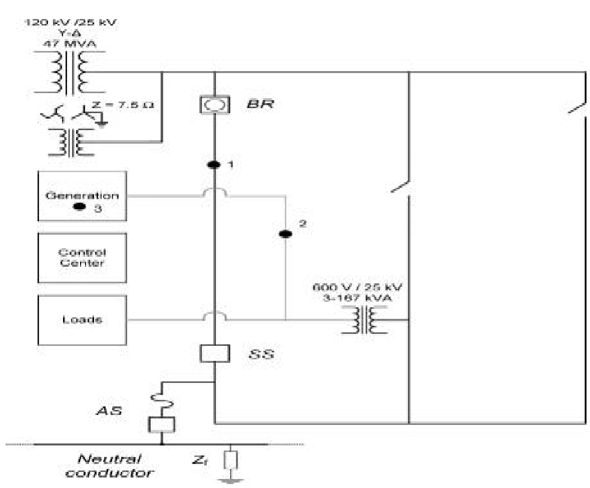

Fig3.Distribution test line model of Auto grounding operation

Illustrates the vacuum bottle based recloser used in the experimental set-up as the *SS*. As the *AS* is connected in parallel with the distribution network only in order to apply the fault, it does not need to interrupt fault current either. As a result, the apparatus is even simpler, and is realized by a slight modification to an automated capacitor bank assembly.

III. MATLAB CIRCUIT AND RESULTS

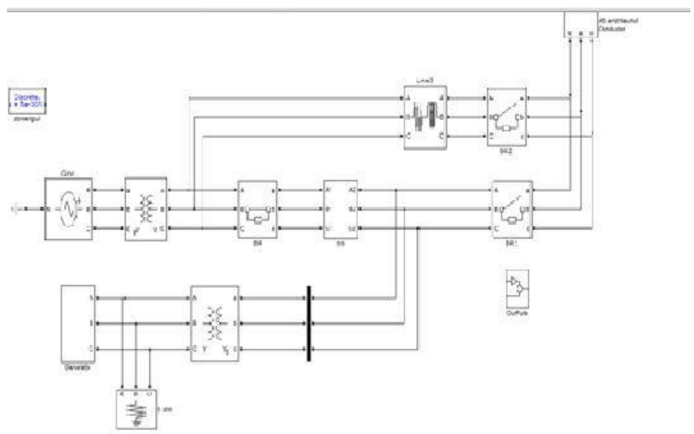

Fig.4.The Monitoring of Proposed anti islanding technique

A. Results

The simulation results for the three cases are summarized in the magnitudes of the peak current (which includes the DC component) are given, along with step voltage measured at 1 meter, and the neutral current. Torque measurements were taken but they are not presented as the reading saturated in each case at 45 N m.

As can be noted, the magnitude of the phase current is roughly equivalent for the three cases; however, the neutral current is much higher, as expected, for the unbalanced auto ground cases. This is reflected in the step voltage measurement, are the measured value represents no issue. Illustrates the case for balanced operation of the auto ground that is, with the three fuses in operation.

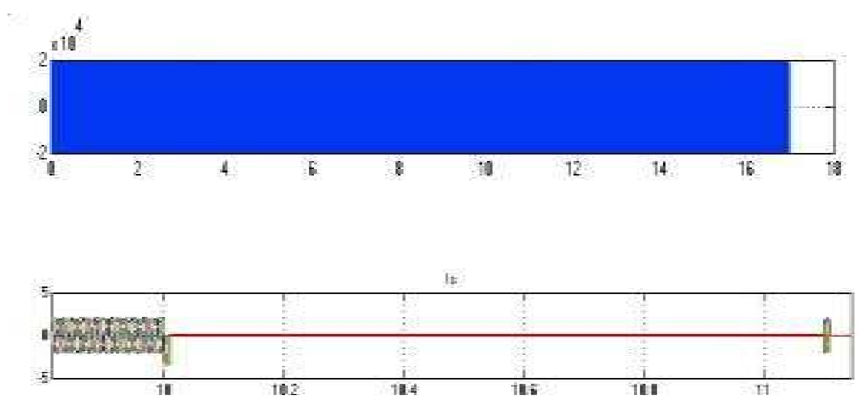

Fig.5 Substation voltages (top) and currents (bottom) during Opening of *SS* and application of the *AS*.

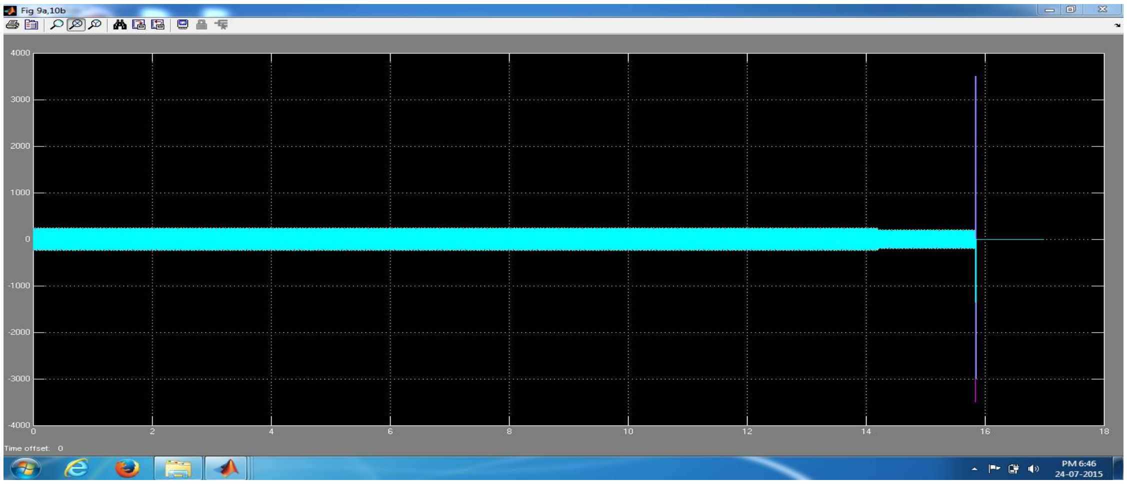

Fig.6 Three phase voltages

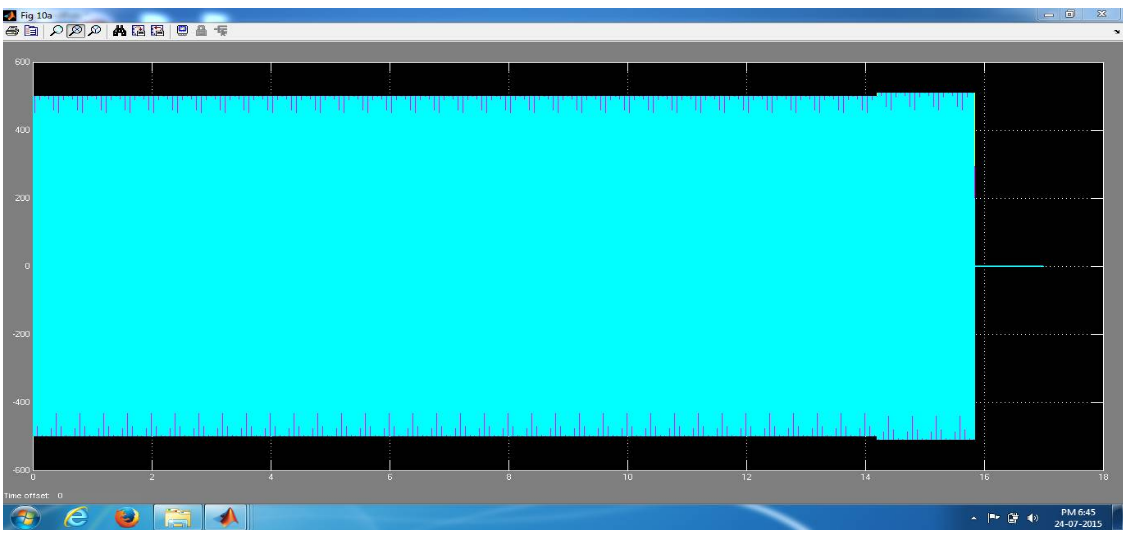

Fig.7 Three phase Currents

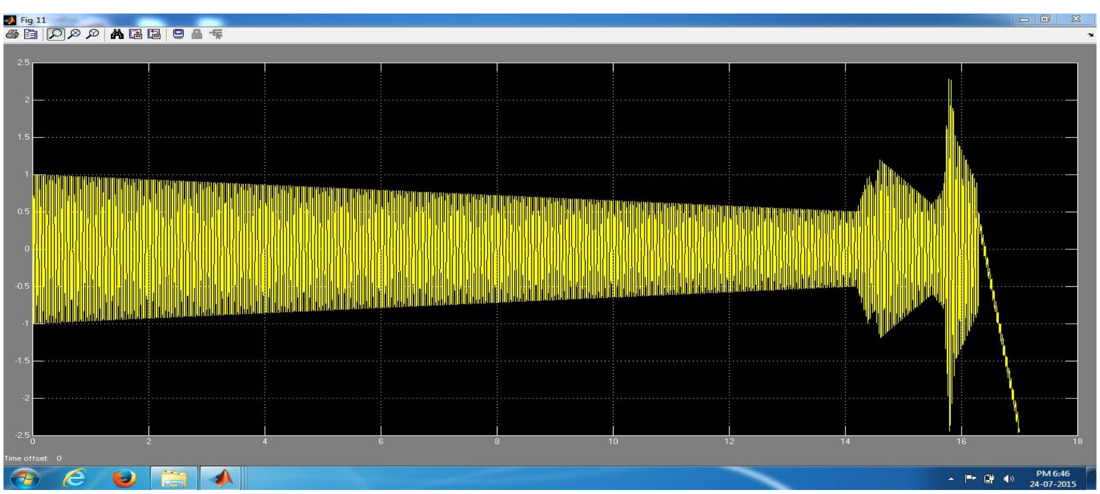

Fig.8 Torque measurement on the synchronous generator shaft

This paper investigated the design considerations for the signal generator. A set of design formulas is established. Typical signal generator parameters are illustrated using actual system data. The proposed scheme can be implemented using other signalling techniques. Developing a signalling technique that can take advantage of the simple requirement of anti-islanding signalling to reduce the cost of signal generator is still opening of any components. This has resulted in a significantly simplified Auto grounding scheme. In addition, a subject worth research.

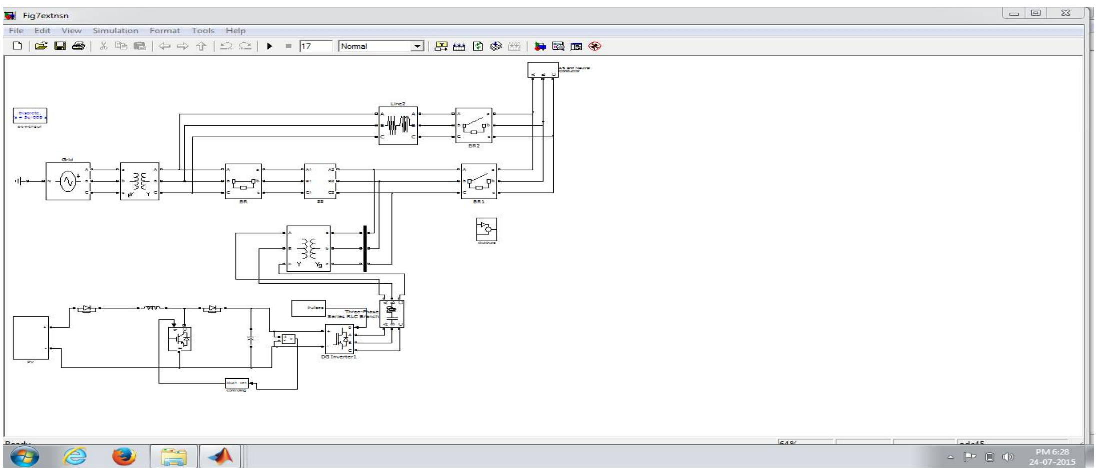

Fig.9 Proposed anti islanding technique with renewable Application.

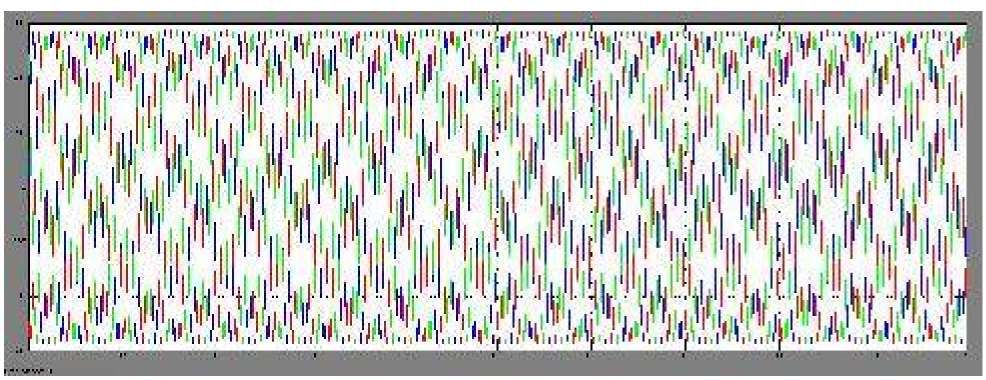

Fig. 10 output result voltages.

IV. CONCLUSION

This paper has presented a scalable, low cost approach for Anti-islanding protection of distributed generation, using a Utility owned and operated system referred to as an auto ground. The design of the system and its control were presented and a prototype system was constructed using standard distribution utility equipment. Testing results were presented for symmetrical and asymmetrical operation of the system. In all cases, the DG's over current protection isolated the generator from the system in less than two cycles. The peak torque observed exceeded momentarily around 4 times the pre-fault value. Using this anti-islanding protection scheme, a renewable Application is presented for better distributed generation. The results validated the concept for a single generator based on a synchronous machine, while future work will study its applicability to systems with large numbers of DG, including those with power electronic interfaces. The solution shows promise due to its relatively low cost and inherent scalability.

REFERENCES

[1] Requirements for the Interconnection of Distributed Generation to the Hydro-Québec Medium-Voltage Distribution System [Online]. Available: http://www.hydroquebec.com/transenergie/fr/commerce/racco rdement_distribution.html

[2] "IEEE application guide for IEEE std 1547, IEEE standard for interconnecting distributed resources with electric power systems," *IEEE Std. 1547.2–2008*, pp. 1–207, Apr. 2009.

[3] J.Mulhausen, J.Schaefer, M.Mynam, A. Guzman, and M. Donolo, "Anti-islanding today, successful islanding in the future," in *Proc. Protective Relay Engineers*, , Mar. 29–Apr. 1, 2010, pp. 1–8.

[4] R.J.Best, D.J.Morrow, D.M.Laverty, and P.A.Crossley,"Synchrophasor Broadcast over internet protocol for distributed generator Synchronization," IEEE *Trans. Power Del.*,vol. 25, no. 4, pp.2835–2841, Oct. 2010.

[5] F. Katiraei, A. Foss, C. Abbey, and B. Strehler, "Dynamic analysis and field verification of an innovative anti -islanding protection scheme based on directional reactive power detection," in *Proc. 2007 IEEE Elect. Power Conf.*, Canada, Oct. 25–26, 2007, pp. 183–188.

[6] C.AbbeyandP.Venne,"Field validation of a reverse reactive power relay for anti-islanding protection of a synchronous generator," in *Proc.CIGRE Canada Conf. Power Syst.*, Sep.2011.

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