© September 2015 | IJIRT | Volume 2 Issue 4 | ISSN: 2349-6002

AN ANTI-ISLANDING TECHNIQUE FORDISTRIBUTION SYSTEMS

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***Abstract*- Due to the variety of distribution generation (DG) sizes and technologies connecting to distribution networks, andthe concerns associated with out-of phase reclosing, anti-islanding continues to be an issue where no clear solution exists. An exemplification system isconstructed by using the standard distribution apparatus and arecluse controller and the distributed generators were trippedthrough the high-speed communications circuit and were blockedfrom closing back it is tested on the utility's distribution test linemodel to a protection. The operation shows anti-islandingdetection time is approximately a cycle longer than the delayassociated with the application of the auto ground. Once the autoground is applied, the DG is disconnected within 4 cycles on overcurrent protection and applies to all DG types, the concept isinherently scalable, is confiscable to various reclosing operationsand does not require additional equipment or setting changes atthe producer's site, and reduces the cost of equipment.**

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

I. INTRODUCTION

Electric power distribution systems have traditionally been designed assuming that theprimary substation is the sole source of power and short-circuit capacity. Distributedresources invalidate this assumption by placing power sources onto the distributionsystem. As a result, DR interconnection results in operating situations that do not occur ina conventional system without generation directly connected at the distribution level.Careful engineering can effectively eliminate the potentially adverse impacts that DRpenetration could impress on the electric delivery system, such as exposing system andcustomer equipment to potential damage, decrease in power quality, decrease inreliability, extended time to restoration after outage, and potential risks to public andworker safety. There are different system issues which may be encountered as DRpenetrates into a distribution system.Load currents through the power and distribution transformer and line impedances causevoltage drops, which reduce voltage magnitude at the loads. Voltage magnitudes atservice locations must be maintained within specified ranges. This is accomplished inboth fixed designs of the system (e.g., conductor selection, substation and distributiontransformer tap settings and fixed capacitor banks) and by voltage control equipmentsuch as automatic load tap changers, step-type voltage regulators (SVR), and switchedcapacitors.

The fixed design of the feeder is based on the assumption that loading profilesgenerally follow a predictable pattern, with real power loading on the feeder causingvoltage to decrease monotonically from the substation. SVR controls continuouslymonitor voltages and load currents to adjust tap positions accordingly. Capacitors(switched and fixed) compensate reactive current, reducing the current from the source tothe capacitor location, resulting in reduced line voltage drop.

However, capacitors willcause a current increase in feeders if the capacitor size is greater than the load reactivedemand due to overcompensation. This will also happen if the capacitor size meets thereactive demand of the total distributed load connected to a feeder, but is installed at alocation where it compensates more than the downstream reactive power demand,resulting in voltage increase. When a distributed generation (DG) is interconnected to thedistribution system, it can significantly change the system voltage profile and interactwith SVR and/or capacitor control operations.Anti-islanding has been the subject of a number of studiesthese approaches can be typically divided into thefollowing two classifications: passive approaches usingthe local measurements of voltage and current, andvariables derived from using these quantities, to delineatebetween islanding and grid connected operation andactive approaches where by the DG perturbs the gridvoltage or frequency, an approach intended to be benignwhile the grid is present, and to destabilize the systemwhen the substation is open. A third approach is in fact avariant on communication based approaches, wherebyusing thyristor valves connected to ground, a disturbanceis periodically injected at the substation-its presence at theDG‘s location indicates a normal condition, whereas itsabsence is indicative of an islanded grid have alsosuggested these thyristor based devices for faultidentification in. Similar to active islanding techniques,this approach could be criticized alone on the impact onpower quality. Additionally, in noisy grids or feeders thatare particularly long, the issue of nuisance tripping is anissue.

This paper proposes an approach to anti-islanding protectionthat is based on applying a three-phase short circuit to the islanded distribution system just prior to reclosing or re-energization. Section II provides the theory and methodology for construction of this utility-owned equipment. Section III presentsthe experimental set-up and results, and we conclude with asummary of various practical considerations.

II. THEORY AND METHODOLOGY

Anti-islanding protection is required of any distributed generator connecting to the distribution network, in order to protectagainst the case that the DG continues to energize the feederwhen the utility has opened-creating an unintentional island. Anunintentional island, although rather unlikely in real life, couldbe created by one of two scenarios.

1. Result of the inadvertent opening of the substation feeder breaker/recloser or 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.
2. It 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.

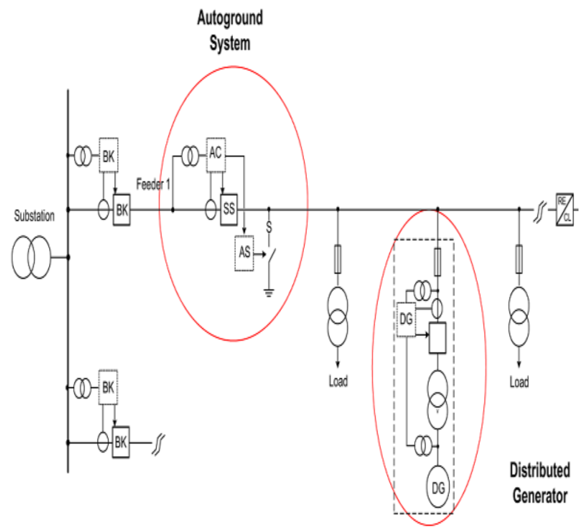

Fig. 1. Description of the autoground concept.

Fig. 1 presents the autoground concept, where the autogroundsystem is installed just downline of the utility protection device (substation breaker or inline recloser). In this configuration,following opening of the utility breaker, the autoground opensthe substation side device, denoted sectionalizing switch (SS)and closes the autogrounding switch (AS) effectively applyinga three phase to ground fault.

A. Control Logic

Fig. 2 illustrates the connection of the controller to the network and the logic for opening and closing of the sectionalizingswitch. It is proposed to detect the opening of the upline protection device using an undercurrent relay.

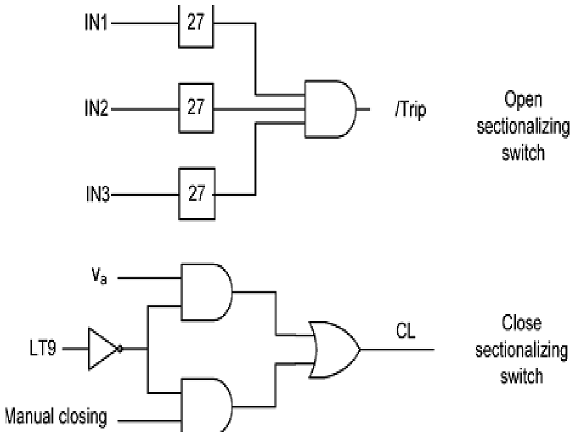

Fig. 2. Autoground sectionalizing switch closing and opening logic.

III. PROPOSED SYSTEM

All DGs that have not already disconnected based on their antiislanding protection will be forced to disconnect based onlineprotection. Here it is assumed that the DG's line protection hasbeen properly configured in order to detect all faults, as requiredby In the case of inverter based DG, over current protectionalone may not be sufficient and more advanced functions suchas 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 autoground 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 as shown in fig.3

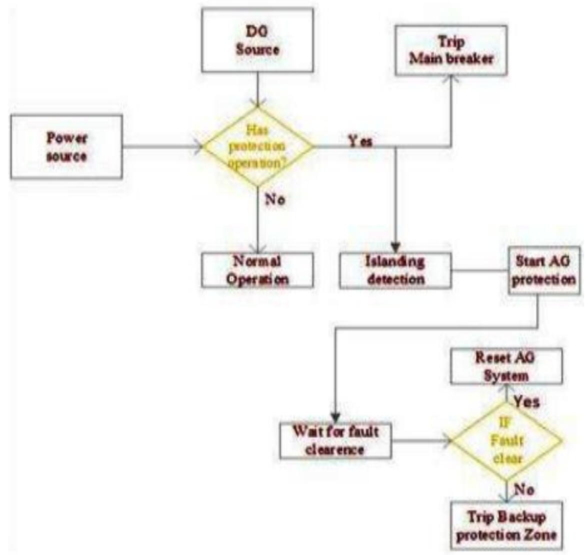

Fig.3. Flow chart of the anti-islanding protection

The autoground system consists of three main components:

1) Sectionalizing switch the
2) Autoground switch, and
3) Controller, which can be implemented using a variety recloser or breaker controls.

Here we describe each of these components in turn the SS is required only to mirror the state of the substation breaker. It is preferable to have the SS as a separate device for the simple reason that costs escalate when work within the substation is required. Any savings associated with the integration of the SS function into the feeder breaker would be outweighed by the cost of linking it with the AS. Illustrates the vacuum bottle based recloser used in theexperimental set-up as the SS. As the AS is connected inparallel with the distribution network only in order to applythe fault, it does not need to interrupt fault current either. As aresult, the apparatus is even simpler, and is realized by a slight modification to an automated capacitor bank assembly.Itautomatically detects the absence of a power line carrier signalwhen the distributed generator becomes electrically isolated(i.e. islanded) from the utility grid due to, for example, theopening of a breaker in the grid. With the knowledge of this situation, distributed generators are automatic disconnected fromthe grid in a timely manner for safe operation

Analysis of the corresponding equations

Xfmr FLA = (KVA * 1000) / (EL-L * 1.732)*3-Ph I sc at Xfmr = (((KVA/1000)* MVA) / (1.732 *EL-L))* 100/ Z %)
3-Ph Isc at fault = Isc at Xfmr *
Where:
EL-L = phase to phase voltage
Z = transformer nameplate impedance
IL-L-L= available 3-phase SC current

IV. SIMULATION RESULTS

The technique is conducted on proposed distribution test linemodel, configured according to the autoground system isinstalled at the end of the first feeder.

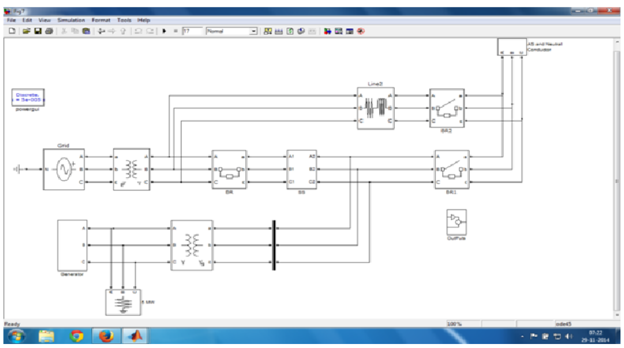

Fig.4 The Monitoring of Proposed anti islanding technique

The synchronous generatoris connected to the second feeder through a 600 V/25 kVtransformer, as indicated.

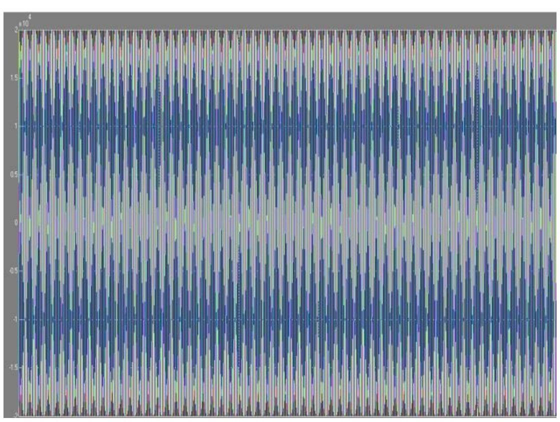

Fig.5

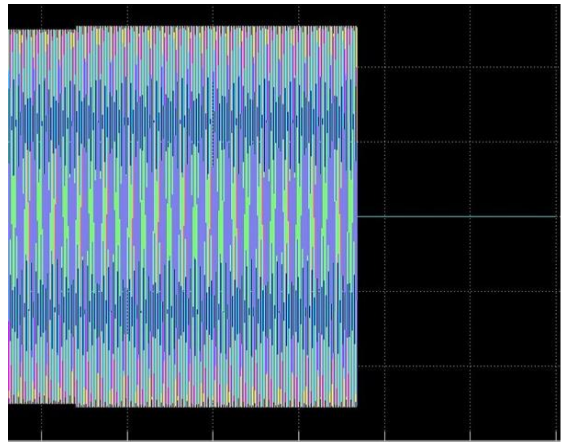

Fig.6

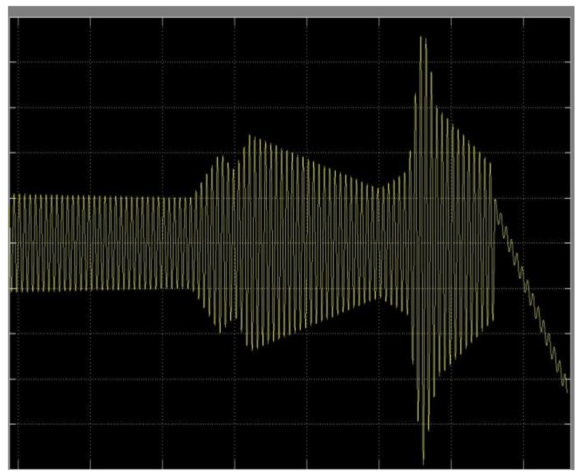

Fig.7

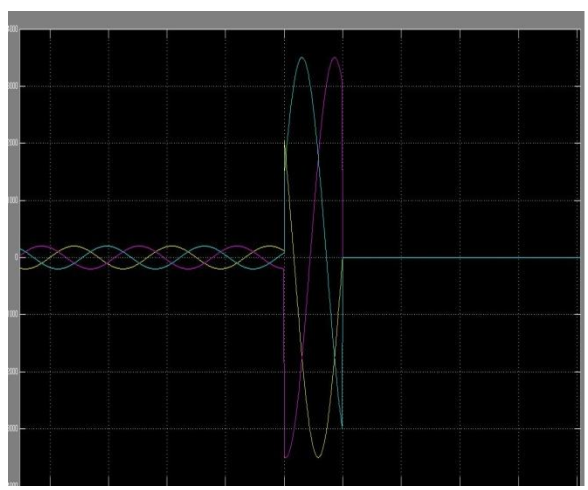

Fig.8

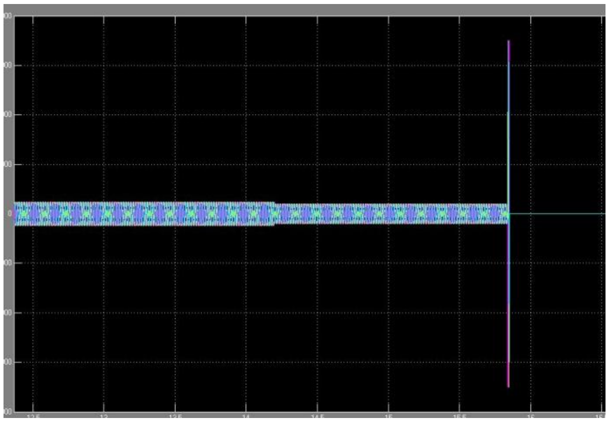

Fig.9

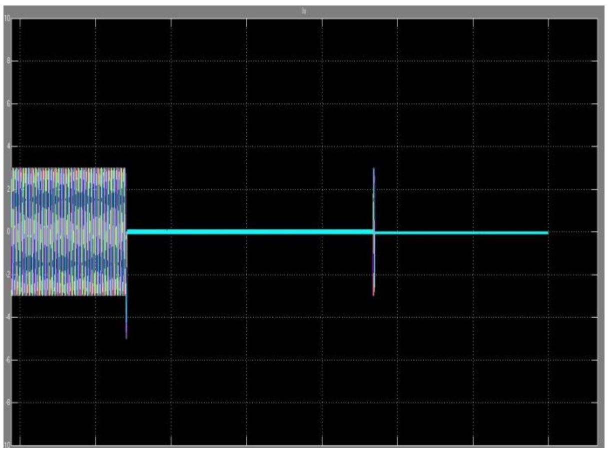

Fig.10

V. CONCLUSION

This paper is presented a new and powerful anti-islandingprotection concept and associated scheme for Utility and DGapplications.However, the signal is sent through power line,which makes the scheme applicable to any distribution systemsregardless the availability of signal detection means. Moreimportantly,since the signal passes through any switches,breakers and other open able components connected between thesubstation and DG sites; the scheme is able to detectautomatically.

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