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Review on Power System DG Protection and Power Scheduling Using Breaker Triggering Time Controlling

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Abstract- One of the biggest changes happening to the distribution system is the introduction of distributed generation. One of the drivers behind this movement is the need to integrate renewable energy sources into the distribution system. Traditional protection schemes used is the distribution system need to be re-evaluated with the integration of DG associated with customer loads. The interconnection protection varies widely depending on factors such as: generator size, point of interconnection to the utility system (distribution or sub-transmission), type of generator (inductor, synchronous, asynchronous) and interconnection transformer configuration. Newer DG systems are utilizing electronic power converters which results in special consideration for DG protection. The impact of DG on existing systems must be examined through detailed simulations and protection studies. Examples of interconnection protection schemes are examined.

Keywords- PID Controller, Power System Stabilizer (PSS), Synchronous Generator.

I. INTRODUCTION

Circuit breakers are used for protection & switching in industrial electrical system. Hence, reliable operation of circuit breaker is essential. Failure of circuit breaker can cause huge damage to industrial electrical system including revenue loss & fatality.
Circuit breakers are subjected to stress during their operation as they contain many mechanical/electrical components, has to carry rated or fault power & participates in arc quenching methods. Due to this circuit breaker ages over time & number of operations. This raises a concern regarding reliability of circuit breaker operation. In order to ascertain reliability of circuit breaker, it is general practice to carry out preventive maintenance at fixed time intervals. In preventive maintenance program, the circuit breakers are taken out of service at regular intervals & its parameter like trip coil current, close coil current, spring charging motor current etc. are measured using special diagnostic equipment. Moreover, visual inspection & cleaning of its components like fixed contact, moving contact, tripping coil, closing coil, spring charging motor, operating mechanism etc. are carried out in order to ensure its healthiness. Being a time-based maintenance approach, downtime of the system increases although the circuit breaker is healthy. Moreover, use of special diagnostic equipment increases the maintenance cost of circuit breakers [1].

One more important issue with reference to circuit breaker is that the control of switchgear is realized through hardwired control logic which increases the size of control & metering cabinet of the circuit breaker & prevents integration of Internet of Things. This approach puts a limitation on timely execution of any modification in the circuit breaker control circuit. Also there is limitation on decision making process as circuit breakers data are not accessible on the fly [2].

Distributed Generation (DG) is loosely defined as small-scale electricity generation. For many DG applications the generation facility is co-located with the loads (at the point of consumption of the energy produced). The connection can be to the distribution network or on the customer side of the meter. For most DG the customer uses all of the output from the DG with any surplus delivered to the distribution system. If the customer requires more power then available from the DG, power is taken from the distribution system.

DG has become more apparent in the power system around North America for a variety of reasons such as: an alternative to constructing large generation plants, constraints on construction of new transmission lines and the demand for highly reliable power. DG has become more attractive as the cost of small generation decreases with technological innovation and changing economic and regulatory environment with the liberalization of electricity markets (11).

Public concerns about climate change have resulted in a large interest in the use of renewable energy and the efficient use of cheap fuel alternatives. Another area of interest is in the development of systems combining the generation of heat and electricity known as Combined Heat and Power (CHP) and also called district heat & power [3].

II. UTILITY REQUIRED PROTECTION

Many utilities will require DG installations to conform in particular areas. The utility may provide detailed requirements in the following areas (2):

- Winding configuration of the interconnection transformer
- General requirements of utility-grade interconnection relays
- CT and VT requirements
- Functional protection requirements (81O/U, 27 and 59)
- Settings of some interconnection functions
- Speed of operation

III. FACTORS INFLUENCING

DG Protection Different energy sources may be used but it is the interfacing scheme used by the DG that will have the largest impact on the protection of the distribution system. A scheme based on direct coupling of rotary machines, such as synchronous or induction generators is different from a DG system connected using a power electronic converter. The type of interconnection transformer will also have a large influence on the protection schemes. Types of DG Generators can be divided into traditional and non-traditional generators.

The traditional generators are based on combustion engines and are further divided into: Low Speed Turbines, Reciprocating and Diesel Engines and MicroTurbines (MT). The non-traditional generators are divided into: Electrochemical Devices (such as fuel cells), Storage Devices (batteries, flywheels, etc.), and Renewable Devices (PV, wind, small hydro).

IV. AFFECT OF POWER ELECTRONICS

Power electronic inverters are capable of converting the energy from a variety of sources such as variable frequency (wind) , high frequency (turbines), and direct energy (PV & fuel cells) (15). Inverter based DG are generally considered low power by utility standards from 1 kW up to a few mega-watts. Generators connected to renewable sources, are not reliable and so are not considered dispatch able by the utility and so are not tightly integrated into the power supply system. The inverter interface decouples the generation source from the distribution network and the islanding characteristics of the distributed generator are primarily determined by the inverter [4-10].

Martin Geidl, Protection of Power Systems with Distributed Generation: State of the Art: The integration of distributed sources into existing networks brings up several technical, economical and regulatory questions. In terms of physical integration, protection is one of the major issues. Therefore new protection schemes for both distributed generators (DG) and utility distribution networks have been developed in the recent years, but there are still open questions. This document is the result of a literature study and intends to give an overview of issues and current state concerning protection of DG. The first part gives a basic introduction to distributed generation and power system protection.

Bhagwan Kharat, Internet of Thing (I.O.T) Base Controlling & Monitoring of Circuit Breaker: This paper discusses “internet of thing (I.O.T) base controlling & monitoring of circuit breaker”. Circuit breakers have a very important role in generation and transmission of electricity and represent a vital of the power system. Reliable operation and monitoring the high voltage circuit breakers represent an important challenge when this activity must be acquired online. This paper presents the architecture of an online monitoring and diagnosis System of electrical equipment which has the role to acquire, to transfer and to process information about the monitored equipment.

An interface is designed on top of which different local and system applications can be recorded by the system. The Microcontroller near the circuit breaker section will continuously transmit all the parameters of the circuit breaker to control room and it will be displayed on screen of computer. as well as after C.B trip it gives signal also to GSM module so that due to GSM the texting message can received with fault description only in registered number. After receiving text message the operator or any authorized person give command for set or resetting the breaker. So that we minimize the fault clearing time and Improve maintenance method in circuit breaker increases life time and reliability of the circuit breaker.

Aristotelis M.Tsimtsios, Generalized distance-based protection design for DG integrated MV radial distribution networks — Part II: Application to an actual distribution line: The first part of this two-paper series proposes generalized guidelines for the design of distance protection in medium-voltage radial distribution systems with distributed generation. In this second part, these guidelines are applied to a real medium-voltage radial overhead distribution line of the area of Xanthi, Greece.

A considerable penetration level of distributed generation is also assumed for this application. Based on the proposed guidelines, the designed protection scheme addresses all the factors affecting distance relay operation in distribution system applications, also dealing with any particularities of the specific distribution system examined.

The installed distance relays prove to operate dependably and selectively against various faults, considering different fault types, fault positions, fault resistance and penetration level of distributed generation. In fact, selectivity is preserved between the distance relays and the remaining protection means (fuses) in the line, as well as between successive distance relays. Economic feasibility of the designed distance protection scheme is evidently taken into account, as the minimum number of distance relays is ultimately installed.

JingMa, An adaptive directional current protection scheme for distribution network with DG integration based on fault steady-state component: In view of the low reliability of traditional protection in the distribution network caused by the massive integration of DGs (distributed generation), an adaptive directional current protection scheme based on fault steady-state component is proposed in this paper.

First, by analyzing the fault transient characteristics and fault equalization methods of different types of DGs, the components of system short circuit current are calculated, and the relationship between three phase components of the short circuit current is revealed. On this basis, according to the fault boundary conditions, the fault steady-state components are obtained. And then, combined with the measured voltage and measured current at the relaying point, the equivalent voltage and equivalent impedance at the backside of protection are calculated.

Thus the adaptive directional current protection criteria for different fault types are formed. Simulation results demonstrate that, the proposed scheme is not affected by the type and power output of DG and the system operation mode, and could effectively prevent the protection from refusing to operate due to voltage drop.

SadeghJamali, Non-communication protection method for meshed and radial distribution networks with synchronous-based DG: This paper presents an efficient protection method which can be used for both meshed and radial distribution networks (DNs) with synchronous-based distributed generation (SBDG) units. The method does not require any communication system in the both grid-connected and islanded modes of operation.

The microprocessor-based relays used in the DNs are programmed with a new time-current-voltage characteristic utilising only local fault voltage and current magnitudes. The proposed method is verified by simulation study on the DN of IEEE 30-bus test system as a meshed network in grid-connected mode. The method is also tested on an Iranian practical radial DN in the both grid-connected and islanded modes of operation. The test cases include different fault conditions, with SBDG at various locations and different DG penetration levels, and also without any SBDG in the networks. It is shown in a comparative study that the new time-current-voltage characteristic achieves a notable reduction in total relay operating times without any communication links. In addition, the method uses the same protection settings for the both grid-connected and islanded modes of operation.

PuladasuSudhakar, Reducing the impact of DG on distribution networks protection with reverse power relay: The assimilation of distributed sources in to existing distribution networks (DN's) will bring up the several technical, economical and regulatory questions. Conventional distribution system is radial in nature, characterized by a single source feeding a network of downstream feeders. Therefore the voltages decrease towards the end of the feeder from the source,

The incidence of distributed generators (DG) in the distribution networks alter the radial nature of distribution, causes the power flow in reverse direction in the event of DG is added in a system, or any fault in the feeding source/end, the DG exceed the local load, that is, towards the high voltage grid, it causes the existing protection system fails to protect the distribution networks against these changes.

To solve this problem reverse power relay (RPR) is proposed to protect the system voltage fluctuations, power reversals condition. The proposed Reverse power relay is a directional power relay it monitor the power flow from a generator (centralized) running in parallel with another generator (DG) or the utility. The reverse power relay prevents a reverse power in the network by disconnect the DG from the distribution network under faulted condition. It also estimates the reverse power and proposes corresponding adjustment value to provide solution to protect distribution network as per the relay settings and distribution system changing scenario. The simulations have been performed using mat lab/simulink.

Esmaeil Ebrahimi, Control of three-phase inverter-based DG system during fault condition without changing protection coordination: Growing utilization of distributed generations in the power system may lead to protection problems. Therefore, in the conventional methods, DGs should be disconnected from the grid in the fault condition.

In the case of high penetration of DGs, this strategy leads to voltage sag problem. In this paper, the inverter based DGs are properly controlled in the fault condition instead of disconnecting from the grid. This approach is called fault ride through strategy.

The simulation results show that the fault current is kept in the desired range by using the proposed algorithm and the protection coordination before connection of DG remains intact even after the connection of DG. In addition, the voltage sag is improved due to DGs reactive power injection during the fault condition. Moreover, this method has not any additional cost because the proposed control strategy is carried out on the interfaced inverter and there is no need to use additional elements.

Hossam A.Abdel-Ghany, Optimizing DG penetration in distribution networks concerning protection schemes and technical impact: Distributed generators (DGs) provide many benefits for distribution networks, however they increase the fault current level and cause mis-coordination between the protective devices. This paper presents a framework to determine the optimal locations and permissible capacity limits of inserting DGs in the distribution system using the genetic algorithm (GA).

A multi-objective function is developed based on the overall maximum capacity of DGs, voltage enhancement, power loss reduction, and fault current level. The optimization process considers the voltage level and protective-devices coordination as two main constraints. The coordination constraint including fuse–re-closer and re-closer–relay schemes is added to the multi-objective function in an augmented fitness function. Furthermore, the effects of modifying the setting of over current relay on the DGs capacity are investigated.

The proposed framework has been implemented on a typical 11 kV overhead distribution feeder. The results show the possibility of integrating large DGs and achieving considerable loss reduction, voltage profile improvement and fault current reduction without replacing the existing protection systems.

S.A.M.Javadian, Adaptive centralized protection scheme for distribution systems with DG using risk analysis for protective devices placement: Conventional electric distribution systems are radial in nature, supplied at one end through a main source. These networks generally have a simple protection system usually implemented using fuses, re-closers, and over-current relays. Recently, great attention has been paid to applying Distributed Generation (DG) throughout electric distribution systems. Presence of such generation in a network leads to losing coordination of protection devices.

Therefore, it is desired to develop an algorithm which is capable of protecting distribution systems that include DG, through diagnosis and isolation of faults. A new approach for the protection of distribution networks in the presence of DGs is presented in this paper. The algorithm is based on dividing an existing distribution network into several zones, each capable of operating in island operation. In the suggested method, risk analysis is used to optimize the protection zones by optimal placement of protective devices.

Multilayer Perceptrons (MLPs) neural networks are used for determination of faults. The proposed scheme has been implemented on a selected part of a real distribution network of a large city and a MATLAB based developed software has been used to implement the proposed algorithm on the real network data.

V. ADVANTAGES & DISADVANTAGES

1. Advantages:

- Devices can be operated from anywhere in the world.
- Efficient and low cost design.
- Low power consumption.
- Real time monitoring.
- Improve circuit breaker reliability and minimize downtime
- Maximize circuit breaker life with maintenance activity to address abnormal operation
- Provides true dynamic loading capability
- Minimize condition monitoring costs through unified monitoring of various parameters for the entire circuit breaker
- Integrate with your facility's computerized maintenance management software (CMMS)
- Measure and record loading of your circuit breakers and prevent overloading [11-15].

2. Disadvantages:

- Depends on the network signal strength.
- Sometimes it may happen that due to weak signal data cannot be send at quick instant. But this problem is not for so much time period.

VI. APPLICATIONS

- This system can be implemented in industries.
- This system can be used to monitoring and controlling the home appliances.
- This system can be implemented to monitoring and controlling Distribution Circuit breakers located at remote areas.

VI. CONCLUSION

In modern control centers, system operators get alarm messages from many devices in real time. From alarms, it is still very hard to find out location and type of the potential equipment problem. One needs an automatic way of processing the events to identify whether sequences of equipment operation were as expected.

Instead of many alarm messages, only one report should be sent to the operators with concise information about success or failure of a switching sequence. In the case of a breaker, report will offer more detailed message whether the breaker failure logic worked out properly and finally disconnected faulted section. This kind of analysis enables tracking of every CB operation allowing reconstruction of an entire sequence of operations.

In our project we studied designed to attain real time control &monitoring of Circuit Breaker. Measure and record loading of your output of C.B and prevent overloading & increasing whole system life.

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