A Power Factor Control Using H-Bridge Inverter for Autonomous System

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Abstract

Energy today is transformed in to a valuable and expensive commodity demanding a high level of consciousness of use, management and conservation. The main aim of the project is reduce the transmission and distribution line losses and save the energy. One of the technologies that offers a decentralized solution to all the losses problems is the micro-inverter technology where one inverter connected to each one solar panel .we made a thorough study on the following areas like machineries (replace h-bridge)motoring system(brushless dc motor).we reduce the losses, harmonics and improve the quality of power to save the energy. It is possible in agricultural drip irrigation system.in future transmission line and reception line losses will be completely eliminated. The number of solar panel used and the size of the whole system will be reduced with increased efficiency.

I.INTRODUCTION

Distributed pv storage, which composed of photovoltaic energy storage, transmission and distributed energy and load, not only can effectively use the distributed photovoltaic power supply, but also can improve the power supply reliability level and the energy utilization rate of power system .in order to effectively utilize the distributed photovoltaic power generation, the control strategy of the power grid with distributed optical storage system is studied. To establish the model of each component of the optical micro invertor system, the modeling of the control system includes maximum power point tracking control, battery charge and discharge control and inverter power factor control. Application of improved bp neural network algorithm to build short-term forecasting model of power generation. On the basis of the various components of the optical micro grid system, the simulation model of optical micro grid system is built, and the simulation research is carried out on the control of the optical micro grid system under different scheduling strategiesthe research presented in this work has been performed the power center for utility explorations study the impact of connecting pv micro grids to the power distribution system. This research focuses on addressing the challenges in utilizing pv micro grids to provide power support to the grid as a result of the fluctuating nature of the energy source and the impact the ‘missing’ capacity has on the power system stability when the solar resource is unavailable. The project involves implementing multiple small-to-medium size (15 kw – 150 kw) size pv dg as peaked plants at various points in the power distribution system to supplement grid supply during peak demand. Furthermore, the project aims to address research activities related to ieee 1547 standards including grid/dg monitoring and control, understanding voltage regulation and stability, and establishing a basis for renewable dg penetration and aggregation.The research presented in this work has been performed the Power Center for Utility Explorations study the impact of connecting PV micro grids to the power distribution system. This research focuses on addressing the challenges in utilizing PV micro grids to provide power support to thegrid as a result of the fluctuating nature of the energy source and the impact the ‘missing’ capacity has on the power system stability when the solar resource is unavailable. The project involves implementing multiple small-to-medium size (15 kw– 150 kw) size PV DG as peaked plants at various points in the power distribution system to supplement grid supply during peak demand. Furthermore, the project aims to address research activities related to IEEE 1547 standards including grid/DG monitoring and control, understanding voltage regulation and stability, and establishing a basis for renewable DG penetration and aggregation. The objectives of this research are thus

- To study and implement various power system components.
- To investigate the influence of interconnected renewable source micro grids on power system voltage stability.
- To investigate the impact the shift in bifurcation point of a PV-based industrial micro grid, having

mainly induction motor loads, has on the short and long-term voltage stability of the power system.
- To investigate the impact of implementing PV micro grids reconfigured with real-time dynamic reactive power controllers on the power system stability.

The current electric grid is designed mainly to operate in a radial manner, with big centralized power stations supplying power over long distances to distribution networks. However, it is undergoing dramatic evolution as smaller decentralized generators are gradually being added to the power distribution system. Over the last few decades, and particularly in the 2000's, renewable energy has constituted a large part of that new distributed generation. Renewable energy sources such as solar, wind, biomass, hydro and fuel cell have shown great potential for viable utilization in distributed generation systems. The production of power from renewable energies is both desirable and beneficial as it provides a sustainable alternative that significantly reduces the rate of environmental pollution in comparison with production from fossil fuels. Traditionally, utilities have had to build new power stations in order to sufficiently meet peak demand. Utilities are required to have enough installed capacity to supply the maximum load demand at all times in order to forestall power system instabilities, such as voltage collapse, but the demand often exhibits severe fluctuations within the day and over the course of a year. In areas with warm weather, peak demand is usually much higher during the summer than during the winter due to the use of air 2 conditioning equipment. Thus, a utility that has the required capacity to meet peak demand during the summer will operate with much less efficiency, as a result of idle capacity, during the winter. Also, the demand in the morning of a hot summer day is much less than the demand at noon and in the evening and the utility is forced to operate inefficiently during the early and late hours of the day. Photovoltaic micro grids are increasingly being integrated into the power distribution network, and they are well suited to augment the power supply during peak load demand, particularly in areas with warm weather, since the peak demand during the summer normally coincides with periods of high solar incidence. The utility is therefore able to augment grid supply by generating pollution-free and comparatively cheaper electricity during the period of the day when electricity consumption costs are highest. However, the photovoltaic array experiences large variations in its power output depending on weather conditions and in the case where the PV-based micro grid is connected to the main grid, it may cause improper operation of the grid. Some of the issues include voltage regulation, frequency deviation, and unintentional islanding. In particular, overvoltage at the point of common coupling (PCC) between the PV-micro grid and main grid can result in the PV resource being taken offline at critical times. Therefore, the PV-based micro grid must be designed so as to always operate within acceptable voltage limits and ensure that it does not have a detrimental effect on grid operation. Additionally, the PV-micro grid can be used to enhance the voltage stability and reliability of the power system by operating it in a non-traditional manner to provide dynamic reactive power compensation to the grid. 3 This work examines the effect of the increasing rate of DG penetration on the power system voltage stability. The impact of the micro grid on the power system voltage stability at the PCC between the micro grid and the utility supply is investigated using models of the various power system components. Based on the simulation results, a method to determine the proximity of DG micro grids to voltage instability using bifurcation theory is presented and a real-time dynamic reactive power controller that operates the PV DG to supply reactive power to support the grid voltage is proposed. The controller reconfigures the PV resource to rapidly supply the reactive power deficit, within capacity limits, that is necessary to maintain the voltage at the PCC within acceptable limits. The operation of PV-based micro grids in this manner will significantly enhance the adoption of renewable DG resources into the power distribution system and can offer several advantages over the current modes of operation since the utility is able to keep renewable energy resources online during peak demand and utilize its reactive power capability to maintain the system voltage stability.

II.OVERVIEW OF ALTERNATIVE ENERGY DISTRIBUTED GENERATION SYSTEMS

The primary source of energy for the majority of current electric power systems are fossil fuels such as crude oil and coal. These non-renewable forms of energy are ultimately finite sources of energy that cannot be deemed sustainable in the long term, while they can also be quite harmful to the environment through the burning of oil and coal in the process of conversion to electricity. Over the past few decades there has 4 been a lot of interest in alternative sources of energy and several approaches have been suggested to upgrade and replace existing energy sources. Renewable energy sources like solar and wind have shown remarkable promise as possible environmentally friendly and cost efficient alternatives to fossil fuels for use in distributed generation. Distributed power generation includes the application of small-to-medium size generators, generally less than 15MW, scattered across a power system to supply electrical power needed by customers. When generating stations are located far away from the consumer, power has to be transmitted over long distances and there are usually non-negligible associated power losses as a result of the transmission and distribution of the electric power. By locating generating stations close to consumers, distributed generation provides advantages in efficiency and flexibility over traditional large-scale, capital-intensive centralized power plants. Apart from the adverse environmental effects of current fossil fuel-based power supply, the finite global supply of recoverable fossil fuels implies that at some point in the future, alternative sources of energy will become the primary source of energy to meet global demand. Solar and wind power represent promising alternatives that will likely initially supplement fossil fuel based energy supply, and eventually replace the fossil fuel energy sources as the availability of the latter declines. When compared to fossil fuels, solar power is a relatively untapped source of energy, thus there still remains a lot of work to be done to make solar power as efficient and reliable as possible.

III.POWER SYSTEM VOLTAGE STABILITY

The power system voltage stability is affected by the ability of generating sources to supply sufficient real and reactive power to the loads. The primary responsibility of utilities is to supply electric power to the consumer, but the electrical load profile of the consumer can vary greatly over the course of the day, throughout the week and from season to season. Thus, in order for the utility to meet the consumers energy requirement at all times, and avoid load shedding, the utility is forced to invest scarce resources into increasing the generating capacity to meet the highest electrical load demand expected throughout the year. This peak demand may only occur for a few hours each day and for a few months over the entire year but the utility must be prepared to meet this demand should it occur. Recent cases of voltage collapse and similar power system instabilities have been linked to imbalances between the load demand and power supply. In sunny regions, the peak demand can be expected during the mid-afternoon of summer months as a result of air conditioning use during the day. During the winter, the peak demand is much less than during the summer causing the utility to be saddled with idle capacity and to operate inefficiently for extended periods. Some utilities have adopted tiered-pricing policies to offset the huge investment outlay required to build peaker plants, but this approach negatively impacts the customer. A solution that is gaining more prominence, as a result of government incentives and advances in technology, is the use of photovoltaic micro grids as peaker plants. Photovoltaic 6 power plants are suitable for use as peaker plants, especially in sunny regions, since the peak power output of the PV coincides with the peak load demand during summer. The challenge is to mitigate the impact of the fluctuating nature of the PV source on the power system stability and utilize the potential of distributed resources to enhance the overall system reliability.

IV.CONTRIBUTION OF THE DISSERTATION

This research is unique as it examines the impact of operating dgswith fluctuating power sources on the power system voltage stability, in the case where there is a significant penetration of dgsthat are dynamically controlled to independently supply active and reactive power to the grid to maintain the local area voltage during peak demand. The main contributions of the dissertation are summarized as follows: Standard mathematical models of various power system components, including PV source, module, induction motor and synchronous generator have been studied.

- The implemented PSCAD models of the various power system components have been integrated to investigate the contributing effect of fluctuating power sources to momentary interruptions that adversely affect equipment and the voltage stability of an interconnected grid.
- The load ability limit necessary to forestall voltage instability in grid connected micro grids has been determined using bifurcation analysis.
- A method to reconfigure grid-tied renewable energy sources to mitigate voltage sags using areal-time dynamic reactive power control has been developed.

V.OUTLINE OF DISSERTATION

This dissertation consists of seven steps, with the first chapter introducing the current applications of interconnected renewable DG systems as well as the challenges associated with the rapid penetration and deployment of DG resources. The motivation for conducting this research and the goals of the study are discussed. The first step also gives an overview of the impact of peak load demand on the power system stability and highlights ongoing research activities related to DG penetration.Step2 presents the literature review on the voltage stability of a micro grid embedded power system including the impact the operating characteristic of the PV source has on the power system voltage stability. The effect of momentary interruptions and voltage sags on the power system stability and reliability is also examined, while the various methods currently used to mitigate voltage sags are reviewed.Step 3 identifies the reasons for the static and dynamic voltage instability of the power system.Standardmathematical models of various power system components, including the synchronous generator and PV source, are described and implemented in Matlab/Simulink. The models are used to investigate the impact of typical grid10 connected PV sources on the local voltage regulation and power system reliability. Based on the simulation results, remedial action to prevent over voltages and unintentional islanding are explored and presented.Step 4 presents an analytical approach to determine the voltage stability limits of an interconnected micro grid. The mathematical models of the short- and long-term dynamics of the generator and load are used to determine the power system load equilibrium point. Bifurcation theory is then applied to find the singularity point of the network Jacobean that leads to voltage instability, and Matlab/Simulink simulations are used to evaluate the minimum margin between the load equilibrium point and the load ability limit. The margin which prevents the stalling of motors during disturbances is used to determine the size and suitability of dgsin the power distribution system. Remedial action to restore the load equilibrium point when a power system exceeds the load ability limit is also explored.Step 5, the voltage impact of operating PV-based micro grids to independently supply active/reactive power during peak demand is examined. A real-time dynamic reactive power controller (DRPC) that regulates the output voltage of the PV DG and controls the reactive power flow using instantaneous power theory and a "voltage vs. Reactive current droop" control method is proposed and implemented in PSCAD. The impact of the controller implementation on grid voltage stability is analyzed and the grid overvoltage protection function is demonstrated.Step 6 presents a case study for a peak load shaving PV system in Tampa, FL (USA). The environmental data and load characteristics of the site are provided, as is the electrical components data. The study system is implemented in EDSA to investigate the steady-state power flow and the effect of source and load variations on the long-term voltage stability of the PV micro grid. Based on the investigations, the sizing and location of PV micrograms as a function of the maximum load demand at the PCC bus is proposed. The final chapter concludes the dissertation with a look on the future development of this work. The references and appendices are attached at the end of the dissertation. The use of neural networks to train large autonomous systems can be useful for the utility to balance the power flow in the power distribution system from the substation.

VI.IMPORTANCE OF THE PROJECT

The power system generally experiences voltage instability when there is a real and/or reactive power imbalance between the generators and the loads. The reasons for the static and dynamic voltage instability of a power system are investigated in this chapter. The basic concepts related to voltage instability are illustrated by firstly considering the characteristics of the transmission and distribution systems and then examining how the phenomenon is influenced by the behavior of generators, loads, and reactive power compensation equipment. The voltage stability behavior of the power system changes significantly when distributed resources are added to the grid as a result of the reconfiguration of the power flow. Therefore, prior to deploying dgsin the power system, it is necessary to properly model and analyze the impact of adding dgsat different locations in the grid. The standard mathematical models of the various power system components, including the synchronous generator and photovoltaic source, are presented and implemented in Matlab/Simulink. The implemented models are used to determine the effect of grid-connected PV sources on local voltage regulation and power system reliability. Some remedial actions such as dynamic voltage regulation and active anti-islanding that can be implemented to prevent over voltages and nuisance fuse operation are explored and presented.

VII.LITERATURE SURVEY

7.1"Evaluation of a Multilevel Cascaded-Type Dynamic Voltage Restorer Employing Discontinuous Space Vector Modulation",

IEEEjuly 2010.

Author: Ahmed M.Massoud, Prasad N. EnjetiIn this project author says, the application of the cascaded multilevel as a DVR is investigated. As most distribution transformers are delta–star connected, no zero-sequence component need be compensated by the DVR. The DVR cascaded multilevel is employed to regulate the positive-sequence component and to cancel the negative-sequence component. Two discontinuous multilevel space vector modulation (SVM) techniques are implemented for DVR control and are shown to reduce switching losses. Employing a multilevel improves the harmonic performance, thereby reducing passive filtering requirements compared to a two-level DVR. Another advantage of the proposed approach is that a DVR with a cascaded multilevel provides extended sag duration support compared to the two-level of the same rating. The harmonic performance of the PCC (load) voltage has been evaluated. The multilevel cascaded enables transformer less connection of the DVR at medium voltage levels, overcoming transformer problems such as high cost, large size, increased losses, saturation, and inrush current.

The cascaded gives better redundancy in the case of a cell failure. Mathematical relationships for the voltage total harmonic distortion (THD) and distortion factor (DF) at the PCC in terms of THD and DF of the DVR voltage are derived. Filter less DVR operation can be obtained at a high number of levels. The CMV at the PCC has been evaluated for the three SVM techniques (the conventional multilevel SVM and the two discontinuous SVM), presenting a lower CMV for the second discontinuous SVM. Results are presented for 11 kvand 5 MVA up to 17 levels, employing the conventional multilevel SVM and the two discontinuous SVM techniques. The main contributions of this paper are summarized as follows.

1) Reduced switching losses can be obtained while maintaining virtually the same harmonic performance as the conventional multilevel SVM at a high number of levels when discontinuous SVM is employed.

2) Multilevel cascaded-type DVR can support an extended sag duration compared to the two-level DVR.

3) The multilevel DVR harmonic performance has been evaluated from the point of view of PCC up to 17 levels for different voltage sag depths (previously, the attention has been oriented to evaluate the DVR output voltage harmonic performance).

4) The CMV at the PCC has been evaluated for the three SVM techniques (the conventional multilevel SVM and the two discontinuous SVM) for up to 17 levels and for different sag depths, presenting a lower CMV for the second discontinuous SVM. The first discontinuous SVM technique introduces the highest CMV.

7.2. "Voltage Quality Improvement Using DVR" IEEE Oct. 2010Author: 1 M.ArunBhaskar, 2 Dr.S.S.Dash, 3 C.Subramani,In this paper an overview of DVR is presented. DVR is an effective custom power device for voltage sags and swells mitigation. The impact of voltage sags on sensitive equipment is severe. Therefore, DVR is considered to be an efficient solution due to its relatively low cost and small size, also it has a fast dynamic response. The simulation results show clearly the performance of a DVR in mitigating voltage sags and swells. The DVR handles both balanced and unbalanced situations without any difficulties and injects the appropriate voltage component to correct rapidly any anomaly in the supply voltage to keep the load voltage balanced and constant at the nominal value. In this work, a portable leakage current monitor was developed and installed in different places, with different ambient, weather and contamination conditions. The developed device, which measure and records the peak value over a set time period, also measure and records some ambient variables, humidity and temperature. In the following, a description of the developed device is made, results from field application are shown and conclusions are made. The conclusion shows that the study of insulating system performance of insulating systems based surface leakage current is better understood when ambient conditions are also taken into account.The problem of voltage sags and Swells and its severe impact on sensitive loads is well known. To solve this problem, custom power devices are used. One of those devices is the Dynamic Voltage Restorer (DVR), which is one of the most efficient and effective modern custom power devices used in power distribution networks. This paper described DVR principles and voltage correction methods for balanced and/or unbalanced voltage sags and swells in a distribution system. Simulation results were presented to illustrate and understand the performances of DVR under voltage sags/swells conditions. The results obtained by simulation using MATLAB confirmed the effectiveness of this device in compensating voltage sags and swells with very fast response (relative to voltage sag/swell time).

7.3. "Photovoltaic Based Dynamic Voltage Restorer For Voltage Sag Mitigation" Author: Ali O Al-Mathnani, Azah Mohamed

To mitigate voltage sag, DVR has been considered as effective sag mitigation equipment and many research works have been carried out focusing in the design and control of the DVR. A detailed comparison of the four types of DVR designs was presented in and various control algorithms have also been presented for DVR control. Most reported control strategy is by using the open loop feed forward control but in the control strategy is by means of combined open loop feed forward and closed-loop feedback control to handle the time varying control reference in voltage sag compensation. The current control method considers hysteresis, ramp and deadbeat control. The hysteresis control gives the best performance but difficult for digital implementation. The ramp control however is better than deadbeat control and has been adopted to control the voltage in uninterruptible power supplies. The sinusoidal pulse width modulation (SPWM) switching Photovoltaic Based Dynamic Voltage Restorer For Voltage Sag Mitigation technique is used to control the AC output voltage by comparing a sinusoidal reference signal with a triangular carrier wave so as to get the pulses per half cycle. Figure 1 shows the pulses generated by using the SPWM in which a carrier signal is compared with a modulating signal. The fundamental frequency is 50 Hz and the phase locked loop provides a voltage-synchronizing signal, which is multiplied by a switching frequency of 1650 Hz. Thus, the frequency of the voltage-synchronizing signal is 33 times the fundamental frequency of 50Hz. The carrier signal is converted into a triangular signal with amplitude between -1 to +1.

7.4. "Comprehensive Approach to Modeling and Simulation of Photovoltaic Arrays"

Author: Marcelo GradellaVillalva, Jonas Rafael Gazoli, and Ernesto Ruppert Filho

The introduction on PV devices is followed by the modeling and simulation of PV arrays, which is the main subject of this paper. Some terms used in this paper require an explanation. A PV device may be any element that converts sunlight into electricity. The elementary PV device is the PV cell. A set of connected cells form a panel. Panels are generally composed of series cells in order to obtain large output voltages. Panels with large output currents are achieved by increasing the surface area of the cells or by connecting cells in parallel. A PV array may be either a panel or a set of panels connected in series or parallel to form large PV systems. Electronic micro inverter designers are usually interested in modeling PV panels (called arrays henceforth in this paper), which are the general purpose off-the-shelf PV devices available in the market. This paper focuses on PV arrays and shows how to obtain the parameters of the I–V equation from practical data obtained in datasheets. The modeling of elementary PV cells or arrays composed of multiple panels may be done with the same procedure. The above literature survey transparently said that the past systems are only strong with their construction and accessories but not in control technique. So we are in the need of a new control method as a proposed system.

VIII.CONVENTIONAL METHOD

Our reference paper proposed controller extensively improves the ephemeral response and disturbance, rejection of the micro inverter while preserving the closed-loop stability control laws to drive the system state trajectory onto a specified surface in the state space, the so called sliding or switching surface, and to keep the system state on this assorted for all the subsequent times. Photo voltaic systems can generate direct current electricity without environmental impact and contamination when exposed to solar radiation. Recently many new methods are proposed for modeling and simulation of photovoltaic arrays (PVA) having higher accuracy and lower assumptions. Being a semiconductor device, the PV system is static, quiet, free of moving parts, and has little operation and maintenance costs. But due to relatively high initial cost and low efficiency essential.

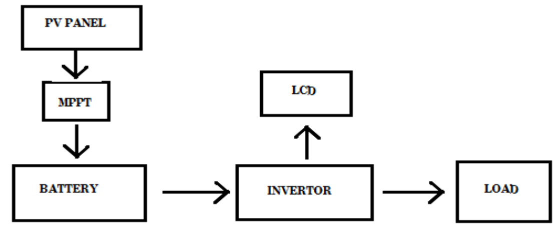

Fig 8.1 Block diagram

For the effective integration of the solar power into the power system, good controlling methods should be developed using power electronics devices. In this paper PV power generation system is
used as energy source, when disturbance occurs and any other disturbance time it will supply power to dump loads. It happens through different micro inverter topologies. The concept of a multilevel micro inverter to achieve advanced power is to use a series of power semiconductor switches with several lesser number of voltage dc sources, which is most suitable for the proposed system collecting power from PV.But due to relatively high initial cost and low efficiency essential. For the effective integration of the solar power into the power system, good controlling methods should be developed using power electronics devices. In this paper PV power generation system is used as energy source, when disturbance occurs and any other disturbance time it will supply power to dump loads. It happens through different micro inverter topologies. The concept of a multilevel micro inverter to achieve advanced power is to use a series of power semiconductor switches with several lesser number of voltage dc sources, which is most suitable for the proposed system collecting power from PV.

IX.DRAWBACK OF EXISTING SYSTEM

- For a voltage profile maintaining process several measuring are required, so more complication.
- The number of switches for micro inverter and is more, so control circuit design and repair is complicate.
- Huge construction, because of their many components and supporting modules.

X.PROPOSED METHOD

The source side of the power system stability dynamic has been examined in the previous chapter, but it is well known that loads are the main driver of voltage instability. Induction motors are the typical loads found in the industrial sector, and the impact of these motor loads on the power system stability is investigated in this chapter.

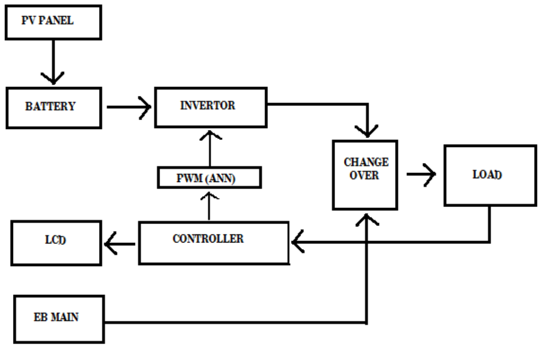

Fig 10.1. Proposed Block diagram

The voltage-power characteristic of induction motor loads is used to define the load ability limit for an industrial power system and bifurcation theory is applied to determine the short-term and long-term margins to voltage instability. Bifurcation theory deals with the emergence of sudden changes in system response due to smooth variations in system parameters - an effect which is similar to voltage instability or collapse.

XI.VOLTAGE SAG EFFECTS ON INDUCTION MOTOR LOADS

Induction motors comprise a significant part of the load distribution for most industrial areas and they have a significant effect on the power system voltage stability. The load characteristic of the induction motor is the reason why it plays such a critical role in voltage stability.

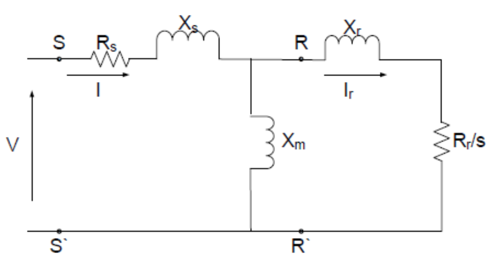

Fig 11.1 Equivalent circuit of induction motor

Those characteristics include the tendency to quickly restore loads (typically < 1s) and operating with a low power factor with a high reactive demand. It is also prone to stalling when the load is increased or the voltage level is not sufficiently high.The three types of induction motor models - the constant torque model, the quadratic torque model, and the composite torque model – that are typically found in the industrial sector and exhibit different steady-state behaviors under different torques are used in this study and are briefly presented next. Some industrial motors exhibit the constant torque characteristic although the majority of industrial motors are more closely represented by the quadratic and composite torque models. In the constant torque model, the mechanical torque is parallel to the *s*-axis. The motor stalls when the mechanical torque exceeds the maximum available electrical torque. *PV* and *QV* curves can be used to express the relationship between the consumed power and the terminal voltage and they are typically used to assess the voltage stability of power systems.

XII.MODELING ANALYSIS

Voltage instability results mainly from the inability of a stressed power system to meet the reactive power demand required to maintain the desired voltage levels at all buses in the system. The power system can experience two types of voltage instabilities voltage collapse and unstable voltage oscillation. The power system experiences voltage collapse if it is unable to maintain acceptable steady-state voltages after a disturbance event. Unstable voltage oscillation usually results from the interaction of controllers with power system equipment. Voltage instability occurs on multiple timescales, and can be classified into short-term and long term instabilities. Short-term voltage stability refers to the small-signal and transient stabilities, including the stability of the dynamics of induction motors and controllers. Long-term voltage stability refers to the long-term dynamics, including dynamic stabilities due to generator excitation limit and load increase. The dynamics and changes in operating condition of the power system can be represented by differential and algebraic equations respectively. The dynamics that result due to changes in operating condition can be decomposed into slow and fast dynamics based on the time-scale of interest. The corresponding state variables can similarly be decomposed into slow and fast variables.

VOLTAGE INSTABILITY MECHANISM

Voltage instability occurs when the power system is unable to maintain steady voltages at all buses. This stems from the attempt of load dynamics to restore power consumption beyond the capability of the power system. A power system subjected to a disturbance may be unable to return to a state of equilibrium once the maximum transferrable power limit has been reached and the operation of automatic load restoration devices push the system towards voltage instability. In this state, the load restoration mechanism leads to a reduction in power consumed rather than the expected increase in power consumption; this is a definite indication of voltage instability. The load is the main driver of this form of instability. Consider the on-line diagram of a power system including an interconnected industrial micro grid, where the total load of all the induction motors in the micro grid is represented with a single motor at the PCC bus, and other loads are represented with a static load.

Switching Devices

There are four main types of switching devices: Metal Oxide Semiconductor Field Effect Transistors (MOSFET), Gate Turn- Off thyristors (GTO), Insulated Gate Bipolar Transistors (IGBT), and Integrated Gate Commutated Thyristors (IGCT).

Control and Protection system

The control mechanism of the general configuration typically consists of Digital Signal Processing (DSP) boards. The software on the DSP board provides the controls such as detection and correction. Filters are commonly used for these purposes. The most common types of filter algorithm are the Fourier Transform (FT) and the Wavelet Transform (WT). Although, the Fourier Transform still remains the most common type.

FREQUENCY STABILITY

Frequency stability refers to the ability of a power system to maintain steady frequency, within acceptable range, following a severe system disturbance that causes significant imbalance between generations and load; it is influenced by the ability of the system to maintain balance between generation and load demand. Instability occurs in the form of sustained frequency swings, leading to generators and/or loads being switched off. Unlike rotor angle and voltage stabilities, frequency stability is not classified based on the size of the system disturbance but rather on the overall response of the system. It can be described as a short or long term phenomenon. Voltage stability refers to the ability of the system, normally operating, to maintain steady voltages at all buses after being subjected to a disturbance. It is influenced by the balance between load demand and supply. Instability occurs in the form of progressive drop in voltage at some buses. The system experiences voltage instability if at any bus, there is a drop in voltage as the reactive power is increased. Similar to the rotor angle stability, the small signal voltage stability and the large disturbance voltage stability refer to the system's ability to maintain steady voltages at all buses when subjected to small and large disturbances respectively. A small disturbance may be a gradual increase in load or momentary voltage sag while a large sustained system fault would constitute a large disturbance. After a disturbance occurs on the systems, loads tend to be quickly restored on the power system as a result of the operation of automatic controllers such as auto-starters in induction motors. The sudden increase in reactive power consumption by the load worsens the voltage sag caused by the disturbance and the load reacts by further increasing the reactive power consumption. This process continues until the stability limit of the system is exceeded, resulting in voltage collapse or even widespread blackout. Some of the system parameters that influence the stability limit of the power system include the generation capacity and the network transfer capacity. But loads are the primary drivers in voltage instability. The duration of interest in voltage stability studies may run from a few seconds to several minutes after the disturbance. Since voltage stability depends on both linear and non-linear characteristics of the system, a combination of both techniques is used for analysis.

EXPECTED OUTPUT

The application of the reactive power control method can be developed further by including a central controller to autonomously regulate the power in multiple DG units. The use of neural networks to train large autonomous systems can be useful for the utility to balance the power flow in the power distribution system from the substation. It will be interesting to investigate the interaction between the slow acting mechanical devices of the synchronous generator and the fast acting devices of the power electronics controllers when the system has to simultaneously respond to disturbances occurring at more than one location. Voltage stability refers to the ability of the system, normally operating, to maintain steady voltages at all buses after being subjected to a disturbance. It is influenced by the balance between load demand and supply. The use of neural networks to train large autonomous systems can be useful for the utility to balance the power flow in the power distribution system from the substation.

ADVANTAGES

- No wires involved in the proposed system. Hence we can avoid power and data loss.
- It can able to detect the faults due to over current, under voltage, increased temperature.
- It can be operated in any environment in a Transformer. Monitoring multiple transformers sitting in an office is possible.
- The different parameters can be measured using sensor technology.

CONCLUSION

The impacts of adverse power quality issues on industrial loads have been presented and different methods to classify the stability margin of an area have been illustrated with some simple examples.

The four existing methods for voltage sag mitigation – synchronous generator excitation control, shunt capacitor application, use of FACTS devices, and transformer adjustment have been compared, and it is found that synchronous generator excitation control is more suitable for voltage regulation of large radial transmission systems than for DG-embedded distribution systems. A new method for voltage sag mitigation based on dynamic reactive power control of DGs has been presented. The method mitigates the transient impacts of static on/off switching of passive reactive power compensation devices. The method also improves the utilization factor of DGs that are already deployed in the power distribution system by regulating the DGs to generate both active and reactive power simultaneously. Utilities are thus able to achieve savings and minimize losses by optimally deploying more flexible DGs into the distribution system instead of speaker plants with low utilization factors. The method uses the same parameters that are used to determine the voltage stability margin of any EPS excluding the contribution from peaked plants or DGs. The maximum potential savings realizable is directly correlated with the distance from the bifurcation point of the EPS with the exclusion of the peaked plants. The impact of the method is greater on the short-term voltage stability, but for relatively small systems, it can also improve the long-term voltage stability by increasing the load ability limit of the power system. The problem related to over voltages at the PCC due to the presence of DGs in the power distribution system has been examined. Simple expressions to determine the potential voltage rise at the PCC as a result of DG current injection have been derived. For Photovoltaic sources, the PV current limit that is necessary to hold the voltage at the PCC below a preset limit is determined based on the maximum capacity of the PV and the distance from the substation. For PV sources operating at unity power factor in industrial areas with a high concentration of induction motors, the local bus voltage rise is found to be higher than for PV sources operating with a lagging power factor.

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