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VOLTAGE STABILITY ANALYSIS OF MICROGRID

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Abstract- Voltage stability analysis of a power system is a very important, particularly in the planning phase of the development or expansion of a power network. In the trans-Mission level, each transmission line has a certain power transfer capability limit. Exceeding such a limit leads to incidences such as outage of a transmission line, losing Generation units, and the possibility of customers losing their power supply. When such scenarios occur, and when these instability events lead to more cascaded outages as well as losing generation and loads, a voltage collapse may be in place. The main Reason for the instability of the voltage or voltage collapse is the load. Either sudden Loosing of major loads or restoring such amount can cause voltage instability problems either over-voltages or under-voltages. Since stability phenomena always link with time Frame, it is expected to have time classification of voltage stability. In the short-term (fast) voltage stability, the voltage collapses in seconds or even less, while for long-term (slow) voltage stability, the system voltage collapse takes more time, say minutes to Hours. A micro-grid is normally composed of relatively small-distributed generators sup-Plying an islanded distribution network. Although a micro-grid may not be a complex interconnected power system similar to a transmission network, but it has some characteristics that makes it undergo instability problems when it is exposed to disturbances. The standard 9 Bus microgrid available in IEEE papers will be developed and simulated in the project considering Different cases by using the Stability Indices such as VCPI, VSI and PTSI. Voltage stability assessment will be carried out in PSAT soft-Ware. The different solution for voltage stability may be suggested and simulated in the project.

Keywords **–** *Microgrid, Power Quality, Harmonics, Power Flow Control, Stability.*

I INTRODUCTION

Microgrid is a cluster of local resources, energy storage systems and loads operating a single controllable source. The disturbance in microgrid can be initiated by any type of fault, line tripping or by any event which can cause single or even multiple enclosure actions.microgrid can be operated in three modes as follows (i) Grid connected mode, (ii) Islanded mode (iii) Transmition to grid connected mode. One of the major technical issues to be found in operation of microgrid is the Reliability.

Major management and operational issues related to microgrid are as follows:

(1) For maintaining power quality like active and reactive powerbalance must be maintained within the microgrid on a short-term basis.

(2)Microgrid should operate stand-alone in regions where utility supply is not available or in grid-connected mode within a larger utility distribution network. Microgrid operator should be able to choose the mode of operation within proper regulatory framework.

(3) In microgrid Generation, supply and storage of energy must be suitably planned with respect to load demand.

(4) Supervisory control and data acquisition (SCADA) based metering, control and protection functions should be incorporated in the microgrid CCs and MCs. Provisions must be made for system diagnostics through state estimation functions.

(5) Economic operation should be ensured through generation scheduling, economic Load dispatch and optimal power flow operations.

(6) System security must be maintained through contingency analysis and emergency Operations (like demand side management, load shedding, islanding or shutdown of Any unit). Under contingency conditions, economic rescheduling of generation should Be done to take care of system loading and load-end voltage/frequency.

(7) Temporary mismatch between generation and load should be alleviated through Proper load forecasting and demand side management. The shifting of loads might Help to flatten the demand curve and hence to reduce storage capacity.

(8) Suitable telecommunication infrastructures and communication protocols must be employed for overall energy management, protection and control.

II LITERATURE REVIEW

Gap between electricity generation, demand and environmental impacts of conventional Generation has forced society to emphasize on power generation through new technologies. These technologies includes renewable generation like solar, wind etc. being Smaller in size, they are connected to grid at distribution level and thus called distribute-specific distributed generation (DGs) and distributed energy resources (DERs).these are self-sustained power System, mainly based on loads feds through radial distribution systems and can operate Either interconnected to the main distribution grid, or

even in isolated mode. The micro-sources of special interest for microgrid are small (100-kw) units with Power electronic interfaces. These sources, (typically micro-turbine, PV panels, and Fuel cells)are placed at customers sites. They are low cost, low voltage and have high reliability. Power electronics provide the control and flexibility required by the microgrid Concept. Correctly designed power electronics and controls insure that the microgrid can meet its customers as well as the utility's needs. The above characteristics can be achieved using a system architecture with three critical components.

- **Micro-source controllers.**
- **System optimizer.**

Various challenges are experienced in operation of microgrid when it is operated in islanded mode. Voltage stability analysis is a demanding topic all over the world due to its direct impact on the overall stability and security of a power system. [4] There are several definitions for this phenomenon. It refers to the ability of a power system to maintain steady state voltages at all buses in the system after being subjected to a disturbance from a given initial operation condition. [4] Other researchers defined it as the ability to transfer reactive power from production sources to consumption sinks during steady operating conditions. Exceeding such a limit leads to incidences such as outage of a transmission Line, losing generation units, and the possibility of customers losing their power supply. When such scenarios occur, and when these instability events lead to more cascaded Outages as well as losing generation and loads, a voltage collapse may be in place. The Main driving for the instability of the voltage or voltage collapse is the load. Either sudden loosing of major loads or restoring such amount can cause voltage instability problems either over-voltages or under-voltages. Voltage stability problems may Also occur in High Voltage Alternating Current (HVAC) systems connected by High Voltage Direct Current (HVDC) links . [4] In the literature, several voltage stability Incidences have been recorded either with or without voltage collapse. Many countries Around the world reported problems related to voltage instability that caused voltage Collapse, such as Japan, Canada, USA, France and others.

III PROBLEM STATEMENT

Referring to the literature survey, A microgrid is a hybrid power system consists of Several distributed generation resources and local loads, which provide the solution to Supply premium power to remote or specific areas. A microgrid is electrically isolatable From the utility microgrid and would often have sufficient cumulative capacity to meet The needs of those within in, although most microgrid concepts also specify a utility backup. Some microgrids could operate as full-time islands, while others could operate As part of the microgrid during normal operation and only separate into an island during Service interruptions. However, some undesired effects are accompanied with their Installations and operations, such as imbalance, voltage fluctuation, and harmonics.

To the aspect of voltage quality, the switching on and off of the distributed generation Resources may cause power fluctuation, hence the associated power quality disturbances Are produced and affect the connected power system. From above discussion, it is observe that voltage stability is most important issues In microgrid, so we can analysis the voltage stability in microgrid.

IV METHODOLOGY

1. Assessment of Voltage Stability in microgrid causes and its effect.
2. To study the different voltage stability indices.
3. Analyze the behavior of voltage stability for different cases.
4. Comparative study of voltage stability and stability indices.

V RESULTS AND SIMULATION

The voltage stability of a power system refers to its ability to properly maintain steady acceptable voltage levels at all buses in the network at all times, even after being subjected to a disturbance or contingency. A power system may enter a condition of voltage instability when the system is subjected to a steady increase in load demand or a change in operating conditions, or a disturbance (loss of generation in an area, loss of major transformer or major transmission line). This causes an increased demand in reactive power. Voltage instability is characterized by gradually decreasing voltage levels at one or more nodes in the power system. Both static and dynamic approaches are used to analyze the problem of voltage stability. Dynamic analysis provides the most accurate indication of the time responses of the system. Dynamic analysis is therefore extremely useful for fast voltage collapse situations, following large disturbances such as loss of generation and system faults, when specific information concerning the complex sequence of events leading to instability, is required. Dynamic simulations however, fail to provide information such as the sensitivity or degree of stability. More importantly, dynamic simulations are extremely time consuming in terms of CPU and engineering resources required for the computation and analysis of the several differential and algebraic equations needed for quantification of the phenomenon.

The simulation software used is PSAT, in which load flow and transient stability analysis is performed for the different Cases. The microgrid test bed. The system Considered has 9 buses and 8 lines. The total load demand is met by a synchronous generator of 47 MVA, wind turbine of 10MW and PV system of 1.64 MW. Industrial loads as well as the domestic loads are met with this generation. A steady state stability analysis is carried out to determine the most critical bus for the events considered. The most critical bus from the simulation is determined as bus 9.

9 Bus Bed System

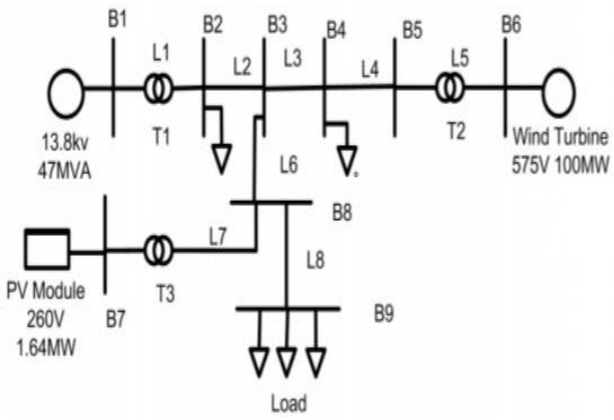

Figure 1 Bus Bed System

Voltage Profile

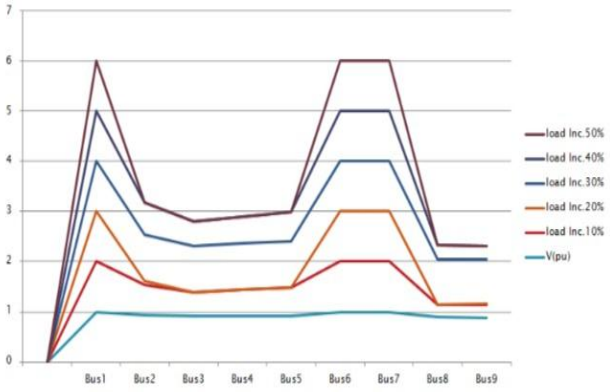

Figure 2 Voltage Profile of all buses.

VSI Assessment

Bus	VSI MARGIN
Bus 2	(0.999, 0.999,0.997)
Bus 3	(0.904, 0.999,0.997)
Bus 4	(0.995, 1, 0.984)
Bus 5	(0.999, 0.969, 0.996)
Bus 8	(0.909, 0.999, 0.999)
Bus 9	(0.999, 0.993, 0.804)

Table 1 VSI Assessment

VI CONCLUSION

One of the challenges identified in the operation of microgrid is voltage stability. So we will analysis the voltage profile of IEEE 9 bus test bed system. A micro-grid is normally composed of relatively small-distributed generators supplying an islanded distribution network. Although a micro-grid may not be a complex interconnected power system similar to a transmission network, but it has some characteristics that makes it undergo instability problems when it is exposed to disturbances. The standard 9 Bus microgrid available in IEEE papers is developed and simulated in the project considering different cases by using the Stability Indices such as VCPI, VSI and PTSI. Voltage stability assessment is carried out in PSAT toolbox. In the microgrid 9 bus system, load is connected to the bus 9. Active power is varied from 10 percent to 50 percent and Voltage stability index (VSI) of each bus is calculated. It is observed that voltage profile suddenly drops at 50 percent of load Increase. Values of show that if index shows 1 value system is stable and index shows 0 Value system is unstable. Thus if load increases by 50 percent of normal load, system Will be unstable system voltage point of view. In other words, system has overload capacity of 50 percent. Overall simulation results show that it can benefit to voltage stability assessment of future electricity grid. Thus it has potential applications in the area of voltage support the modern power system structure.

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