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Active Reactive Power Droop Control in Cascaded Type Micro-grid; A Review

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Abstract - *Because of their zero emission characteristics, distributed generating units with power electronics are growing in popularity. Control and coordination of these generating units are the most crucial factors in assessing the flexibility and successful operation of microgrids. A space vector PWM technically controlled distribution unit connected to the series with constant power sharing is used in this research. Two significant issues with cascaded-type microgrids that demand quick fixes are the synchronization and power balancing of distributed producing units. In order to achieve this, an f-P/Q drop control is proposed in this study, and its stability is also investigated. Under resistive and resistive loads, this proposed drop-control can independently achieve power balance.*

Key Words: Power System, Micro grid , PWM, SPWM, Matlab Simulation,

1.INTRODUCTION

An effective way to safely integrate distributed energy resources that can be utilized in both grid-connected and isolated modes is through micro grids. The microgrid can be divided into two groups based on its configuration: cascaded and parallel. The former was looked at in detail. Droop control is widely used to accomplish parallel microgrid power sharing and has been expanded to other uses such as state-of-charge (SOC) balancing in storage systems, an economical distribution system for distributed generators (DGs), and a PWM system drive system for droop control. Additionally, a new type of microgrid that was just presented is the cascaded microgrid.

The cascaded converter was first applied to multilayer inverters before being extended to microgrid applications for higher voltage and more efficient use. The cascaded form is very helpful for battery management and PV grid-linked applications. In a microgrid of the islanded cascaded kind, the power balance of each module is crucial. A reverse drop control, which might also be used in the DC microgrid, is recommended in order to achieve power balance. A unique inverse power factor drop control is proposed for power balancing in the AC microgrid. However, the method is only applicable when a researcher is dealing with resistive inductive loads. However, this method is used to both capacitive and inductive resistive loads.

2. MICROGRID

As large, centrally connected power plants are transformed into small, horizontally distributed power generating and distribution systems via vertical networks, the architecture of the electrical system is changing.Energy security, fossil fuel prices, and climate pressure are the driving forces behind this shift. Traditional high-capacity power plants contribute significantly to greenhouse gas emissions and are fueled by extremely polluting fossil fuels.Thus, the battery storage system is rapidly growing due to the low cost and environmental benefits of renewable DGs like solar photovoltaic and fuel cells.

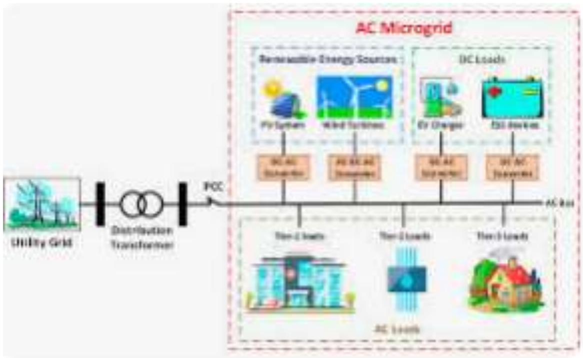

Figure1. basic Micro grid technology

Additionally, the concept of a microgrid has been proposed for the effective and adaptable usage of these DGs. A microgrid is, by definition, a group of connected loads and distributed generation units with clearly defined electrical borders. It may be connected to or disconnected from the grid to operate in both grid and isolated modes, offering a more adaptable and reliable energy system. Although micro-grids improve the overall reliability and efficiency of the supply system, the challenging tasks in such a hybrid system are energy balancing and voltage and current regulation due to the inherent intermittent nature of renewable DGs like solar and wind.

There are numerous functional classification schemes and definitions of microgrids in the literature. "A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid," according to a broad definition developed by the U.S. Department of Energy's Microgrid Exchange Group, an ad hoc team of research and implementation specialists. A microgrid can function in both grid-connected and island mode by connecting and disconnecting from the grid. Three requirements are included in this description: 1) to enable the microgrid-based distribution system component to be recognized as separate from the remainder of the system;

2) to manage the microgrid's resources together rather than with separate resources; and 3) to make the microgrid functional whether or not it is connected to the larger grip. The scale or type of technologies that could or ought to be used for the dispersed energy resources are not included in the phrase.

1.1 CASCADED-TYPE MICROGRID

For the dependable integration of distributed power resources in both grid-related and isolated modes, MICROGRID offers an effective solution. The microgrid can be classified into two primary types based on its configuration: parallel and cascaded. The cascaded converter was initially applied to multilayer inverters before being extended to microgrid applications for higher voltage and more efficient use. The cascaded form is very helpful for battery management and PV grid-linked applications. In a microgrid of the islanded cascaded kind, the power balance of each module is crucial. A reverse drop control, which might also be used in the DC microgrid, is recommended in order to achieve power balance. A unique inverse power factor drop control is proposed for power balancing in the AC microgrid.

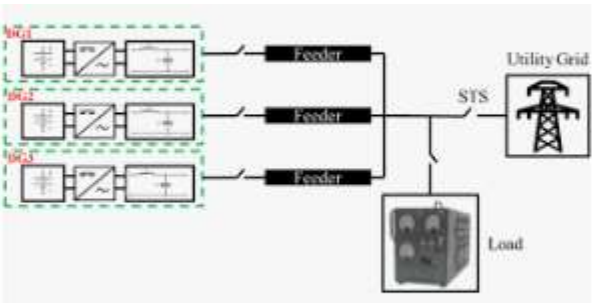

Figure 2.casecaded Types Microgrid

In order to overcome the constraint, this letter proposes an f-P/Q droop control technique for cascaded type micro grids. It is possible to achieve frequency synchronization and power sharing among all DGs under resistive and resistive loads on its own. The proposed system's stability is demonstrated theoretically.

2. LITERATURE REVIEW

Nurul Farhana Abdul Hamid, Muhammad Alleef This article covers the design and modelling of single-phase inverters utilising unipolar modulation of the sinusoidal pulse width (SPWM). The circuit was developed and simulated using the software Matlab/Simulink. A switch was employed to the Metal Oxide Semiconductor Field Effect Transistor (MOSFET).

Sirviö Microgrid operations are difficult because they include many players and manage a wide range of active and intelligent resources or devices. Management functions, such as frequency control or isolation, are specified in the idea of the microgrid, although certain functions may not be required depending on the application. A thorough case study is needed to evaluate the necessary functionalities for network operations and to see the interactions among the players running a specific microgrid. This article provides the case modelling approach for microgrid management at a more practical level from an abstract or conceptual one. By using case studies, prospective entities may be identified where real solutions need to be developed or improved.

Tejas & Vaikund In this article, energy management system control (EMS) for a photovoltaic microgrid (PV)-based distribution generating system (DG) is provided. In improving the performance and efficiency of the distribution system network, the DG units and energy storage devices play a crucial role. Hill Climbing method is utilised as MPPT algorithm for extracting maximum power produced from photovoltaic source and augmented by battery-based energy storage systems in overcast circumstances.

Masoud Worldwide electricity networks are transitioning progressively from traditional fossil-fue producing units to green energy sources. The environmental and economic concerns are the reason for this shift. Moreover, current electricity systems are overloaded every day since the population is steadily growing and thus transformers, transmission and distribution lines overburdened. Although renewable energy sources provide overwhelming benefits, few significant problems are involved. Injecting DGs into the existing power system, for example, causing discrepancies between generated power and the associated load, disturbing the system's balance and causing undesired oscillations and overshoots in voltage and frequency.

Srivani In order to establish an autonomous power balancing in a cascaded microspace system, this research primarily focuses on the f-P/Q drop control. The synchronisation and power balancing of distributed generatorsconstitute two new micro grid issues that need immediate solutions in a cascaded manner. The obvious advantage is to expand the programme with regard to the management of the reverse power factor decrease. Finally, the simulation results show that the suggested approach is feasible. The DGs are replaced with extended sources of energy (PV, super condensers, wind). For this expansion, use of PV as a DG. It knows the proper real power and reactive energy balance independently with resistive and resistive loads. DGs are replaced by distributed energy sources.

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3. DISTRIBUTED GENERATION (DG)

Distributed generation (DG) refers to electricity generation done by small-scale energy systems installed near the energy consumer. These systems are called distributed energy resources (DERs) and commonly include solar panels, small wind turbines, fuel cells and energy storage systems. Conventional, centralized power plants require electric power to travel long distances over complex transmission lines. Distributed generation systems are decentralized and require little to no long-distance energy transport. DG systems can power individual households and businesses. They can also connect into a microgrid, which is a small-scale grid that powers a localized area, such as a university, hospital or military base. Distributed generation helps strengthen grid resiliency, decrease the environmental impact of electricity generation and increase energy efficiency. It is also known as dispersed generation or onsite generation.

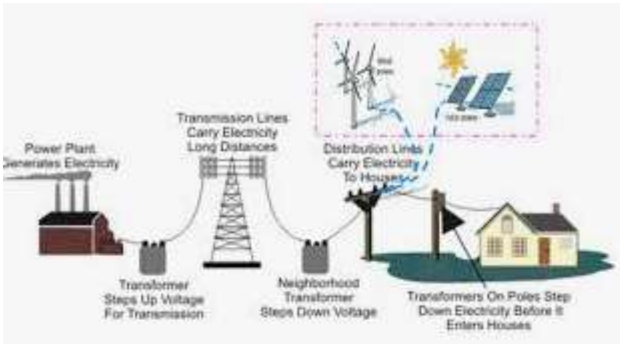

Figure 3.casecaded Types Microgrid

4.DROOP CONTROLLER METHOD

Droop control is a method used in power systems, particularly in microgrids, to allow distributed generators (DGs) to share power loads proportionally to their ratings without the need for communication between them, by simulating the characteristics of a synchronous generator.

It is autonomous approach for controlling the frequency and voltage amplitude of the generator connected to micro grid. It takes the advantages that real power controls frequency and that the reactive power controls the voltage. The power sharing can be done by the droop control method by using the real power controller and reactive power controller

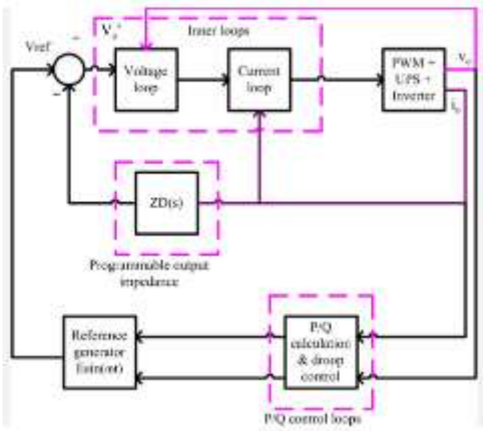

Figure 4. Droop controller Technique.

The expression defining the real power frequency control of droop characteristic are expressed as

$\omega(t) = \omega* - (Pj* - (t))$ (1) $\beta j = \omega* - \omega min / Pj* - Pj,max$

Where (t) is the actual active power output of the Distributed generation system and βj is the slope of the P- ω droop characteristics

Where (t) is reactive power output and is the slope of reactive – voltage droop characteristics.

The total harmonic distortion (THD) at the point of common coupling are minimized for the stand-alone and system relating the problem on reactive power sharing

capacitive virtual impedance loop is used to control the voltage harmonics which occurs at PCC. In grid connected mode, the current control loop is applied to flow the active and reactive power for the power grid and frequency operation. In autonomous mode, power converters are used for operation in three sub-moles like convection droop mode, PCS mode and synchronization mode. The (Vg\Vdc) droop control which provides the dc link voltage at inverter output to maintain the power in micro grid. P-Vg droop control maintains the voltage limiting the constant power band. The hierarchical control consist voltage droop control and impedance control loop for VSI based MG system. These maintaining the phase angle and voltage reference of real power and reactive power. Virtual inductor is used for inverter output of power electronic devices connect to DG system which disconnect the coupling between real and reactive power. An enhanced droop control based on virtual impedance for controlling the frequency to minimize the reactive power load, unbalanced power load and distorted harmonic power load issues.

Transient droop controller is used to minimize the transient voltage. Virtual inductance are connected in this controlled to avoids the harmonic voltage in grids. The droop control provides the active and reactive power influence on voltage and frequency. It supply the smooth voltage and frequency control but is mostly dependent on the specification between inverter connected distribution generation and load.

5. CONCLUSIONS

The output voltage of the SVPWM Technics Module has less THD and less active power rips. It attains an exact real-power under resistive and resistive loads, and reactive-power balances on its own. The ac bus voltage can be changed in the interim. In order to obtain an exact load sharing ratio across series inverters in island micro grids, this paper suggests an innovative method. In this study, communication links are used to modify the voltage drop pitch in order to compensate for the voltage drop in line impedances. The method guarantees accurate power distribution even in the event of a connection outage.

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