

# MICROGRID CONTROL TECHNIQUES

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**Abstract** - A microgrid is one of the improving concepts and creates the power grid works as smarter. Control technique in Microgrid working and operation is a key element for application and research. The paper establishes the detail about the Microgrid development through the control techniques for present scenario. Here the process is classified into two different research areas. There are control strategy and hardware design. And, also master-slave control method and Peers-to-Peers methods are explained in this paper.

**Key Words:** Islanded, Distributed Generation, Microgrid, Grid Connected, Master-slave control, Peers-to-Peers.

## 1. INTRODUCTION

The large RPM implementation of the world economy is a need for developing the electrical power with large quality is more. Consider the Large-scale generation; the main portion is Distribution Network. The Distribution Network is an important part for present grid development scenario. Though, main grid or mega grid connection is not strong also it generates the difficult for the distribution network. It creates the security and loss issues. Also, it makes numerous severe problem in network. Depend on this research few popular accidents happen in past decades. Most of the researchers focus on the improvement of the network and grid protection and control in DG (Distributed Generation), also makes the effective answer to creating the grid is dynamic. In generally DS is eco-friendly. For this, if low loss generation technique gives it should help the public grid. In this case not easy to construct the DG with the public grid in parallel connection. Many of the RES contains no inertia and low inertia which creates Distribution Generation linked to the public grid; it will make the oscillation in voltage and power. For these issues solved by new Microgrid principle.

The MG principle considers as a cluster of load connection as well as micro-sources works a one controllable system. It will give both of the power and thermal through the local region. In this paper control is one of the keys. Many research people concentrate the micro-grid control for operating modes, two modes are available. There are connected mode and islanded mode. The analysis base on the control strategies for the development of control strategies and power electronics device & drives.

## 2. ANALYSIS ON POWER ELECTRONICS DEVICE AND DRIVES

Various of the synchronous machine and most of the DS linked MG through the Electronic power devices. As a result, the improvement of the power electronic devices is nearly connected to the control strategies present in the Microgrid.

One of the interface devices is Inverter. It classified into two types. That is, half bridge and full-bridge. Most of the researchers suggest full-bridge inverter and also the research using a full-bridge inverter.

The Full bridge inverter must bring numerous harmonic distortion compares to the half-bridge inverter. In a microgrid, half-bridge inverter construction is very complicated. Since, it needs large DC capacitor. The capacitor range comes approximately around **46000µF**. If need to reduce the capacity range means, use novel half-bridge inverter will be introduced.

Then the Power Electronic Transformer (PET) introduces the fresh way for MG control. The PET is utilised at a Point of Common Coupling. It has three significant benefits. The advantages are 1. Good Controllability, 2. Power flow could be control in bidirectional, and 3. Frequency isolation.

### 2.1. CONTROL METHOD: GRID-CONNECTED MODE

In this method, the MG act in parallel with public grid. It is used to their power exchange. The public grid will regulate the frequency of the MG if the MG has to monitor the output of real and reactive power. Another one of the control is P-Q. The P-Q control could straight regulate the output power. It is a common use of grid-connected mode. Control variable get Phase angle to current and current will be decoupled at the axis of dq by using the Park transformation. The transformation is simple.

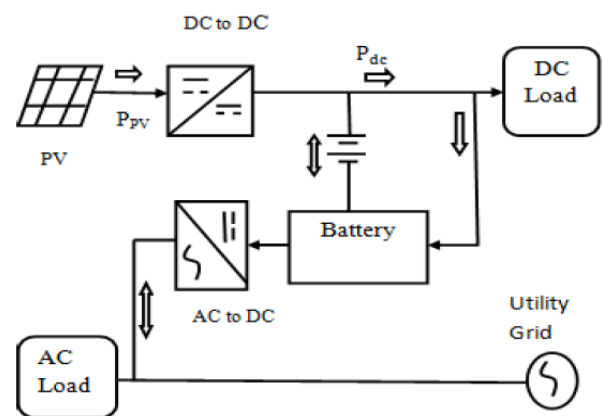


Fig-1: Grid Connected Mode

### 2.2. CONTROL METHOD: ISLANDED MODE

In this mode, the Microgrid is disconnected from the public grid. It works as independently. Master-slave and Droop

Control are the important control strategies using in this method.

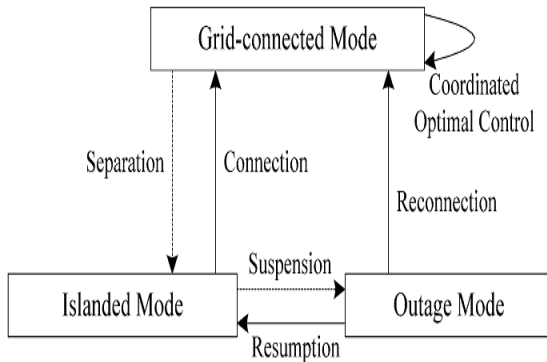


Fig -2: Islanded Mode

### A. Peers-to-Peers Control

In this control method is applicable for synchronous machine. It is used to obtain the power transferring in between the number of parallel sources not connecting any of the communication lines. Also, the conventional droop method used for poor voltage regulation.

In this method four parameters are present.

There is P/f, Q/V.

Where,

P - The active power

Q - The reactive power

f - The frequency

V - The output voltage.

These four parameters present in the conventional droop method process. Since the frequency modulation value current within the MG limitation. Particularly, when the grid consists of the frequency sensitive loads. While using the P/V process frequency droop could be exchanged at output impedance (R).

In this above figure,  $V_{dc}$  is Voltage in DC,  $V_g$  is RMS value of voltage in AC. In parallel control, multiple sources are connected. In that case, load sharing is important and essential. For this cause using large droop control method. But this method is weak to analyze the system stability and dynamic characteristics. In this state space analyzing the Eigen value for the system. When the Eigen value is larger, it will go for RHP as well as the system said to unstable. The method of root locus will examine the result.[6]

When working stability problem, development by modeling the additional loop containing the 3-lag portion. [19-20]. These lag and lead will neglect the large frequency oscillation.

The equation will be written as,

$$f = f^* - mP$$

$$V = V^* - nQ$$

Where, m and n indicating the Q/V, P/f droop slope relation.

$f^*$  indicating the Reference Voltage

$V^*$  indicating the Reference Voltage

$\phi$  indicating the phase angle

In this method, the P controller is exchanged into the PID controller. [20] [3] the output result will display the two developments. It could raise the dynamic characteristics by using the pole placement method. It could be utilised to regulate the quality control. To add an extra loop for these methods. It will raise the difficulty of the system. For this system, U/I multi droop control method will be introduced. It is applicable for P/f droop control. It is called as Variable Droop method.

The development could protect the generation of Distribution Generation goes to the upper limit and concurrently raise the output of the high Distribution Generation. The disadvantage of this type is power sharing is less. Also, less efficient in the additional loop, so the slope is minimal.

Another side the inner issue for this controller is oscillation, additional noise (harmonics), intermittence, and the difference between the output impedance and effect of system stability. If develop the load sharing efficiency means, have to introduced the  $H_\infty$  Control Method. If adding this compensation, the outer loop it will improve the control accuracy as well as the efficiency of the Distribution Generation. For harmonics reduction process introduced the Robust Control Method Process.

### B. Master-Slave Method

Inter-unit communication need for Master-Slave Method. When showing the CS architecture, master-slave method is one of the hierarchical control methods. The main unit collects the data from the various controller of a slave also pass the control sign again back to the process. In high scale MG, this control method is more useful for every section.

The Mater-Slave Control Method majorly classified into two. There are Decentralized and Centralized. MGCC implements the centralised control. It works brain for the entire network. Here, none of the particular commander unit present in this. When MG work individually from the main grid (public grid), any one of the groups should be Turn ON within the master unit. The application of the master unit is performing like a public grid to modify another unit generation amplitude and frequency.

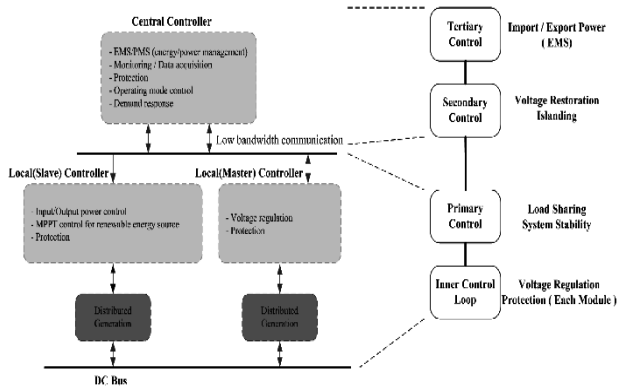


Fig-3: Mater-Slave Control Method

### 3. CENTRAL CONTROL METHOD

Micro-Grid Control Center is key element to develop the control strategy in central. The principle should be applicable for Micro-Grid Control Center lies through the essential part of the analysis. Therefore, obtaining the index consisting of the financial, stability, eco-friendly and many researchers analysed the many various control types. It should be classified into three techniques. The techniques are Fuzzy Control, Optimal Control, and Neural Network.

Smart Grid one of the important for economical operation. Discuss the performance and characteristics of the economic working principle, estimation loss, as well as advantages present in the environment. These analyses used to construct the objective function. When considering the situation as well as economic benefits the object function obtains the highest profit. Likewise, the MG operates usefully in environmentally friendly and economical too.

### 4. P- GRADING CONTROL METHOD

Here much analysis's applied the concept of the control strategy. Compared to the upgrading method and central control approach could eliminate the more cost in Micro-Grid Control Center unit. It is also removing the difficulty in communication. Depend on the upgrading approach need the unit of upgraded to contain large capacity. Therefore, it helps another units (i.e.) Power and Frequency. The requirement controls the MG flexibility working as well as the operation of the MG.

### 5. CONCLUSION

Microgrid control research Islanded mode is important part of the analysis. For this mode, obtain the droop control, not including any of the communication. The disadvantage of the droop control method is very apparent. And it could not solve load sharing and voltage regulation at the equal period. In future research goes under the solve those type of problem in this method. The MG operation control analysis focuses the control strategies present in the MG side. Most of the researchers concentrating through the public grid is very low. The stability examination focus penetration of the MG particularly numerous MG penetration requirement focus.

To main grid, MG neither source nor load. It is very flexible. Also, create the examination challenges. Determination of Load utilised to analysis the stability present in the conventional grid. It might be a methodology to enhance the examination as well as monitor the public grid part when MG enters to the Public Grid.

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