

TECHNICAL HINDRANCE IN MICRO GRID

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Abstract: Micro grid is a source to provide reliable and improved quality energy to the consumers. It consists of prime movers to produce energy, converters, storage system to store energy and loads. Micro grid can be operated in grid connected mode and also in islanded mode. With passage of time the involvement of micro grid in various types of applications are also increasing. The layout and the control design of micro grid depending on the type of application, this may affect the stability of the micro grid. This paper presents various technical hindrance a micro grid is faced with, like protection issues, operational issues, stability issues, faults etc. These factors affect the overall stability and reliability of micro grid.

Keywords: Microgrid, island

1. INTRODUCTION

Due to depletion of fossil fuel resources and also due to environmental pollution hazards of conventional energy sources, there was a need to search for an alternate means of energy source. Solar and wind energy system are becoming very popular as clean energy technology [1]. But distribution network encounters various problems due to the intermittent nature of such sources. Micro Grid is the best solution to overcome some of these problems and also the present energy crisis to some extent.

Lasseter [2] introduced micro grid as renewable energy technologies to generate power and heat at residential industrial plants or commercial buildings. Lopes et al [3] defined micro grids as an additional means to generate power and heat with the help of Low Voltage (LV) network connected to small modular generation systems. Many research has been carried out regarding designing and implementation of stand alone, isolated micro grid [3-5]. Designing the best reliable and resilient microgrid to satisfy all the customer needs is the biggest challenge now a days. Resiliency can be defined as the ability of systems to anticipate, absorb, and rapidly recover to the normal state from an external, high-impact and low-probability events [6]. Micro grid now has shown a new way of marketing power and in the long run will encourage individual customers in local power generation[7]. Sharing of power in microgrid is the biggest challenge in modern world. Various issues and problems that needs to be addressed regarding the integration of microgrid has been discussed in the literature by A.Oudalov et al. [8]. Numerous schemes of protection techniques and als various control strategies for microgrid have been proposed in many literature for stable operation of the system.[9,10]. Protection issues related to inverter interfaced distributed generators has been also been researched in various literature [11]. This paper focuses on the technical issues related to microgrid networks.

2. RESILIENCY ISSUES

Resiliency deals with the recovery systems to minimizing the overall effect of low probability but having a probability of high risk disruptive events, for sustained period of times after the disaster events [12]. Although the two terms reliability and resiliency are often used interchangeably but actually they are not the same. Reliability of grid is basically to deliver adequate quantity of good quality electric power to the end used. And resiliency is the robustness of the system which helps the system to withstand and also to recover from extreme, damaging conditions. Several indices like System Average

Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), Average Service Availability Index (ASAI), Expected Energy Not Supplied (EENS) are available in past literature to assess reliability issues [13]. Sajjad RAHMANZADEH et. Al [14] addressed the issues of Resiliency by developing a model with sets of resiliency constraints depending on the usage of different DG systems. Important critical events were identified and resiliency factors were also collected for the same. The said findings were supported by a case study of a small village. It was concluded that such events which are unexpected and also uncontrolled increases the probability of interruption of power supply. So while designing a microgrid system if reliability and resiliency factors are taken into account this will make the microgrid robust and fail safe to some extent.

3. CONTROL ISSUES IN MICRO GRID

A set of DG system integrated with energy storage system is a micro grid [15,16]. It is an autonomous system, which has the capacity to take the entire load. Smart micro grids are ICT based systems with smart metering concepts [17-19].

Microgrids are becoming very complex day by day and hence various challenging issues are coming up for the proper operation of such systems. Some of the most common issues are synchronization of DG systems, optimal placement of DG in the system for proper power management, reverse power flow problems, Island detection, v/f correction etc. To overcome these problems communication aided control and monitoring is one of the solutions.

A. Operation of Micro-Grid in Island Mode

In micro grid operation the network topology completely changes as the operation shifts from grid mode to island mode. In this mode of operation the stability of the grid is completely dependent on the scheduling of loads and generators. Since in island mode the entire network topology changes there is a need to change the control action also quickly for uninterrupted operation. The problem that commonly arises due to this change over are, reverse power flow, network configuration change, protection issues and also V/f control. Detection of island mode by the system is the most important problem, because this will help in implement voltage and frequency corrections in the new system. Now a days various online algorithms are available that are able to detect the island mode based on online data and network parameters. Boolean algebra is the logic behind the operation of most of the island detection algorithms. Paolo Pinceti et al. in their new proposed algorithm for island mode detection requires only topological data and is independent of network parameters [20]. Depending on critical event, the algorithm will automatically decide whether to go for shedding of either generator or load.

B. V/f control

Maintaining V/f in their limits during the operation of microgrid in island mode is the biggest challenge. Unpredictable nature of renewable Energy Sources along with other uncertainties are the major causes of V/f variations in micro grid. The solar and wind generations are purely weather dependant and mostly unpredictable. Now a days many small microgrids are being operated in coordination with other near by microgrid for better power sharing [21,22]. So frequency violation may lead to the block of microgrid and as all the microgrids are connected, it will quickly spread to other microgrid, and it will start a chain of failures. The overall dynamics of microgrid in island mode causes variation in voltage and frequency, and proper control mechanism is required for its smooth operation. In a microgrid there are two layers of control mechanisms, primary control mechanism and secondary control mechanism. Primary control unit is for the local units only. It covers very less area and controls at that less local area only. Secondary

control unit can be decentralized or centralized operation type. Decentralized control mechanism is preferred when the microgrid is operated in grid connected mode [23,24]. Installed decentralized control facilitates collects data from various units in the system and sends the control signals accordingly after processing the information. There are many methods available in the literature for for achieving quick frequency deviation in minimum time. With the fast advancement of energy storage systems for microgrid, now these energy storage systems are being used for frequency and voltage correction, by adjusting their voltage angle and magnitude. [25,26]. Also drop control method and virtual impedance method of improving voltage and frequency is becoming popular now a days [27]

C. Relay malfunction

When in a system, DG units with inverters are used with large number of distributed generating units of small capacity, the fault current level is changed, to a very low value [11,28]. As the fault current is very low there is a possibility that during the occurrence of the fault the relay may not operate, hence the fault may damage the entire system. When the microgrid is operated in island mode along with distributed generation units and inverters, the fault current becomes very less, so the traditional protection system will not work properly with the system. Again if a fault occur on downstream of the bus where DG is connected to load, the impedance measured by relay placed in upstream will be higher than real fault impedance. This will cause delayed operation or no operation at all

D. Reverse Power Flow Problem

In a typical microgrid system, sources are located in both sides of load. So power flows in opposite direction from different sources towards the load. This caused power quality problem and voltage fluctuation.

E. Presence of PV in the system

PVs are single phase system, so the presence of PV in the system causes unbalance current to flow through the system.

F. Presence of Harmonic in DC Micro Grid

The Harmonic currents present in the system need to be reduced for the reduction of harmonic losses. Proper harmonic compensation methods needs to be installed in the system in [30].

4. SOLUTIONS

As the world is adopting the concept of microgrid, in the system, lots of research are going on to overcome all the problem of protection issues of the system and to make the system robust.

- One of the possible solution to overcome the protection problem can be to use inverter interfaced units along with energy storage devices in the system. This will increase the level of fault current, in case of fault in the system.
- To set up a completely different protection scheme for the microgrid operating in island mode. Evolving distribution system with pilot wire line differential scheme can be one of the solution [29].
- By using proper inverter controller design the protection issues can be addressed.
- Installation of technology that automatic changes the relay settings when micro grid changes from grid connected mode to island mode and vice versa, will solve most of the issues related to microgrid problems.
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5. CONCLUSION

For the above discussion it is clear that there are mainly three key issues that needs to be addresses for proper operation of microgrid. They are voltage and frequency control, islanding and protection. Efforts for development and application of concepts is required to overcome these problems completely. Adaptive micro grid protection system is the best solution to overcome all the problems associated with all issues in micro grid. There is no doubt that in future in the new power generation layouts, provision for microgrid will be present for economic and environmental benefits as compared to traditional power system.

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