

A Review on Micro-grid application

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Abstract: In this paper the application and challenges of Micro-grid discussed. For the reliability of the power system and also to reduce the transmission loss the micro-grid concept is used. Also to promote the NCES (non-conventional energy source) in the form of solar and wind power the distributed generation is widely used and all distributed generation could be combinedly used by using the micro-grid. Micro-grid can be classified as isolated micro-grid and grid connected micro-grid. Isolated micro-grid is one which acts as small power system (Generation, transmission, distribution) and is functioning with distributed generation as power source. With the limited availability of fossil fuel like coal and oil the future energy dependability must be on renewable energy as solar energy and wind energy. Very soon the solar energy, wind energy and other non-conventional energy source combined refer as distributed generation is main source of power for society. A micro-grid is group of loads and “distributed generators” that operate as a single Entity.

Keywords: Micro-Grid, , DGs, T&D, Distribution Generation, Power Quality, , Biomass, Wind , Solar, Diesel set (DG), Generation plant(GP)

I Micro-grid importance and advantage

With the increasing use of distributed generation in the form of solar power, wind power, mini hydro power, bio-gas power the concept of micro-grid comes in picture importantly. As micro-grid is group of loads and DGs(Distributed Generations) as a single entity, DGs and load must be act as power system at local level and that local power system(generation, transmission and distribution) with load at local level is known as micro-grid[4][5].

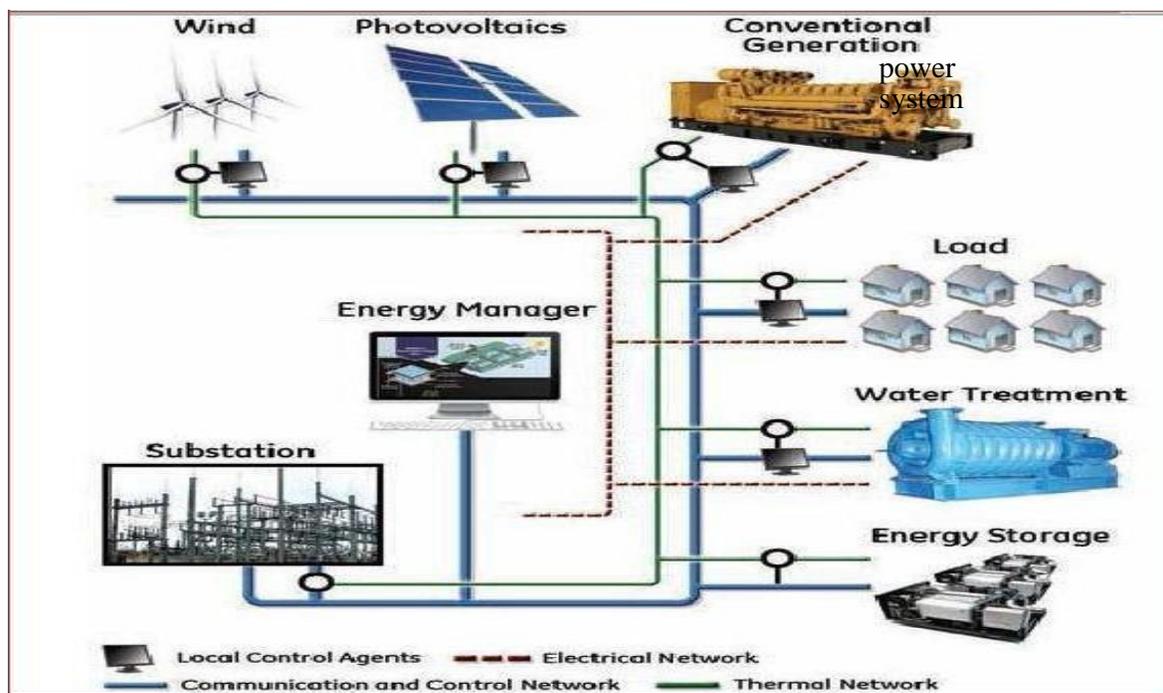


Fig.1:
Micro-grid

So in the micro-grid system renewable energy in Distributed generation form (DGs) could be used easily and dependency on conventional method reduces. For country like India energy demand increasing very rapidly and conventional methods unable to fulfill this demand, to fulfill energy demand distributed generation is very important. Distributed generations mainly solar power and wind power are important source to fulfill energy demand of country [2]. Different countries implement Distributed generations and defined it in their own way some examples are given as; In UK Distributed Generation (DG) is defined as a generation plant (GP) which is connected to a distribution network and not to a transmission network. In a similar manner in USA it is said to as small scale generation of electric power by a unit sited close to the load being served. Both of these justify terming Distributed Generation (DG) as embedded to distribution system. In India also effectively it means decentralized small scale generation directly supplying load and having interconnection with distribution network. Moreover it is very often in the context of electrification of rural areas including remote villages [2]. Micro-grid also leads to minimizes the transmission losses during transmission over long transmission network, in micro-grid power source is distributed generation(DG) in solar ,wind, biomass etc. and directly given to distributed network so losses can be minimized. Also reliability can be increased because the network with comparison with conventional grid is small so chances of faults are Minimum and reliability of system is increased [6]. The micro-grid generally Supplies electricity and heat to the user by means of CHP, gas turbines (GTs), fuel cells, PV cell systems, wind turbines, etc. batteries and flywheels are energy storage systems usually include [7].The device for energy storage in the micro-grid is same as the rotating reserve of high capacity generators in the conventional grid which confirms the balance between energy generation and consumption especially during fast changes in load or generation [8].

II Isolated micro-grid and grid connected micro-grid

Micro-grid can be classified as isolated micro-grid

and grid-connected micro-grid. Isolated Micro-grid functioning as local power system acts independently with no linkage with grid or conventional power source. As it works with local power system the reliability increased and losses can be minimized. Whatever amount of power generated by Distribution generations (DGs) is only source of power for that micro-grid [2]. In the grid connected micro-grid the cluster of load and power sources must be connected to grid so that whenever people needs some more amount of power they could withdraw with grid and micro-grid would fulfill future and uncertain demand[5]. Both types of micro-grid have their own advantage and disadvantages. For the distant location, hilly areas isolated micro-grid is more popular [3].

III Technical challenges in micro-grid

Technical challenges leads to the use of micro-grid are immense. Maintaining stability, reliability, and power quality in the power quality in the islanding modes of micro-grid is challenge for the person involved for this [6]. In the small power system said as micro-grid protection is important concept to observe. The Switchgear protection should “cut off the micro-grid from the main grid” as rapidly as required to protect the micro-grid loads for the one case and for the another case the protection system should isolate the smallest part of the micro-grid when fault is cleared [7]. A segmentation of micro-grid, i.e. a structure of multiple islands or sub micro-grids must be supported by micro-source and load controllers. In these conditions problems related to selectivity (false, unnecessary tripping) and sensitivity (undetected faults or delayed tripping) of protection system may arise. Mainly, there are two main issues concerning the protection of micro-grids, first is related to a number of installed DER units in the micro-grid and second is related to an availability of a sufficient level of short-circuit current in the islanded operating mode of micro-grid since this level may substantially drop down after a disconnection from a stiff main grid. In[12] author wrote Short-circuit current calculations for radial feeders with DER and studied that short-circuit currents which are used in over-current (OC) protection relays depend on a connection point of and a feed-in power from DER. The directions and amplitudes of short circuit currents will vary because of these conditions [12].

IV Hybrid micro-grid

The configuration of the hybrid system is shown in Figure below where various AC and DC sources and loads are connected to the corresponding AC and DC networks. The AC and DC links are linked together. Islanding modes of micro-grid is challenge for the person involved for this [6]. In the small power system said as micro-grid protection is important concept to watch. The protection system should cut off the micro-grid from the main grid as rapidly as necessary to protect the micro-grid loads for the first case and for the Second case the protection system should isolate the smallest part of the micro-grid when Clears the fault[7]. A segmentation of micro-grid, i.e. a design of multiple islands or sub micro-grids must be supported by micro-source and load controllers. In these conditions problems related to selectivity (false, unnecessary tripping) and sensitivity (undetected faults or delayed tripping) of protection system may arise. Mainly, there are two main issues concerning the protection of micro-grids, first is related to a number of installed DER units in the micro-grid and second is related to an availability of a sufficient level of short-circuit current in the islanded operating mode of micro-grid since this level may substantially drop down after a disconnection from a stiff main grid. In[12] author wrote Short-circuit current calculations for radial feeders with DER and studied that short-circuit currents which are used in over-current (OC) protection relays depend on a connection point of and a feed-in power from DER. The directions and amplitudes of short circuit currents will vary because of these conditions [12]. Through two transformers and two four quadrant operating three Phase converters. The AC bus of the hybrid grid is tied to the utility grid.

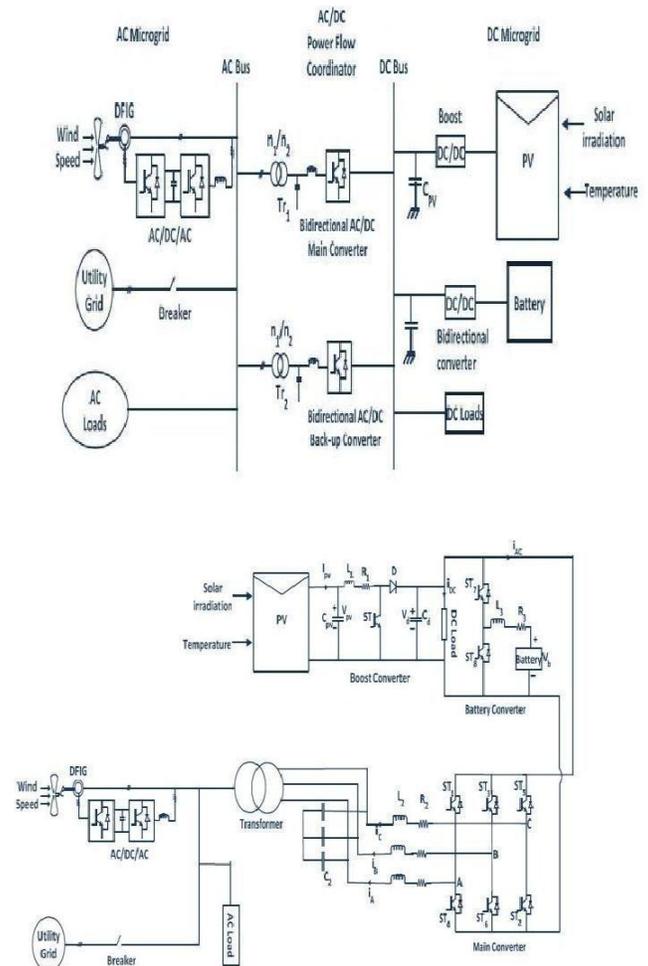


Fig.2: configuration of hybrid micro-grid(i,ii)

In the proposed system, PV arrays are connected to the DC bus through boost converter to Simulate DC sources. A DFIG wind generation system is connected to AC bus to simulate AC sources. A battery with bidirectional DC/DC converter is connected to DC bus as energy Storage. A variable DC and AC load are connected to their DC and AC buses to simulate Various loads.

V Hybrid-grid performs its operation in two ways

A. Grid tied mode:

In this mode the main converter is to provide stable DC bus voltage, and required reactive Power to exchange power between AC and DC buses. Maximum power can be obtained by controlling the boost converter and wind turbine generators. When output power of DC sources is greater than DC loads the converter acts as inverter and in this situation power flows from DC to AC side. When generation of total power is less than the total load at DC side, the converter injects power from AC to DC side. The converter helps to inject power to the utility grid in case the total power generation is greater than the total load in the hybrid grid; Otherwise hybrid receives power from the utility grid. The role of battery converter is not important in system operation as power is balanced by utility grid [8].

B. Autonomous mode

The battery plays very important role for both power balance and voltage stability. DC bus voltage is maintained stable by battery converter or boost converter. The main converter is controlled to provide stable and high quality AC bus voltage [8].

VI Conclusion and future work

The present work mainly includes the grid tied mode of operation of hybrid grid. The hybrid grid may be feasible for small isolated industrial plants with both PV systems and wind turbine generator as the major power supply. Micro-grid is very useful to use the renewable source of energy as distributed generation and use as local load center. The transmission losses can be minimized and reliability of the system can be improved.

The modeling and control can be done for the islanded mode of operation. The future work also may be focused on smart micro-grid. The two way

communication as developed for main grid may be developed for micro-grid and that may be considered area of research.

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