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Review Article of PV Connected Design of Micro Gird/Smart Grid with Power Compensation

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Abstract- In this work, a Microgrid (MG) test model based on the 14-busbar IEEE distribution system is proposed. This model can constitute an important research tool for the analysis of electrical grids in its transition to Smart Grids (SG). The benchmark is used as a base case for power flow analysis and quality variables related with SG and holds distributed resources. The proposed MG consists of DC and AC buses with different types of loads and distributed generation at two voltage levels. A complete model of this MG has been simulated using the MATLAB/Simulink environmental simulation platform. The proposed electrical system will provide a base case for other studies such as: reactive power compensation, stability and inertia analysis, reliability, demand response studies, hierarchical control, fault tolerant control, optimization and energy storage strategies.

Keywords:- Electrical engineering, System diagnostics, Power system operation, Power converter, Smart grid technology, Distributed resources, Microgrid benchmark, Hybrid energy systems, Power flow.

I. INTRODUCTION

The liberation of the energy market and the new conditions in the energy field are leading towards the finding of more efficient ways of energy production and management. The introduction of new ideas capable of evolving in the new conditions might lead to more suitable solutions compared to any possible malfunctions the new market model can create.

Renewable energy systems (RES) propose a new technology that is cleaner and capable of supplying the growing electricity demands of interconnected and isolated communities. In recent years, MGs have become a great attraction for the scientific community as well as a promising solution for future traditional energy systems. MGs are seen as a possible technology for the integration of variable renewable energy systems in the traditional grid.Currently, with the evolution of new digital technologies, such as micro-processed systems and advances in power electronics, many applications Have been implemented in SG, specifically in the development of controllers and electronic energy converters. In recent decades, researchers have made significant contributions which have had a high impact in these areas, mainly aimed at data acquisition, automation, and control of MGs [1, 2, 3].

MGs not only integrate the distributed generation to the Main Grid in a reliable and clean fashion, but also provide high reliability in its capacity to operate in the face of natural phenomena and active Distribution Grids, which in turn results in less energy losses in transmission and distribution and less construction and investment time [3, 4, 5, 6].

Research developed in [7, 8, 9, 10, 11, 12, 13, 14, 15] show actual implemented MGs. Some of the examples can be seen in CERTS in the US, NEDO in Japan, and a vast majority of MGs in Europe.A MG can be defined as a low-voltage distribution power system to which small modular generations systems, such as renewable energy sources, other distributed generators, as well as intermediate storage units are connected and can fulfill the load demand. This

particular power system can be treated by the utility grid as a controllable load or generator [6].

Although MG configurations can be exclusively DC, AC, or a hybrid of the two technologies, some investigations are particularly focused on AC MG. This is due to its ability to operate together with the Main Grid. It is known that each have several advantages which in turn leaves a HMG benchmark a turning point in this investigation [8].

All MG technologies must face the dynamics and steady state characteristics of the distribution generators (DG), the unbalance and nonlinearity of loads and the proper dynamics of energy storage systems (ESS) [7]. HMGs must also face the problem of an accidental or a programmed disconnection from the Main Grid.

An HMG benchmark must be subjected to two typical scenarios, as in any other power system Distribution Grid: minimum and maximum demand situations. HMGs must manage abnormal operations of its electrical infrastructure. A set of three-level control structures is a well-known strategy to control MG parameters [1].

Specialized literature has reported implemented and experimental MGs in Europe, Africa, Asia and America [2]. In fact, there is also a discussion about its acceptance [3]. Power electronics are included in MG configurations due to the nature of most renewable generation technologies. It is necessary to control the injected power delivered to the MG [7].

If appropriate closed-loop control strategies are implemented, its power quality problems may be overcome [5]. The performance of the MG configurations and different technologies may be improved by the use of parallel inverters [6].

In this study, a detailed model of a Hybrid Microgrid (HMG) benchmark has been simulated. This model is based on the original IEEE-14-distribution-bus model. The proposed benchmark does not offer any wind energy resource since the effort is focused on the ability of the MG to operate one of two renewable energies. This is usually the case, as one of the two energy resources is more available than the other.

The main objective of providing this benchmark is to set up a complete and detailed model for further studies: reliability and resilience, optimization, fault diagnosis, system identification, and fault tolerant control.

There are many control techniques for the operation of controlled rectifiers or inverters, as interfaces to renewable energies. In this thesis, some converters have been settled to operate in an open-loop control strategy and others operate in a closed-loop control strategy. Additionally, these rectifiers or inverters use pulse width modulation techniques of different carrier frequencies [7].

II. TECHNOLOGY STATUS

The technical and commercial status of distributed generation globally depends very much on the past history of a country's power industry. Countries, whether developed or developing, with power sectors that are largely state controlled either remain tied to a centrally controlled transmission system that is connected to large-scale fossil fuel, hydro or nuclear power stations, or are developing such systems.

Countries where liberalisation has taken place, on the other hand, have the incentive to consider alternatives. It is in these countries that distributed generation has started to gain a foothold because of its lower capital cost, modular construction and short build times.

The mix of distributed generation technologies exploited depends on, among other things, energy market and political issues. The USA probably leads the world in developing distributed generation, driven by commercial issues and by poor power quality and the lack of security of supply in a number of states. In other words, the market is demanding solutions that distributed generation technologies can provide. This has resulted in a distributed generation market that is dominated by low-cost, high-reliability fossil-fuel plant (usually gas-based) but that has a growing renewables component.

III. EFFECT OF DG SIZE AND LOCATION

The loss sensitivity based analytical method has been used to find the optimal location and size of DG without use of admittance, impedance or jacobian

matrix. The analytical expression for finding the optimal size and power factor for different types of distributed generation units to achieve the highest loss reduction in the distribution system was presented.

The rapid increase of load on the system needs additional power supply sources. Due to the non-availability of conventional sources, the non-conventional sources support the system by supplying the power to the loads.

The placement and sizing of DG is an important task for the planning engineers because the improper location and sizing introduce more power loss and voltage stability problems. By proper allocation and sizing of DG leads to achieve greater power loss reduction and improves the voltage profile of the system. Hence the determination of optimal location and sizing.

The conventional sources of energy are rapidly depleting. Moreover the cost of energy is rising and therefore renewable energy sources are future promising alternatives. They are abundant, pollution free, distributed through the earth and recyclable. The hindrance issue is its high installation price and low conversion potency.

A micro- grid includes a small scale power supply such as wind turbine, photovoltaic array or diesel generator connected to serve the demand of small communities. Precisely, we can say it is a distributed generation (DG) network work as a group or individually to provide energy [2]. A micro-grid have green energy sources like wind turbine, PV array and all are connected to conventional utility through bidirectional convertor.

This mode of operation is called grid-connected mode, unlike the autonomous island mode where the conventional utility is disconnected from the micro-grid. In fact, micro-grid can include AC sources, DC sources or both of them to form a Hybrid Micro-Grid [3].

IV. MOTIVATION OF WORK

The micro grid concept acts as a solution to the conundrum of integrating large amounts of micro generating units without disrupting the operation of the utility grid. With intelligent coordination of loads and micro-grid units, the distribution network subsystem (or 'micro grid') would be less trouble some to the utility grid, than conventional micro generation.

The net micro grid could even provide ancillary services such as local voltage control. In case of disturbances on the main grid, micro grids could potentially disconnect and continue to operate separately. This operation improves power quality to the customer. From the grid's perception, the benefit of a micro grid is that it can be considered as a controlled entity within the power system that can be functioned as a single aggregated load.

Customers can get benefits from a micro grid alone because it is designed and operated to meet their local needs for heat and power as well as provide uninterruptible power, enhance local reliability, reduce feeder losses, and support local voltage and also correct voltage sag.

In addition to generating technologies, micro grid also includes storage, load control and heat recovery equipment. The ability of the micro grid to operate when connected to the grid as well as smooth transition to and from the island mode is another important function.

There are some ongoing researches focused on Micro grids and a lot of investigation has been conducted by many researcher groups to determine the feasibility and benefits of micro grids. Even though the fundamental principles of micro grids are well known, implementation of the system is not always well mastered.

V. OBJECTIVES OF PAPER WORK

- To propose and develop a hybrid AC/DC micro-grid (with combination of Photovoltaic, wind and storage for backup) that consists of both ac and dc networks connected together by bidirectional converter.
- The Proposed Hybrid micro-grid would improve the dynamic performance of the Grid connected PV System in a day ahead market and optimization by using PSO technique.
- This work deals with system integration and controller design for power management of a islanded gird.

- The coordination control algorithm is proposed for smooth power transfer between ac and dc links for stable system operation under various generations and loading condition.
- The profile of ac and dc bus voltage is analyzed especially, when the operating conditions or load capacities changes under the various mode of operations.

The main objective of this thesis is the development of hybrid micro grid which will reduces the multiple reverse conversion associated with individual ac.

In past few decades, some artificial intelligence optimization technique have been proposed for solving optimization problem to avoid the difficulty and problems of capability of global search for many conventional techniques like genetic algorithm, particle swarm optimization, ant-bee colony, evolutionary algorithm, bacterial foraging have been widely used to solve reactive power dispatch problems.

VI. OUR PROPOSED METHOD REDUCTION OF POWER LOSS

In computational science, particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. It solves a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity. Each particle's movement is influenced by its local best known position, but is also guided toward.

1. PSO Method:

In procedure science, particle swarm optimization (PSO) could be a procedure methodology that optimizes a tangle by iteratively attempting to boost a candidate resolution with reference to a given live of quality. It solves a tangle by having a population of candidate solutions, here dubbed particles, and moving these particles around within the search space per straightforward mathematical formulae over the particle's position and velocity.

Each particle's movement is influenced by its native best known position, however is additionally guided toward the best known positions within the search space, that are updated as higher positions are found by alternative particles. This is expected to the swarm toward the most effective solutions.

PSO is originally attributed to Kennedy, Eberhart and Shi and was first intended for simulating social behaviour, [4] as a stylized representation of the movement of organisms in a bird flock or fish school.The formula was simplified and it absolutely was discovered to be activity improvement.

The book by Kennedy and Eberhart describes several philosophical aspects of PSO and swarm intelligence. An extensive survey of PSO applications is made by Poli. [6] [7] Recently, a comprehensive review on theoretical and experimental works on PSO has been published by Bonyadi and Michalewicz.

PSO could be a meta heuristic because it makes few or no assumptions regarding the matter being optimized and might search terribly giant areas of candidate solutions. However, met a heuristics like PSO don't guarantee. An optimum answer is ever found.

Also, PSO does not use the gradient of the matter being optimized, which suggest PSO doesn't need that the improvement drawback be differentiable as is needed by classic optimization strategies like gradient descent and quasi newton strategies.

Particle swarm improvement (PSO) is also a population based random improvement technique developed by Dr. Eberhart and Dr.Kennedy in 1995, impressed by social behavior of bird flocking or fish schooling.

PSO shares several similarities with biological process computation techniques like Genetic Algorithms (GA). The system is initialized with a population of random solutions and searches for optima by another generations. However, unlike GA, PSO has no evolution operators like Crossover and mutation. In PSO, the potential solutions, known as particles, fly through the matter by following this optimum particles.

The elaborated data are given in following sections. Compared to GA, the benefits of PSO square measure that PSO is straight forward to implement and there square measure few parameters to regulate. PSO has been with success applied in

several areas perform improvement, artificial neural network coaching, fuzzy system management, and different areas wherever GA are often applied. Objective function is determined by the requirement of reactive power dispatch (loss reduction) at different location. Reactive power dispatch problem makes considerable effect on power system operation which results in loss in transmission system.

It has considered as most prominent problem in the area of power system. The solution is made in reactive power dispatch in order of determining the location reactive power generation for optimization of objective function. Reactive power loss can also be responsible for the power factor decrement [1-3].

A stochastic, population based search technique termed as particle swarm optimization (PSO) is well suitably implemented for multi-dimensional space.

Increased standard of living of people, industrialization, rural electrification at large scales lead to increase the demand of electric power in higher order in the world. The demand is dominating the supply [4].

To fulfill this criteria, establishment of renewed system for generation, transmission and distribution is required whereas decrement in losses caused technically such as in transmission, distribution system and the losses due to in-efficient metering, energy thefts should be made in order to fill the gap of supply and demand of energy as well as avoid the unwanted shutdowns.

As the loss of the system would be maintained i.e. technical and non-technical both, utilization of available energy resources would be increased to satisfy the demand for the affordable transmission and generation cost. This requirement motivates to initiate the optimal power flow program for the planning and operation of a power system [5].

Identification of appropriate control variable with allocation of their corresponding operating value is the main objective of an optimal power flow problem having a specific objective of loss minimization in the network with satisfied equality and inequality constraints. Derivation of equality constrains is done from the power balance equation whereas limits on control variables are the parameters to achieve in equality constraints that may be continuous or discrete in nature. For solving problems like optimal power flow, economic load and reactive power dispatch/loss reduction etc., some traditional approaches such as newton method, quasi-newton, sequential linear programming, sequential quadratic programming and gradient method were employed [6].

On the basis of rapid convergence, easy handling of inequality constraints, problem solving ability for absence of initial feasible point, some available methods like deterministic methods, interior point method were taken into consideration over others. Interior point method involves the simplex method to find out improved direction striated in the feasible space with the movement from one to adjacent feasible vertex along the boundary of the feasible space till the achievement of the optimum point.

As the various classical approaches were proposed, out of these some conventional optimization methods were considered for reliable solution of reactive power dispatch (loss reduction) problems, whereas in this case also global optimal solution has not guaranteed, while handling of constraints and discrete variable were the major issues for most of them. Initial selection condition decides the solution quality and global convergence [7]. For these methods requirement of presence of a differentiable and continuous objective function is noticed which availability is rare for practical reactive power dispatch (loss reduction) problems.

VII. RESULT AND SIMULATION

In addition, the base case obtained in this research with maximum and minimum demand scenarios allows future studies in many areas of great current interest, associated with the efficiency, reliability and quality of the electric power. The proposed system allows the analysis of power dispatch in the event of grid contingencies or unbalances between load and generation. The impact of the insertion of the electric car in the demand studies of both scenarios can be analyzed.

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1. MATLAB Simulation Modelling:

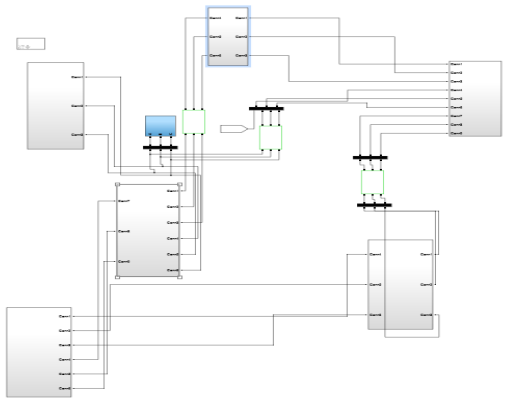

Fig 1. Matlab Simulation on MATLAB 2015A software.

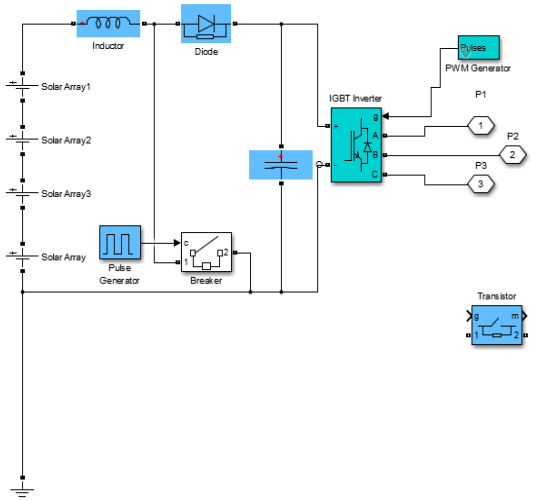

Fig 2. Solar Grid.

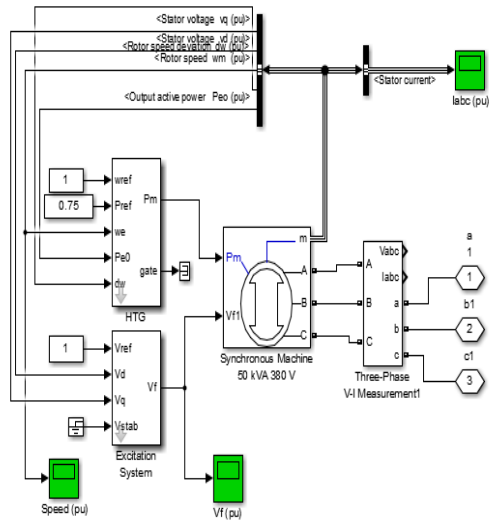

Fig 3. Solar micro grid another power generation grid.

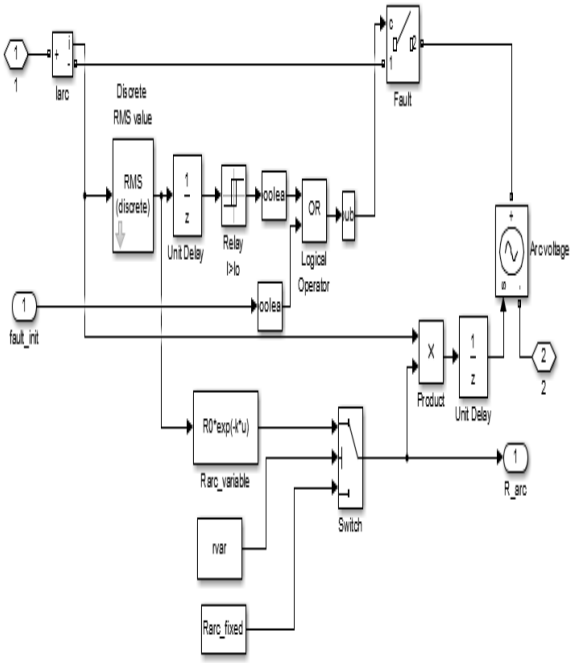

Fig 4. Interlinking Convertor.

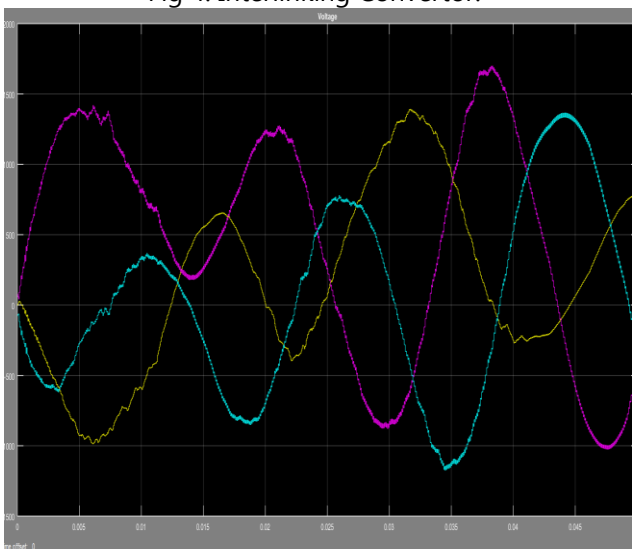

Fig 5. Solar across voltage generation.

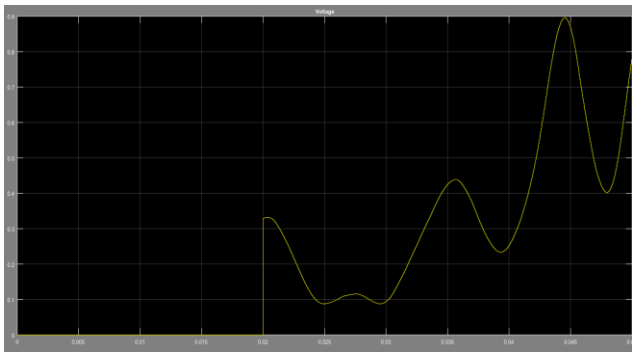

Fig 6. Voltage form THD Reduction.

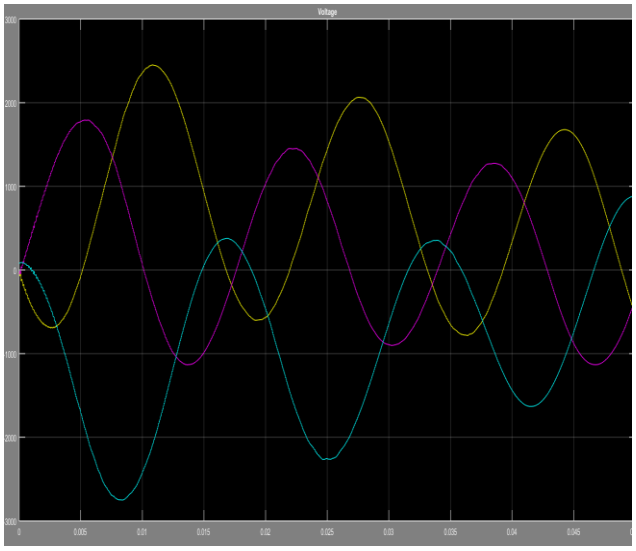

Fig 7. Second power generation source across voltage.

VIII. CONCLUSIONS

The modeling of hybrid micro grid for power system configuration is done in MATLAB/SIMULINK environment. The present work mainly includes the grid tied mode of operation of hybrid grid. The models are developed for all the converters to maintain stable system under various loads and resource conditions and also the control mechanism are studied. MPPT algorithm is used to harness maximum power from DC sources and to coordinate the power Exchange between DC and AC grid.

Although the hybrid grid can diminish the processes of DC/AC and AC/DC conversions in an individual AC or DC grid, there are many practical problems for the implementation of the hybrid grid based on the current AC dominated infrastructure.

The efficiency of the total system depends on the diminution of conversion losses and the increase for an extra DC link. The hybrid grid can provide a reliable, high quality and more efficient power to consumer. The hybrid grid may be feasible for small isolated industrial plants with both PV systems and wind turbine generator as the major power supply.

1. Scope of future work-

The modeling and control can be done for the islanded mode of operation.The control mechanism can be developed for a micro grid containing unbalanced and nonlinear loads.

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