International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.44 (2015)

Study on Restructured Indian Distribution Feeder Self Sustained MG

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***Abstract*—The challenges in the present Distribution System, how to manage the DG power for smart operation and control with energy efficiency. In connection with this, Indian Government had taken keen steps to motivate the public customers to install DG nearer to their places to generate their own generation. This paper is discusses about how we can installed the restructured micro grid to save the energy for the Distribution Feeder. The existing Indian Distribution Feeder simulated in PSCAD and Restructured to MG1 and MG2 with Interconnected connection to Electricity Board. The performance of the proposed MG studied for steady state and transient conditions.**

Keywords— Distribution System, Micro Grid, Solar and Wind

I. INTRODUCTION

According to the present scenario in the world the co2 emission is increasing day by day, in India carbon dioxide emission is 2% per capita. The major cause of this pollution changes is conventional thermal power plant, Now a days, population is increasing day by day and we have to meet the demand with pollution free generation. So to overcome this we are using the micro-grid. Micro-grid is considered as small grid, which uses the loacally available energy resources like solar , wind , geo-thermal, bio-mass etc. It is inter connected to more than one renewable energy sources to meet the local demand, because of this only it is known as Distributed generation. Microgridsis a more well-established part of global electrical system and it can be classified as dispatchable and non-dispatchable or inertial and non-inertial. MGs are basically used for controlling real and reactive power to maintain stable operation.In this paper we are using solar and wind energy to generate the power with MGs. In the solar power system we are using the PV cell. A photovoltaic cell (PV cell) is a specialized semiconductor diode which converts sunlight into direct current . DC is converted in to AC with the help of inverter. The output of MGs is optimal output in which the economical growth will not be affected with the help of microgrid.

In the next section, the various analysis on low voltage MG will be done.The operation of MG will be performed in different platform.

II. LITRATURE REVIEW

A micro grid can work either grid connected or islanded mode [1],[2].In the grid connected switching control which is used to achieve power flow regulation at the point of common coupling(PCC), which can be achieved from the power controller of DG inverter[3],[6].In islanded mode , the switching control is used to maintain the amplitude of micro grid voltage and frequency during interrupt power sharing. The switching control for islanded mode is classified into two groups, with respect to the use of interconnected works [3],[4],[6],[8].The first is dependent on active load-sharing technique, like centralized , master slave, average load sharing and circular chain control[6]-[8].In this switching control typical intercommunication wires are necessary for modules. The second is dependent on droop control in which intercommunication line is not required. It controls the frequency and voltage during the time of power sharing [5]. Droop control may be used either of the following modes, i.e., grid connected mode or islanded mode.

The author gave the concept of implementation of MGs in remote area like Himalaya. Author used the renewable sources of energy like solar, wind, bio-mass etc. that was already available in the village. To get the total estimation of load, he did a survey, in which he went to door to door and noted down the load of particular house. Remote location like Himalaya is having abundant amount of sunlight as well as wind speed, so it is easy to implement the uses of renewable sources of energy. The main aim of the author is to present this paper is to provide the electricity in remote area like Himalaya by saving the convention sources of energy[9].In the second paper the review of recent work in micro grid.The next generation smart power grid work on the concept of bidirectional communication driven demand response.It can be enhanced by distributed micro-grid which may generate, distribute and regulate the flow of consumers. From algorithm of greedy coalition formation it allows the macro-station to coordinate mutual power loss across the entire power grid, including the cost of charging or discharging power storage device and power loss due to power transfer. To communicate power exchange needs for micro-grids to micro station.Themicro station will calculate reduced power loss per unit for each pair of micro grid sort them and create exchange pair by"Greedy algorithm" until all demand is

met. By form coalition and exchange power to microgram, the total power will reduce.From greedy novel coalition formation algorithm,It allows the micro grids to make decision on whether to charge or discharge their power storage devices and to find other micrograms form coalitions [10].

In the third paper the author gave the idea of supplying the electricity, when natural disaster happen. In this paper, there are two way of generation of electricity is implemented. The first one is distributed generators and the second one is local energy storage. In both the system, renewable energy is used to meet the load demand. The most commonly used renewable sources are solar and wind, author used the same. With the help of solar and wind energy system he made the concept DG. The local energy storage is used as a back for the system. To fulfill the load, both solar and wind system is connected to each other with the help of power electronics interface and the output is given to the load[11]. The review of recent work in micro grid is discussed bymicrogrid needed for the supply for the householders and business owners and also he gives the motivation to the customers that how to stop the energy wastage, and also we utilize the renewable sources of energy.In that He uses intelligent HAEMS, it is the component which receives information about task operating status, usage requests and network signal, and sends control actions back to the smart devices[12].

In all the paper, we saw that the entire author gave their concept for analysis of MG through some benchmark systems. This paper states that how Indian low voltage distribution feeder is Restructured into autonomous MGs. The existing system is restructured and then solar and wind system is used to fulfill the load demand. The proposed system tested for various case studies to check the sustainability of the system performance.

III. EXISTING DISTRIBUTION FEEDER

In this existing system there are two feeders in which all the load is connected to a transformer. The power supply of this feederis given by the grid, in which there is no backup If any fault mayoccur, then the whole system will stop working. The distribution system is of radial types, so emergency supply will not reach to the customer.

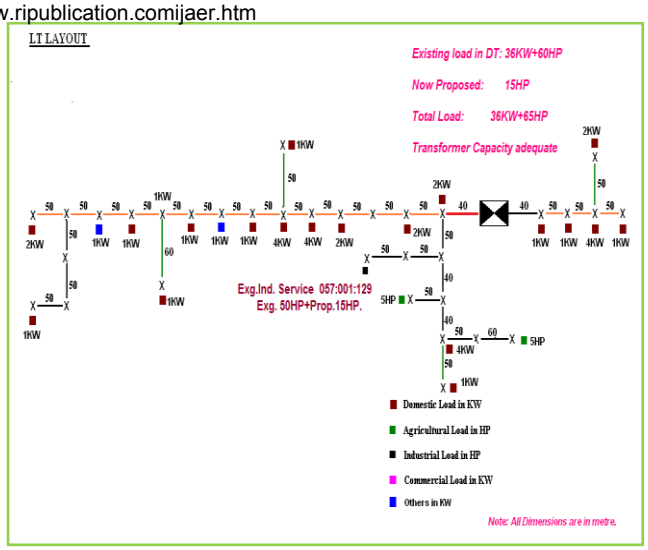

Fig:1 layout of the LV distribution feeder

The fig.-1 is the low voltage distribution system, in which most of the load connected is domestic and agricultural.

Table 1

Details of LV distribution system

Basic details of the existing layout	
Domestic Load (KW)	36 KW
Agricultural Load in (KW)	7.355 KW
Other Load (KW)	13 KW
Transformer	100 KVA
Average Load	440 V
Transformer rating	11 kVA /440 V

In the table-1, it is stating the total load of the distribution system, with their component rating.The step up transformer is used the existing system to step down 11 KW to 440V.

A. PSCAD SIMULATION OF THE LAYOUT

In the PSCAD, We are simulating the existing system. With the help of simulation we are able to find the voltage at each bus and it is also possible to find out how much voltage drop is happening in the system. The simulation is done with each load connected at their respective bus.

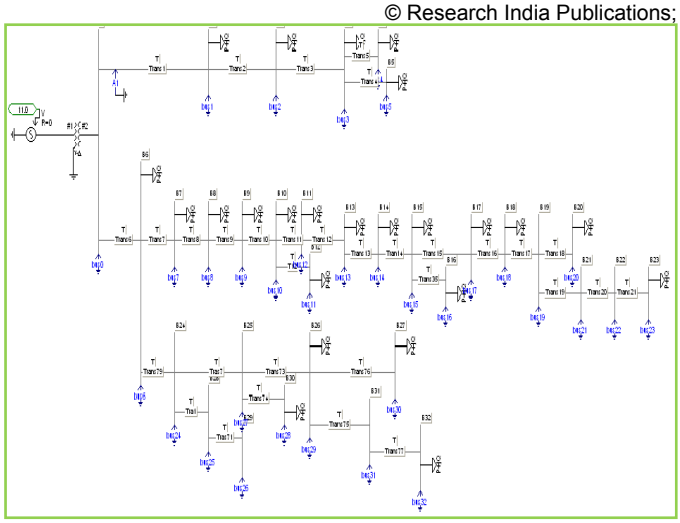

Fig:2 simulation of the layout.

In the fig.-2 , the simulation of the existing system is done with the respective load at each bus. At different bus, voltage drop is there. So there is large variation in between the first bus and last bus.

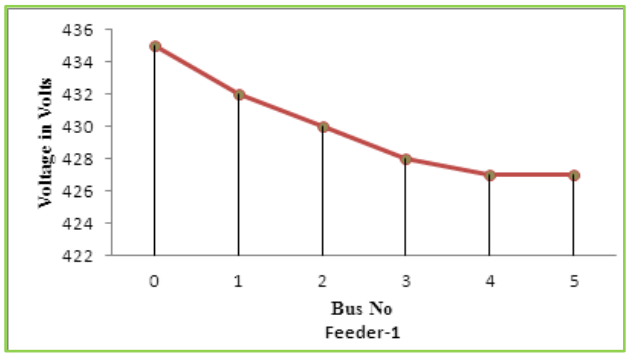

Fig.3:Bus voltage output in feeder-1

Initially we can see in the feeder-1 that at a bus no.-1 the voltage is 435 and at bus no.-5 ,it is 435V.It is similar in feeder -2 , that at bus no.-6, voltage is 430 and at bus no.-23, it is 380V.

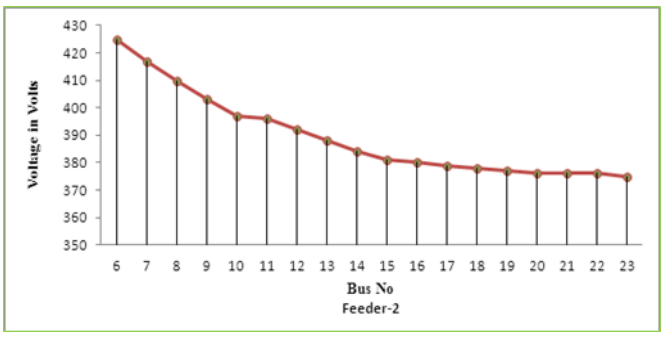

Fig.4: Bus voltage in feeder-2

The fig.4 shows the graph of voltage dropdown in feeder-2,The voltage at different bus is given of the existing system feeder-2. The voltage at bus no-6 is 425V and at the last bus i.e. 23, it is only 375V. so it is analyzed that as the load is increasing at the bus, the voltage drop down at each bus is increasing and this lead to large voltage variation in the feeder.This is the major problem of this existing system.

IV. PROPOSED MICROGRID

Our team is already working in energy audit, We are always going to take a survey in a domestic area. Once our team found that as the load is increasing on the bus, voltage is getting reduced. We analyzed the situation and found the problem with the existing system. We gave the idea of our concept to get rid of problem to people. We suggested the people to use the sustained micro-grid. Our team gave the expenditure of total investment and appreciated the concept. They are ready to accept out idea because it is saving of conventional sources of energy for our upcoming generation.

The issue of the existing system is removed by thepurposed system, in which solar, wind and diesel generator are used in the autonomous mode and renewable energy is used in an effective manner so that the load demand is fulfilled and also the economical problem that may occur due to diesel generator,will be reduced.

The output graph of this voltage v/s number of bus is shown in fig.3.T

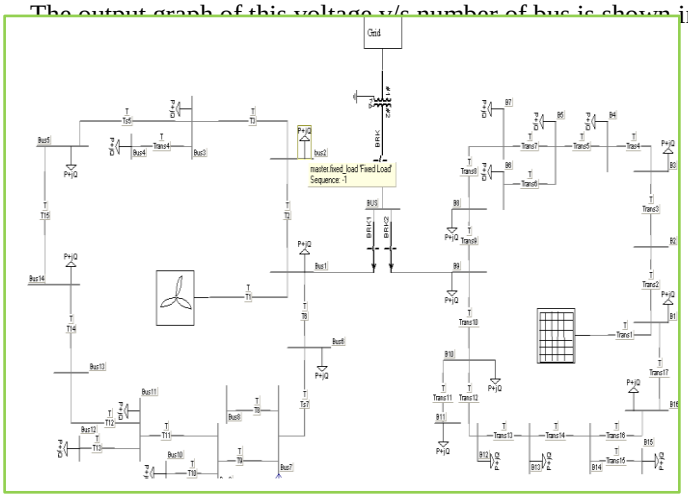

Fig.5: Proposed system simulation layout

Thesimulation shown in the fig.5 is a ring type distribution system.in which grid is connected to the solar and wind generation system. To switch the load from one feeder to another circuit breaker is used in the system. Separate circuit breaker is connected to each generation unit so that switching can be performed easily. With the help of this load sharing, the power of the grid is saved and it is also reducing the usage of convectional sources of energy by not affecting the society from any source of pollution. The different breaker are used in the system to switch the load from one network to another. Solar, wind and diesel generator system are used in the proposed system in which solar and wind play a vital role to supply the load. In the night, the solar energy system fails to supply to the grid then we will share the load with wind energy system. Suppose due to sudden atmospheric changes both solar and wind power system stop working then we will

use the diesel generator and power grid supply to fulfill the load. Diesel generator is used only in the emergency case not for regular use. The three phase system with equal voltage and frequency are used with every power generation system so

that at any time any feeder can be switched with any power generation system.

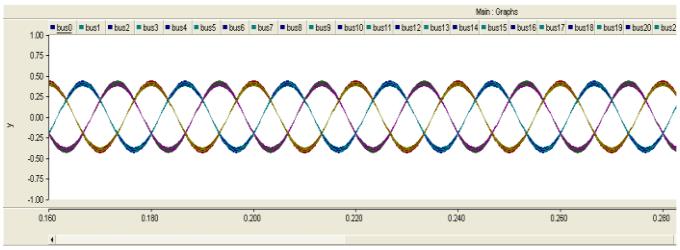

Fig.6: Output of proposed system

In the figure 6, the output of proposed system is given, in which it is shown that at every bus the voltage is same. There is very less reduction in voltage between the first and last bus.

A.*WIND MODELING*

The modeling of wind power system consists of wind source, wind turbine, wind governor, synchronous generator. A figure 7 is statesthemodeling of wind system in an effective manner without causing any pollution to the society. The default speed of the wind in the system is 13m/s.The wind power system is effective system for some area like hilly and coastal area because there wind speed is always optimal to generate power.

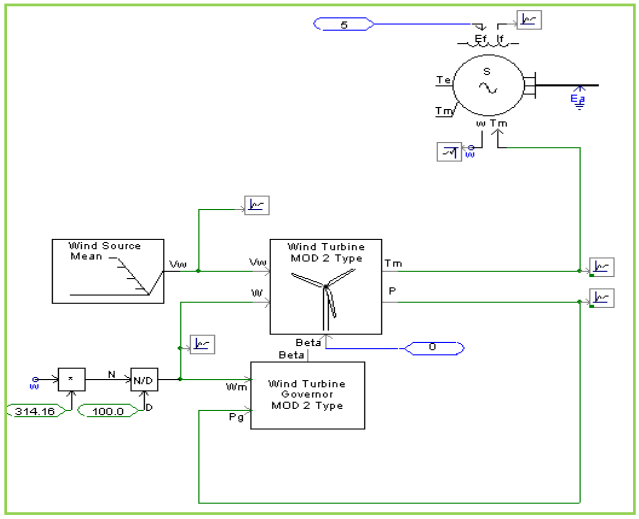

Fig.7: Simulation of wind model

The simulation of wind power is shown in fig.7, in which all the major component of wind power system is connected to get the correct output.

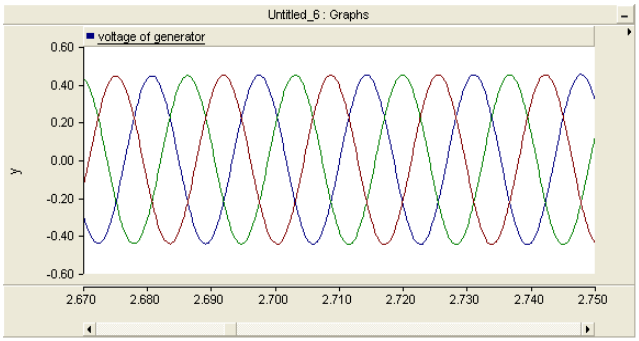

Fig.8: Output of wind power system

A graphical layout is presented in the fig.8,In which the voltage of the generator is given which is in constant mode and there is voltage fluctuation in this model so it is useful to get the desired output

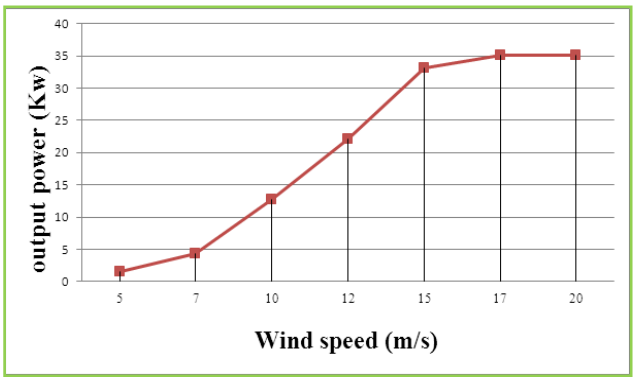

Fig.9: Wind speed v/s Output power

The fig.9 states the wind speed and output power graph, in which initially the output is rising as we are increasing the speed but after some time the 20 m/s the output power remain same.

B.SOLAR MODELLING

In the solar model, we are using the PV cell to trap the solar radiation.A PV module is made up of so many solar cells connected in series as well as parallel to get the desired output voltage and current. This MG will be used in the day only because the sunlight will be available in daytime only.

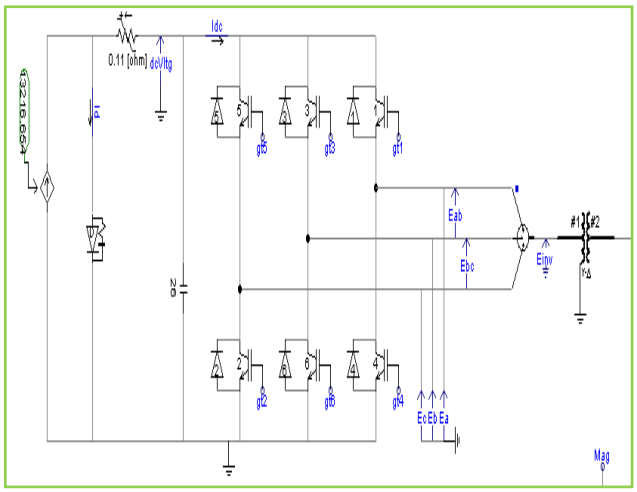

Fig.10: solar model

In the fig.10, the solar model is shown in which, the entire component is connected for converting the output of PV cell.The output of PV cell is DC current. We need the AC current so we need the inverter circuit to change the DC voltage in AC. The above circuit is inverter circuit in which the DC is considered as input and AC is output.

C.DIESEL GENRATOR MODELLING

A diesel generator model consists of an internal combustion (IC) engine and then it is coupled to a synchronous generator.The IC engine is connected with a governor for controlling the output speed of the rotor.

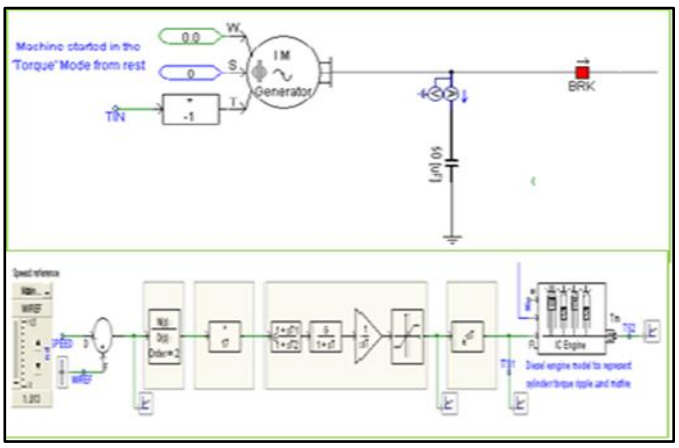

Fig.11: Diesel generator model

In the fig.11, the simulating model is shown in the figure with all the component of diesel generator set. The internal combustion engine is used to decompose the fuel into another energy which is used by the machine.

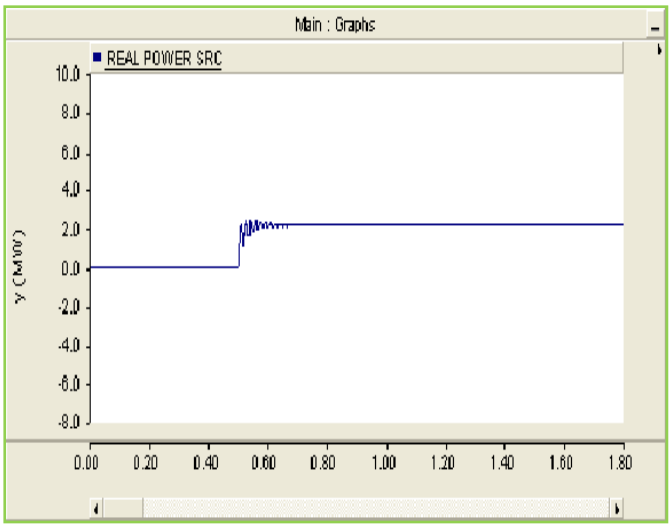

Fig.12:Real output power of diesel generator

The fig.12 shows the real output power of diesel generator. We can see in the graph itself that as the generator get started once it produces power it is constant.

V. CASE STUDY RESULT

The main objective of this simulation is to give the case study analysis of microgrid operation in different mode as well as load. In the PSCAD simulation software we are analysing the distribution system with the different types of operation of microgrid.

Inthe PSCAD software, we are simulating the structure of existing system into our proposed system. In which we are using the solar and wind as a renewable energy and diesel generator as non-renewable energy. We are giving the AC source of 440 V as a utility grid which will be used when the renewable source of energy system are not working due to some atmospheric condition. In the simulation case study the speed of wind turbine is 13m/s.

A. . The Steady State

In the steady state all the system is working perfectly, but due to heavy load connected to each bus the voltage is reducing. In the graph we can see that at the stating bus no-1 voltage is 435V and as we are going to the last bus the voltage is reducing.We can clearly see in the graph that when we are reconstructing our existing layout into micro-grid and then if we install MGs in different feeder then the voltage drop problem will not come.

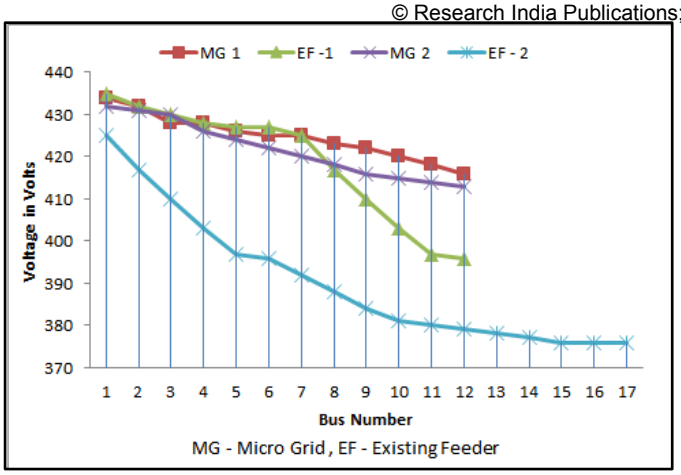

Fig.13:Comparison between various system

.The comparison of various power system with their voltage drop is shown in fig.13. The MG1 and Mg2 are using renewable sources and this proposed system. EF1 and EF2 are using conventional sources and this is existing system..

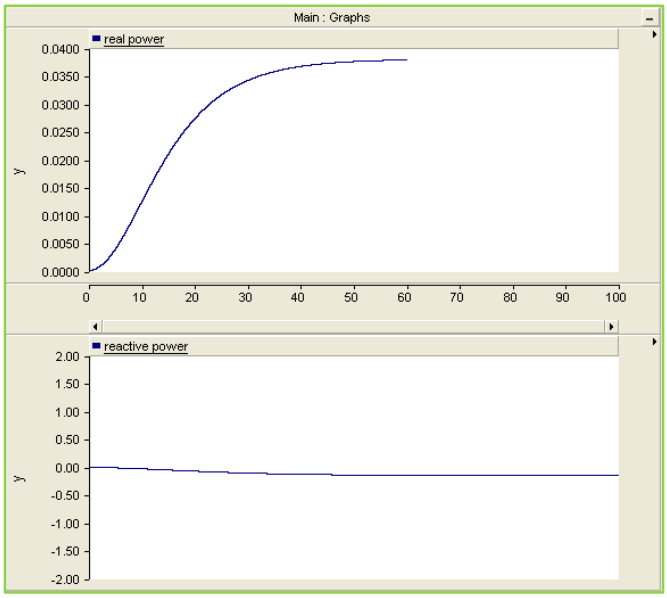

Fig.14: Real & Reactive power of wind system

In the fig.14,The real power and reactive power of wind turbine is shown. Real power controls the frequency of the system and reactive power controls the voltage of the system

B.*Sharing of power among the MGs.*

In this case study, we will analyze the sharing of load of one feeder to another feeder. Initially all the load is connected to their respective MG in the daytime.Solar and wind energy system is working perfectly in daytime because of proper availability of sunlight and wind speed. In the night time the sunlight is not their so the load of feeder- 1 and feeder-2 will be fulfilled by wind energy system.

Layout of power sharing among the two power system

As we will connect the load of another feeder to the windsystem the voltage fluctuation may occur. The sharing of load will be done with the help of control circuit. The proposed layout will elaborate the power sharing.

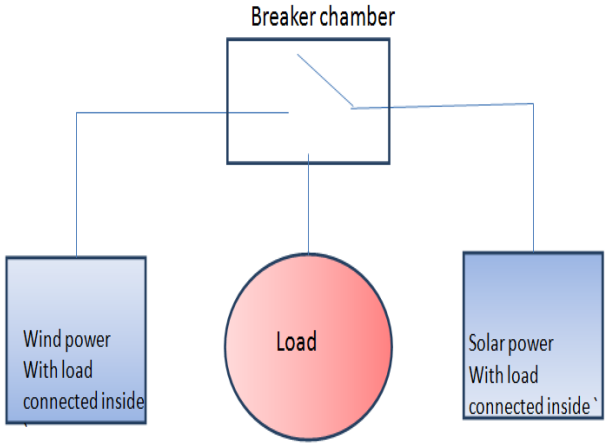

Fig.15: The pscad simulation of the power circuit is given below.

In the simulation, two different feeder working with their own MGs but both are connected among themselves with the help of circuit breaker. Circuit breaker plays important role in the power sharing.

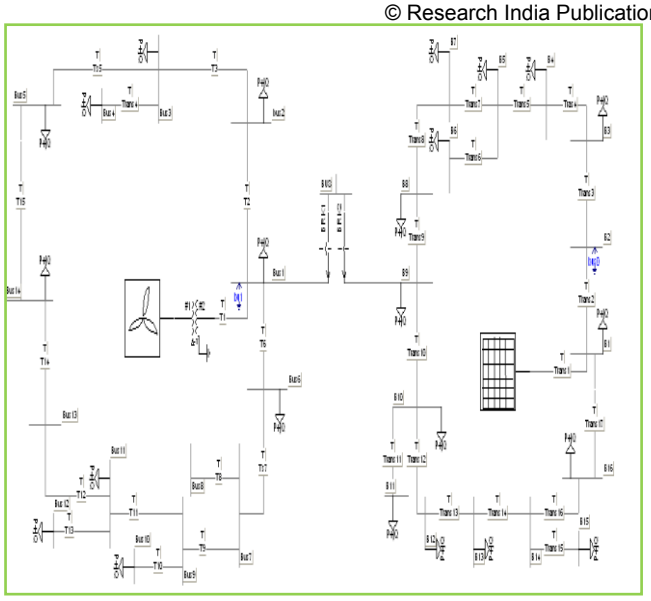

Fig.16: Sharing of power from MG2 to MG1.

In the Fig. we can see that when feeder-1 and feeder-2 is connected with only one MG, i.e wind power system then the voltage drop is happening at large extent. Due to which the system is not stable and so we are using the diesel generator to share the load of feeder-2.diesel generator willbe used only in emergency case only.

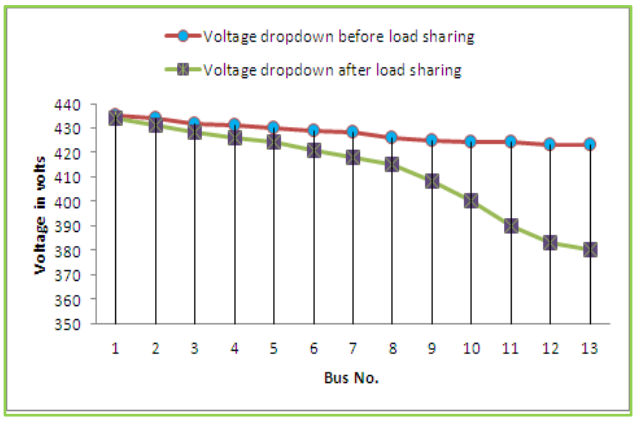

Fig.17: Voltage dropdown after load sharing.

In the fig.17, when the MG1 is connected to MG2, there is lot of voltage variation and large voltage is reducing. Due to which the system is not stable and getting the shutdown issue of feeder. To overcome this issue we are sharing the load with Diesel generator also. Diesel generator will be used in the emergency case only, if the neighbor wind power system is completely going to shutdown.

C.When the domestic load decreases in the feeder.

Suppose there are 10 customers going outside for summer vacation. In this case the load of 10 domestic house load will be cut so the total load on the feeder will decrease approximately 10 KW. Then the voltage level in the feeder will raise and the another thing is the amount of reduction of voltage from starting bus to last bus will also reduce. All these thing is happening because at each bus according to load the voltage drop occur.

The voltage level is decreasing but it is very less decrement because of reduction of load in the feeder.

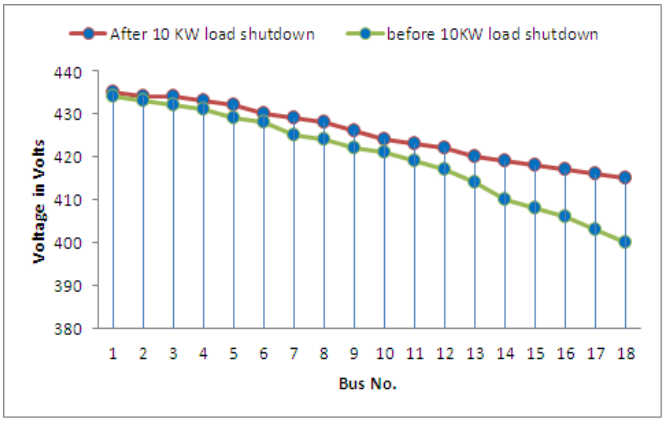

Fig.18: voltage rise after disconnecting the 10KW load.

As the 10KW load is disconnected through the feeder the rise in voltage is shown in the fig.19. there is a some change in voltage level at each bus, that is shown in the above graph.

VI. CONCLUSION

A restructure micro-grid simulation model was developed in PSCAD software. The MGs consists of all the fundamental component of power system. The main contribution of this paper is to save the energy for the future society through DG initiative. The groups of case studies are conducted for the proposed system performance. It is observed that the proposed system will able to manage the loads even in the failure of solar and any sudden change in loads. The limitation is that there will be a small drop in bus voltage. The proposed system will be recommended to customers for implementation.

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