Importance of microgrid in the current scenario and its Islanding

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Abstract - *As we know that development is taking place all around the world with great pace due to which demand for electricity has increased enormously and it will continue to increase more and more in the time to come. As a matter of fact in the time to come the importance of microgrid either connected with non conventional or conventional sources is going to increase. Microgrid can play a vital role in future electricity transmission. Microgrid alone cannot fulfil the requirement its proper functioning is also required, which means that we would be able to connect or disconnect it to the main grid whenever required. Proper islanding in proper time is required to increase the reliability of the system as a whole. In this paper, the importance of microgrid connected to the main grid and the importance of islanding in proper time is analyzed during the fault in the main grid in the ETAP environment.*

Key Words: **DER, MG,WTG,PV,HTG**

1.INTRODUCTION

Today the three phase AC power system is mostly used because we can transform the power from one voltage level to another also in it we can supply the power to large distances. Not only this but we can also transmit the power at higher efficiency and also at relatively lower cost as compared to other systems of transmission. But now the electrical industry is going through major change because of non conventional sources are linked to the distribution systems. It has become possible because of the huge availability of power conversion devices and increased in the efficiency of their performance. Because of this whole electrical industry has been becoming more environment friendly [1]. Due to tremendous increase in demand of electricity and to maintain continuity of supply in important regions or for important applications such as railways, hospitals, airports etc it has become necessary to connect the main grid with microgrid containing renewable energy sources so that in the event of failure of the main grid or some fault in the main grid, the microgrid is able to maintain the continuity of supply. So that the whole system remains stable. World has already seen some major black outs that have occurred in the past. All these blackouts are mainly due to the failure of the main grid. For example when a fault occurs in the main grid its voltage and frequency collapses due to which the major portion of the load lost its supply. In these events the control actions such as OLTC (on-load tap changer) changing, capacitor banks switching and load shedding are significant actions to be taken to stabilize the voltage and frequency.The condition becomes worst when the microgrid is also connected to the main grid in this situation. So proper islanding of microgrid is required if this condition persists in the main grid to stabilize the voltage and frequency of the system. Therefore islanding becomes one of the most important tool in this situation. Necessary actions should be taken and guidelines should be made to prevent the extreme conditions so that continuity of supply is maintained and the voltage and frequency of the whole system remains stable [2]. A minute system which is located near the consumer containing energy resources is called Microgrid. If a microgrid contains several energy sources then it is called Hybrid Micro Grid and it can be operated in islanded as well as in the grid connected mode. Turbo Units, Hydro Units, Biogas Plants , wind, diesel-generation, solar power generation are the various energy sources in the Microgrid. They can be used to supply electricity to the areas which are very far away where there is no access to the main grid. The designing and installation of micro grid is to be done in a proper way so that its operation and maintenance can be easily done. Microgrid helps the main grid in reducing its congestion , also it helps in reducing the losses of the line thereby increasing the efficiency of the line. [3] - [5]. Due to environment concerns the major confront these days is the execution of nonconventional sources of energy into the existing systems. Microgrid with its operation in grid connected as well in islanded mode provides higher flexibility [6],[7]. To convene the more and more rising demand of electricity and to improve energy consumption efficiency, novel power generation technologies, including renewable energy, uncontaminated and efficient fossil fuels, distributed generations have been developed [7]. To lower the need of main grid which is heavily loaded and which has high voltage distribution system the concept of micro grid is deemed in shape. [8].

In this paper a microgrid linked to the main grid in ETAP environment is analyzed to show the importance of microgrid when a fault occurs in the main grid and also the importance of islanding microgrid in this condition.

2. Islanding

When a fault takes place in the particular region in the power system then it is required that by some mechanism it is not only detected immediately but also cleared from the system and if it not cleared then the region where the fault takes place must be cut off from rest of the system which is working normally.This method of isolating faulty part of the system from the rest of the system is called Islanding and the region which is cut off is called islanded region. Major fault in the power system needs to be detected properly and proper controlling should be done to maintain the quality of power and to minimize the after effects such as voltage and frequency disturbance.

Islanding system is generally designed on the basis of the condition of the main grid, point of connection of microgrid to the main grid, types and number of generators connected to the microgrid and many other parameters such as voltage,frequency of the main grid as well that of the microgrid.

Islanding basically helps in protecting the microgrid from any disturbance which has taken place in the main grid. Islanding is done not only to find the faulty condition in the main grid but also to disconnect the microgrid quickly from the main grid. Actually during the islanding the circuit breaker which is connected between the main grid and the microgrid is tripped. Islanding is done in two ways either it can be done intentionally or it can be done unintentionally. Whenever it is required to maintain the quality of power then it is done intentionally. But when maingrid develops some fault then unintentional islanding is done. Unintentional islanding becomes important when we have to deal with the stability issue of the whole system that is to maintain the stability of the system and also protects the people who are working in that system. It also helps in protection of the various equipments which are connected in the system. Unintentional Islanding detection methods are basically of two types local method and remote method .When we continuously measure different parameters of distributed generation such as frequency and voltage then it is called Local method While in remote method the contact between different utilities and load is considered. We can rely more on remote method as compared to local method but its only disadvantage is that its cost is very high.

3.MICROGRID UNDER CONSIDERATION

In this paper a microgrid is considered which is connected to the main grid is designed containing renewable as well as non renewable energy sources. This microgrid is analyzed in ETAP environment to show how important is to connect the microgrid to the main grid for increasing the system stability and reliability. The importance of islanding has also been shown when a fault takes place in the main grid. Figure 1 shows a single line diagram of the main grid and the microgrid. This microgrid is of hybrid type consists of sources of solar power generation, wind power generation and hydropower generation as shown in the above figure-1. The main grid is connected to the microgrid with the middle circuit breaker linking the microgrid with the main grid. Now when the three phase fault takes place in the main grid then voltage falls down severely. So by the process of islanding this microgrid has to be disconnected from the main grid. The model under consideration contains in total 13 buses, 17 circuit breakers, and cables. Three generating units consisting of hydro turbine generator (HTG), wind turbine generator (WTG) and photovoltaic cell

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(PV) rated 0.75 each at 480 V are the sources of supply in the microgrid. Transformer-1 and transformer-2 which are grid transformers are step down transformers which steps down the voltage from from 115kV to 12.47 kV and then from 12.4 kV to 480 V. At bus no. 9 a capacitor bank of rating 400 KVAR rating is connected to the microgrid. There are two types of loads that are connected in this microgrid one is static load(load 1 and load 2) of 0.55-MVA and the other is induction motor load(three induction motor loads) of rating 200 HP.

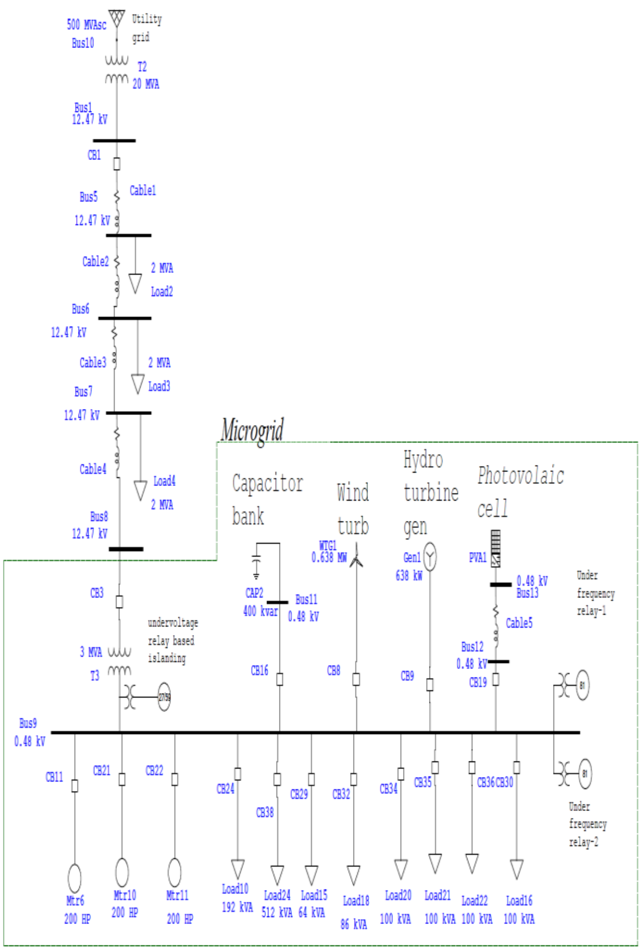

Figure-1 ETAP Model of Microgrid

4. Design

To prevent the voltage collapse in the microgrid due to the fault, under voltage and under frequency relay based islanding is employed. Relay logic for islanding is shown in Figure-2

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(i) Voltage relay protection

Here voltage relay (27/59) is used. Under voltage relay (27) is used which can detect fall in voltage and do the parting of this microgrid and the main grid. This relay monitors the unbalance during the fault condition between the reactive power produced and the reactive power consumed. The relay (59) is an overvoltage relay and operates during the overvoltage condition.

(ii) Frequency relay protection

An under/over frequency relay (81 H/L) takes its decision based on the frequency of the system.

Recommended relay settings for islanding:

Islanding has been done as follows: When the voltage is less than 88% of its rated, value then voltage relay sense this condition and trips the central circuit breaker , with time delay of 0.3 seconds. For frequency relay, doorsill rate of frequency is considered between 59.3Hz and 60.5Hz with time wait of 0.2 seconds.

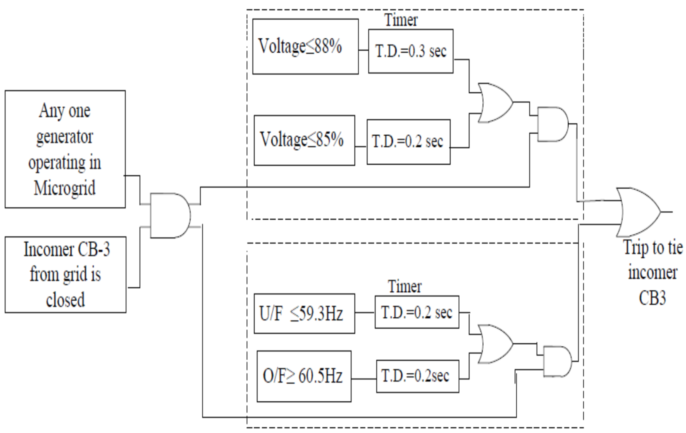

Figure-2 Setting of voltage and frequency relay

5. Combination of resources and their simulation in ETAP

One condition has been considered to achieve the desired result. In this condition all the resources are kept on for feeding the load such as the main grid, hydroturbine generator,wind turbine generator, PV source connected to microgrid and also the capaciator bank is kept on. A fault is created at 0.5 seconds of the utility grid or the main grid. In this condition the transient stability analysis of the proposed model in the ETAP is done. On doing the transient stability analysis the frequency as well as voltage of the microgrid before and after islanding process are compared.

1)Frequency

Before Islanding

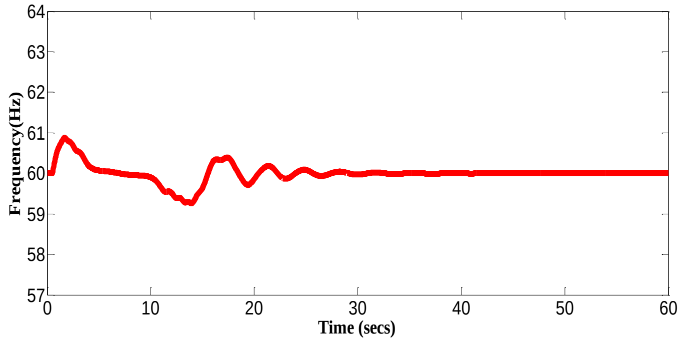

Figure-3 Frequency of microgrid before Islanding

2) After Islanding

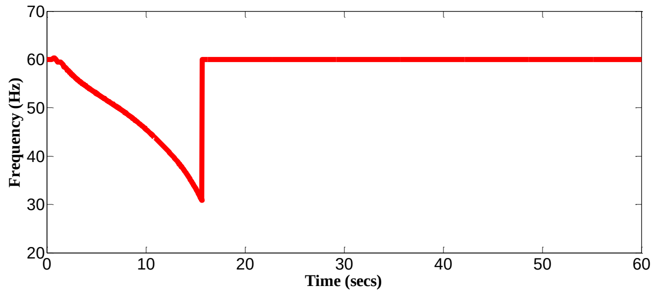

Figure-4 Frequency of microgrid after Islanding

Similarly the voltage before and after islanding has been analyzed.

1) Voltage

Before islanding

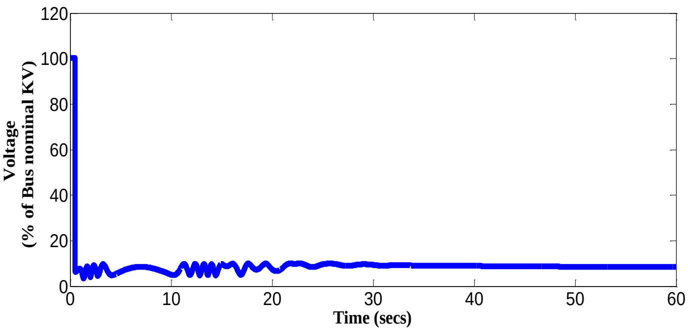

Figure-5 Voltage of microgrid before Islanding

After Islanding

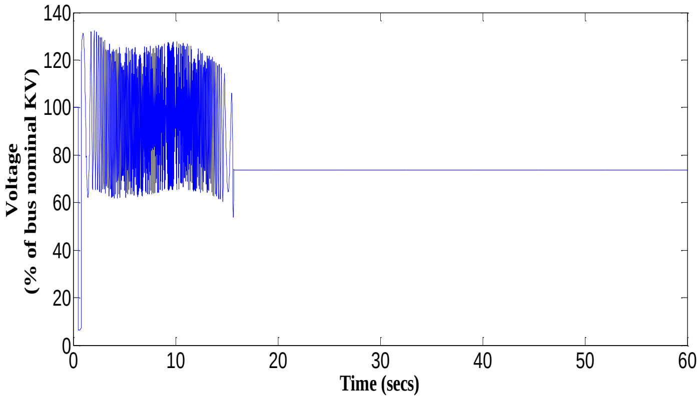

Figure-6 Voltage of microgrid after Islanding

Implications from the above results:

From the above results of voltage and frequency analysis it has been seen that the frequency before islanding settles to a constant value after nearly 32 secs as evident from the figure-3 and just after islanding it stabilizes in just 16 seconds as shown in the figure-4.Therefore time required for settling of frequency after islanding has been almost reduced to half in this condition. This shows how properly designed islanding technique helps in improving the stability of the system faster.

Also it has been shown that before islanding due to fault voltage drops suddenly as shown in figure-5 and after islanding it has been recovered to 70% of the rated value in nearly 16 seconds as shown in the figure-6.This particular voltage recovery after islanding shows that why properly designed islanding scheme is necessary to isolate the hybrid microgrid from the main grid in case of fault in the main grid.

Also above results show that if there is no hybrid microgrid connected to the main grid and if a fault occurs in the main grid then contuinity of supply could not be maintained and the whole load has to be cut off and the system becomes unreliable. But with the microgrid connected to the system not only we are able to maintain the continuity of supply but also we are able to make our system more reliable.

6. CONCLUSION

The above paper has shown that with continuously increasing demand of electricity we cannot rely only on main grid but we need distributed energy sources such as PV solar generation, Wind turbine generation etc. to be connected to the main grid with the help of microgrid to increase the stability as well the reliability of the whole power system. Secondly it has been concluded that proper islanding scheme is required to island the microgrid from the main grid when a fault takes place in the main grid. Also it has been shown that to maintain continuity of supply and to make the system more reliable islanding has to be considered as an integral and important part of the power system.

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