Smart Grid and Micro Grid: A Reliable Combination of Power System Network

Neha Kakkar[1], Mrs. Shuchi Shukla[2]

[1]Research Scholar, Department of EE, RCERT, Jaipur
[2]HOD, Department of EE, RCERT, Jaipur

Abstract— *Demand of electricity is rising day by day and by virtue of same the power system leads to use of renewable source of energies just because of limited sources of conventional energy. As migrating toward non conventional energy sources one the first end it solve a major issue by providing us a huge amount of energy which is not going to consume with respect to time or raw material. On the other hand it also produces some instability in our power system. As sun do not rise with same intensity throughout the year and wind's flow is also independent of time and session. Still they can somehow count as per segments but it leads to a huge uncertainty. So it is required to co-ordinate these devices and to form a Smart Grid. While talking about smart grid a concept of energy storage strikes in mind. For storage of energy there are a lot of devices are available in power system market. These devices are used as per their requirements. These devices (like Battery, super capacitor) have their own charging and discharging characteristics. So it's required to create a micro grid by co-coordinating them all together. Both smart grid and micro grids have their own significance but due to rising unstably in power system it is required to add a smart and micro grid to design a reliable system. This approach will require a division of micro grid is to be dividing in some segments so that it can by utilized more efficiently. In this paper we will be presenting a combination of a smart and micro grid to create a reliable and efficient network for modern power system.*

Keywords— Smart Grid, Micro Grid, Power system Networks.

I. INTRODUCTION

Since the evolution of light, electricity was the point of attraction for humans. They always tried to improve production and efficiency. Along with same electricity is also played a key role in various (approx all) modernization processes. But about a few decayed ago about total amount of electricity was produced by using conventional energy sources. With the increasing demand of energy scientist gather an attention toward non conventional energy sources (Renewable). As the demand of energy is always non - linear but increasing day by day, month by month. So use of renewable energy made it easier to operate able. Initially the operation was unidirectional which means from generation to consumer end but when renewable started acting it invented a concept of smart grid. In smart grid the power system have a two way communication from grid to consumer and back to grid as per requirement of consumer. A batter supply in power system network stand for a unintrepted and almost regulated power supply, which can be yield by using a reserve source of energy. A reserve source of energy again took a point toward the energy storage systems. In energy storage system there are two kinds of issues first one is the voltage sag or voltage amplitude disorder. Here we do need such a device which can charge sudden and discharge very quickly. For the same concern we have implemented a super capacitor as its rate of charging and discharging is up to an appreciable point. On the other hand the energy coming from renewable is not constant so a storage device is also required to overcome it. At this stage we do need a power back up which should be around 15% of total power. If reserve capacity is not perfect then load level is greater than generation level, this will upset the proper functioning domestic and industrial devices just because a sudden and measurable fall in line potential. In the depth of the paper we will be dealing with synchronizing all the available energy sources and for the same they are connected the DC-DC multilevel convertor through a one way bus. The micro grid will be fragmentized and the components will be places at various locations to get an uninterrupted and regulated power supply. At the end of network a light load is being placed to measure the network.

II. SMART GRID: AN OVERVIEW

The intermittency and uncertainty of solar and wind generation are major issues that must be pointed before the overall potential of these non conventional can be reached. Smart grid—A Development of electrical power networks toward greater reliance on computation, control and communications—promises a appreciable solution. The term gained prominence through Security Act (EISA) of 2007 and U.S. Energy Independence, the European Technology Platform for the Electrical power Networks of the Future, and all other similar initiatives across various other countries.

The Advantages of smart grids are as follows. They:

- Allow consumers to be a part in optimizing the operation of power system
- Better facilitate the operation and connection of generators of almost all sizes and technologies
- Provide consumers options for choice of supply with greater information
- Improve and maintain the existing high levels of system security, Quality and reliability
- Effectively reduce the environmental impact of whole electricity supply system network
- Improve and maintain the existing services significantly

III. ENERGY STORAGE SYSTEM

Electrical Energy Storage (ESS) is one of the major technologies in the areas covered power system network. EES techniques have unique capabilities in coping with many critical characteristics of power system, e.g. periodic variations in price and demand. At very First, EES reduces electricity prices by storing electricity available at off-peak times of day, when it's cost is lower, for feeding usable amount of electricity at peak times instead of electricity that is to be bought at higher costs. On the other hand, in order to improve the reliability and stability of the power supply, the EES systems support consumers when electrical power network failures take place due to natural disasters, e.g. their third role is to improve and maintain power quality, potential and frequency. Regarding growing market needs, in on-grid areas, Energy storage systems is expected to solve issues – such as undependable power supply and excessive power fluctuation – which are associated with use of huge amounts of non conventional energy. In off grid domain, electric vehicles are the most promising technology to change conventional sources of electricity by renewable sources

IV. DC-DC MULTILEVEL CONVERTER

In order to adapt the output potential of the energy storage/ supplies systems to the medium voltage, boosting of DC voltage is essential. For high voltage step-up ratios this important task is usually performed by DC-DC converters which are based on galvanically type isolated transformers. Where, in case of lower step-ratios, generally given in the considered applications, and if the galvanic isolation is not essential, a much higher power density and efficiency can be achieved by using non-isolated boost converters. As with the backup energy storage systems, multilevel boost converter concepts generally enable to use rapid semiconductor devices.

V. SIMULATION AND MODELING

In modeling part we have modeled a system of grid connected solar and wind power plant the modeling is done by using matlab 2013a. The block diagram of system is displayed below. The whole system is been divided in some segments like source (solar, wind and grid) , ESS (Type A) which has high rate of charging and discharging like super capacitors, DC-DC multilevel converter (to synchronize all source with a certain frequency), ESS(Type B) like battery to feed backup , Consumer Load.

As renewable sources are variable in nature and they vary with respect to time so a high charge and discharge rate storage unit can do the solutions for same. In Above model we have used super capacitors for this purpose. Fig 2 shows the input of renewable (solar and wind) without ESS and fig 3 displays the output after ESS

After filtration of ESS one DC-DC multi level convertor synchronize all three sources which make lower dependency of individual failures if any of source fails for a short duration then ESS one ad Multi level convertor compensate it well.

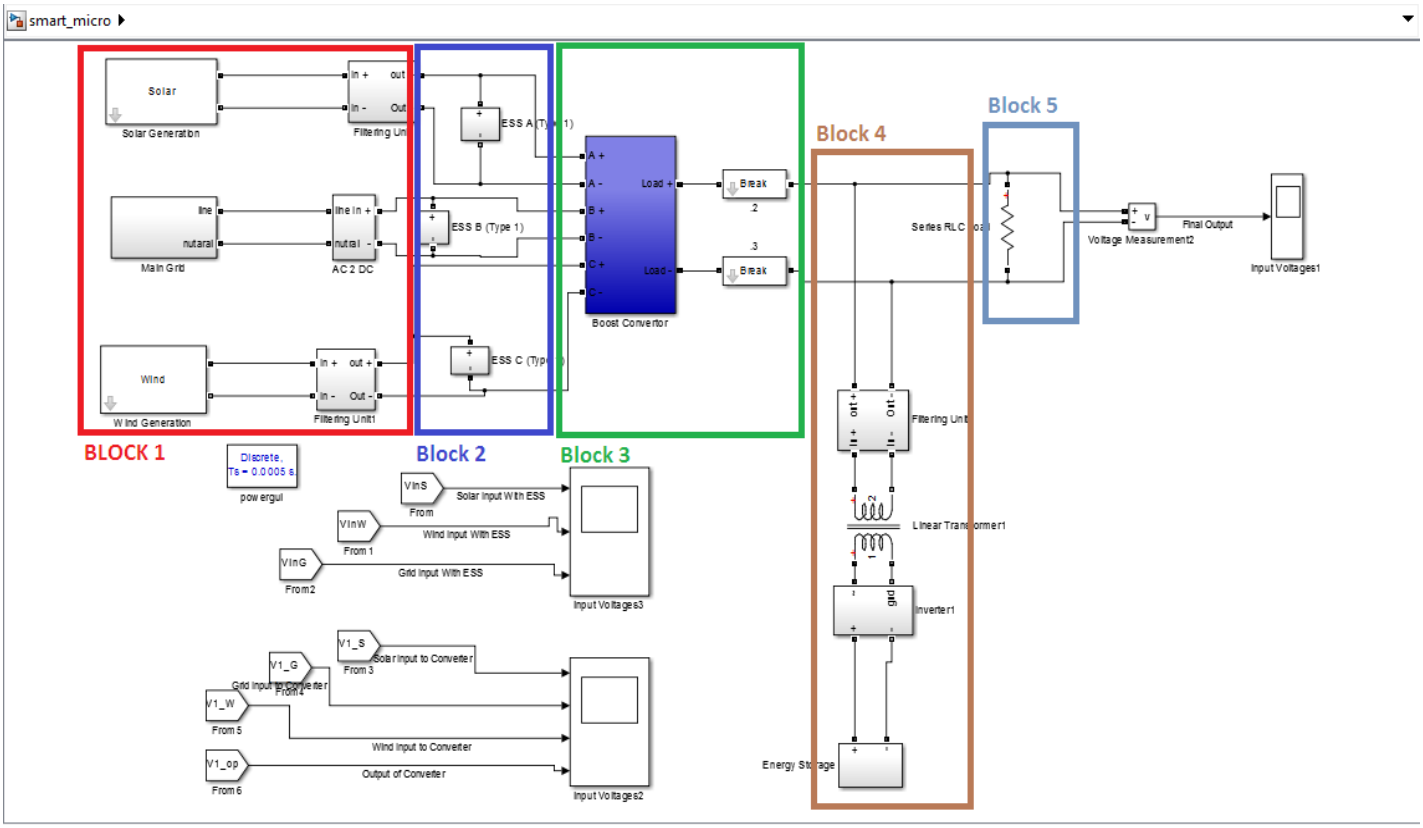

FIGURE 1 : MAIN SIMULINK MODEL WITH BLOCK NOTATION

Here our type one ESS filters the variation in generations of our Non conventional energy sources.

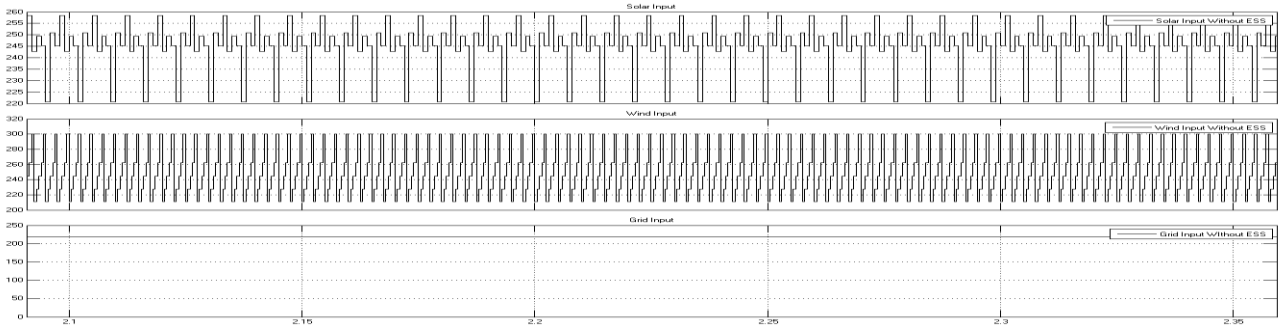

FIG 2 INPUT WITHOUT ESS TYPE 1

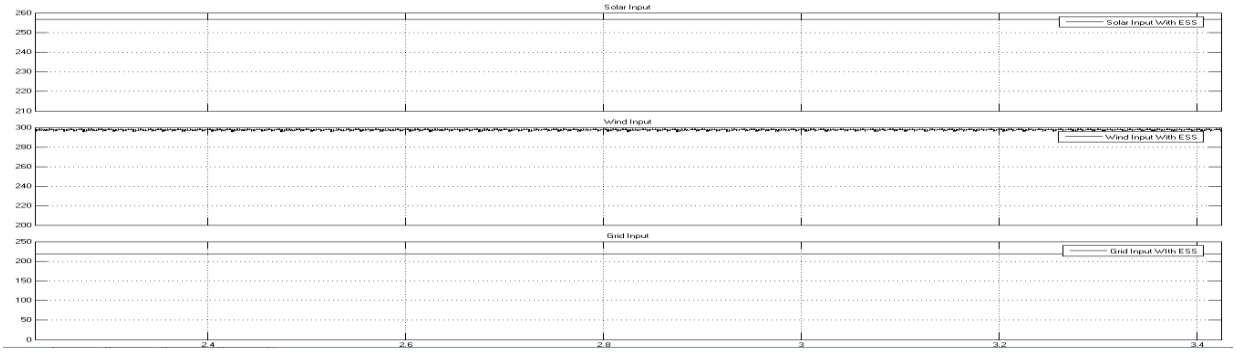

FIG 3 : OUTPUT WITH ESS

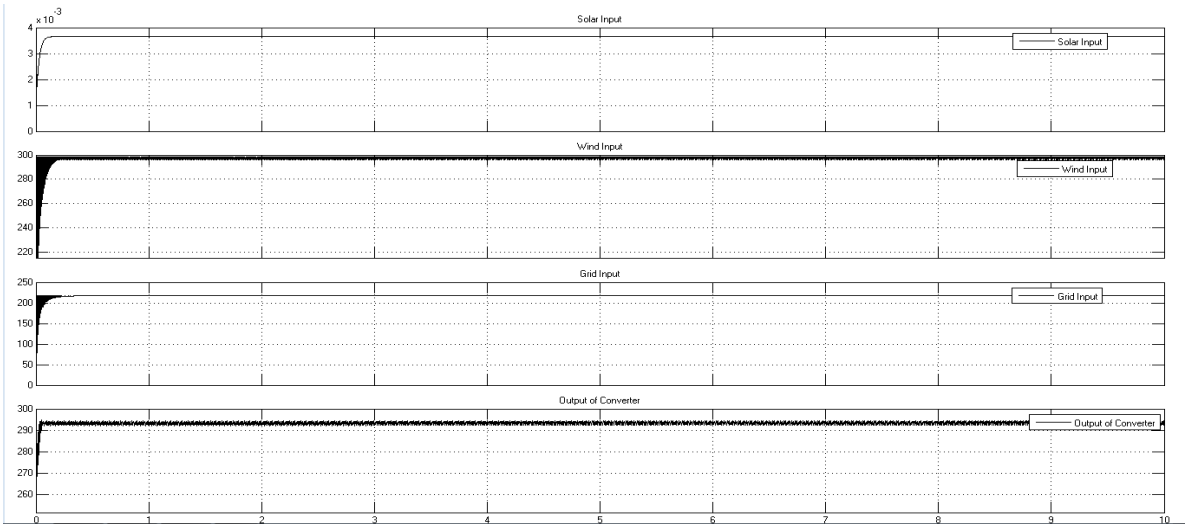

FIG: 4 WHEN SOLAR IS NOT FEEDING POWER

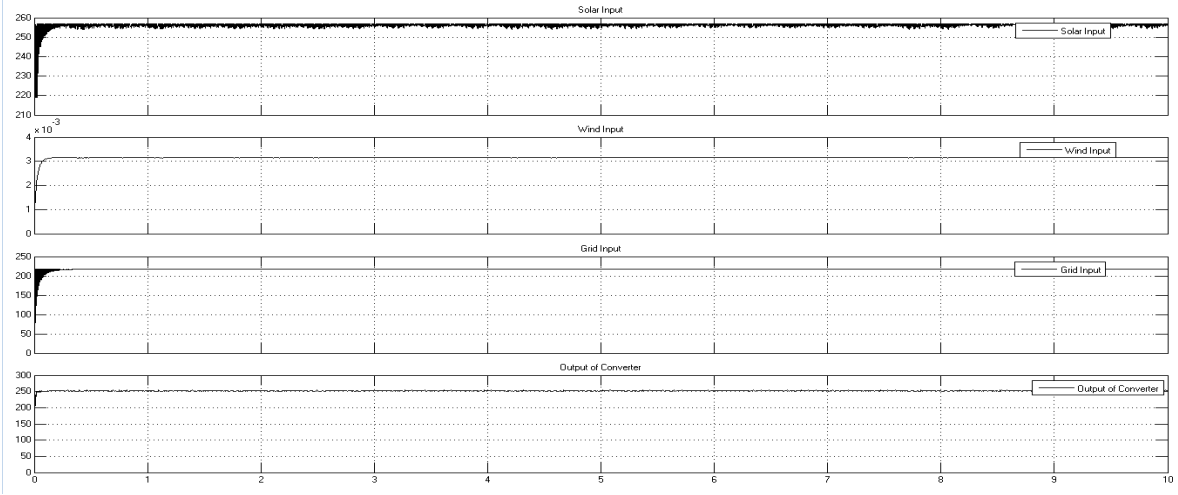

FIG: 5 WHEN WIND IS NOT FEEDING POWER

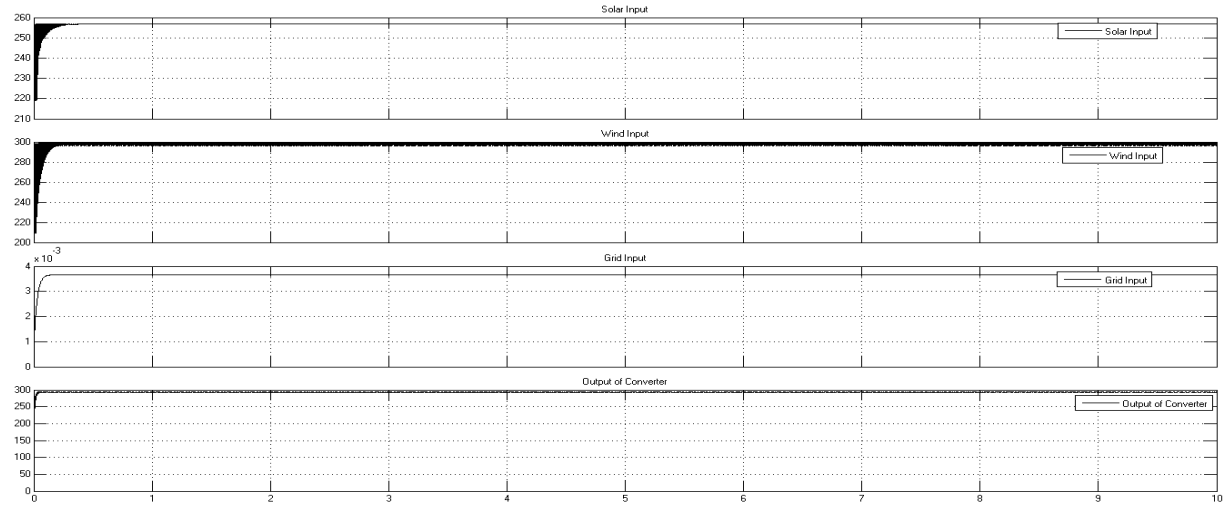

FIG: 6 WHEN MAIN GRID IS NOT FEEDING POWER

As the output of system is somehow independent of all the miner failures for short duration of time in today's era the demand of power is quite high which leads to unreliable power system network. The fault can occur at any stage of electrical power system. So always a back up protection is kept. Another ESS with a good storage capability is use to feed the load at the moment of main failure.

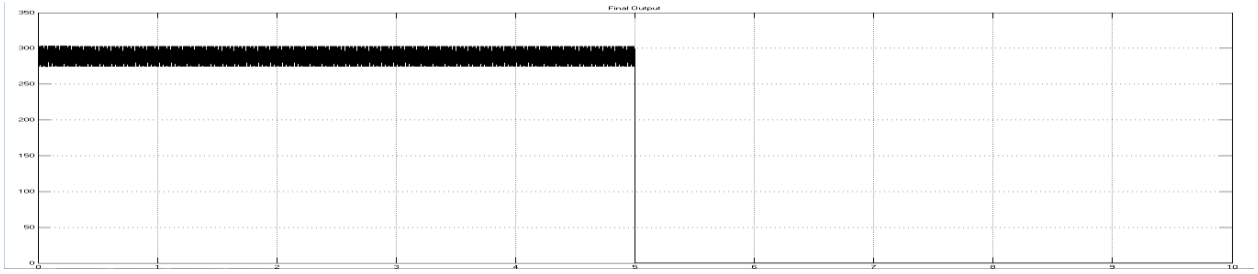

FIG: 7 SYSTEM FAILURE WITHOUT ESS

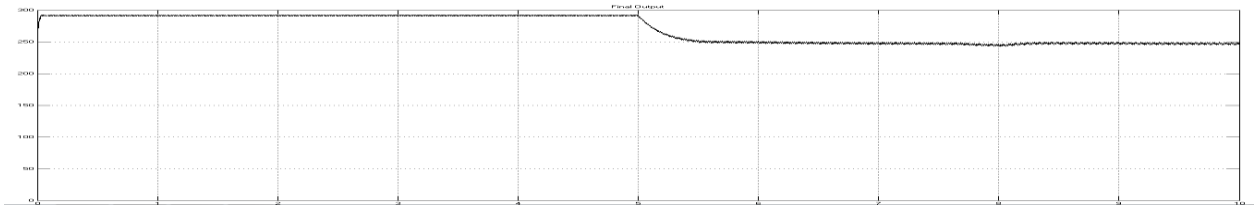

FIG: 8 SYSTEM FAILURE WITH ESS

VI. RESULTS AND FUTURE SCOPE

The above system describe a basic implementation of coordination in between smart grid and micro grid which provide an ability to our power system that it can face the miner upset of power system network. Here the system is faced various issues like failure of independent grid sources (solar wind and main grid), and failure of whole system (all three systems) but provided an uninterrupted supply to network. The system still has some issues regarding harmonics which can be solved after perfect implementation of same.

REFERENCES

[1] Rosas-Caro, J.C. Ramirez, J.M. ; Peng, Valderrabano, A DC-DC multilevel boost converter, Power Electronics, IET ,Volume:3 Issue:1

[2] Paul Denholm, Erik Ela, Brendan Kirby, and Michael Milligan The Role of Energy Storage with Renewable Electricity Generation, NREL, January 2010

[3] Eduardo F. Camacho, Tariq Samad, Mario Garcia-Sanz, and Ian Hiskens Control for Renewable Energy and Smart Grids, The Impact of Control Technology,2011

[4] G. Butti and J. Biela Novel High Efficiency Multilevel DC-DC Boost Converter Topologies and Modulation Strategies, Power Electronics, IET ,Volume:3 Issue:1

[5] J. C. Mayo-Maldonado, R. Salas-Cabrera, H. Cisneros-Villegas, M. Gomez-Garcia, E. N. SalasCabrera, R. Castillo-Gutierrez and O. Ruiz-Martinez Modeling and Control of a DC-DC Multilevel Boost Converter, Proceedings of the World Congress on Engineering and Computer Science 2010 Vol II