OPTIMIZATION OF RURAL ELECTRI SUPPLY SYSTEM THROUGH DISTRIBUTED ENERGY SOURCES

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Abstract—

Rural distribution feeders are characterized by low voltage, low efficiency, non optimized distribution of electric power, and become burden for utilities hence suffers with least priority in operation and maintenance issues. In most of the remote and non electrified sites, extension of utility grid lines experiences high capital investment, high lead time, low load factor, poor voltage regulation and frequent power supply interruptions. Hence, a convenient, cost-effective and reliable power supply is an essential factor in the development of any rural area. To overcome all the disadvantages possessed by the conventional method of electricity generation and transmission to rural electric grid, distributed energy generation locally is being preferred and promoted.

This report presents design and implementation of small solar wind hybrid system which can feed a rural load without any interruption. It focuses on three areas:

1. The present condition of the distribution system in rural areas.

2. The upgrades needed to deliver good quality power, particularly in rural networks, with the least technical and nontechnical losses.

3. The introduction of new technology needed for to enhance electric power distribution reliability.

Key words: 1.Rural electric supply,2. Solar PV- Wind hybrid system,

I. INTRODUCTION: RURAL ELECTRIC SYSTEM.

Although electrification commenced some one hundred years ago, currently still about 40% of the world's population especially in rural areas have neither access to electricity, nor to sufficient other non-traditional energy forms. The conditions necessary to satisfy basic needs and to promote economic and social development cannot be fulfilled. The lack of access to a reliable energy source is a major impediment to sustainable development in developing countries and to the harmonious progress of the global society.

Rural distribution feeders are characterized by low voltage, low efficiency, non optimized distribution of electric power, and become burden for utilities hence suffers with least priority in operation and maintenance issues. It is estimated that the cost to install and service the distribution lines are considerably high for remote rural areas. Also there will be a substantial increase in transmission line losses in addition to poor power supply reliability. In most of the remote and non electrified sites, extension of utility grid lines experiences high capital investment, high lead time, low load factor, poor voltage regulation and frequent power supply interruptions. Hence, a convenient, cost-effective and reliable power supply is an essential factor in the development of any rural area.

About 35 per cent of the total power generated in India is consumed by over 70 per cent of the country's rural population [1]. India is predominantly agricultural country and has the highest number of electricity-run-motor-pump sets as compared to other countries in the world.

The ultimate goal of rural electrification is:

- To electrify the remaining 80000 villages in the country.
- To strive for better service in the villages already electrified.
- To provide continuous 24-hour electricity supply to villages and rural industry.
- To provide minimum 8-10 hour continuous reliable electricity supply for daily agriculture

through the agriculture load factor in any state will not exceed 15-20 percent.

- To provide electricity for all rural houses as nearly 70 percent of households in rural India, are still without electricity.
- To improve voltage profile and remove voltage fluctuations on the worst feeder.
- To bring efficiency in the use of electricity which is very low at present and is not more than 15 percent overall in rural India.
- To design low tariff for agriculture as high tariff in agriculture is not suitable

Concerted endeavour must be made to raise this consumption to 50 per cent of total generation, which can serve as good index of India's rural prosperity. According to available data, there are 5.87 lakh of un habituated villages in India of which 5.08 lakh (86.53%) had been electrified by March 2001, also fact remains that about 70 per cent of households in rural India still not electrified To fulfill this task utmost economy in design and development of renewable energy sources are required. In rural areas long scattered 11kV lines and heavy peaks with predominant agriculture loads lead to the usual problem of bad voltage regulation, low power factor, heavy distribution losses and lower load factor.

It is necessary to keep the cost of rural electrification low, so as to afford lower power tariff by establishing generating plants near load centres in rural areas. It is noted that rural and remote areas often have substantial renewable energy potential. New technologies effect at both the supply side and the demand side and there is reason to believe that current developments and trends in the power sector will have an effect on the way rural electricity supply is approached. It is also likely that the developments will not only influence new systems but also existing rural electricity supply schemes. For this, micro/mini hydel power plants should be established on hill streams and canal falls, which have an estimated potential of 10000 MW in the country, agro waste based mini thermal plants be set up. Considering the favourable factors of rural sector and potential of energy availability solar and wind hybrid farms are found to be economically viable and efficient. These hybrid systems cannot provide continuous source of energy as individuals, as they are seasonal. Therefore, suitable energy storage systems will be required for these systems in order to satisfy the power demands. Usually storage system is expensive and the size has to be reduced to a minimum possible for the renewable energy system to be cost effective. The cost effective solution would be hybrid power systems which can reduce energy storage requirements. For villages, where we can get abundant source of sun rays and wind blow, one can use a hybrid technique employing solar and wind energy. This can release the amount of requirement of the electricity from conventional sources to meet the demand. This report presents design and implementation of small solar –wind hybrid system which can feed a rural load without any interruption.

Section I described about characteristics existing electric power system and potential of renewable energy sources. Section II deals with potential of energy resources, and section briefs about system configuration.

II. RENEWABLE ENERGY SOURCES.

India is potentially one of the largest markets for solar energy in the world. The estimated potential of power generation through solar photovoltaic system is about 20 MW / Sq.km in India . The estimated potential of various renewable energy sources in India by IREDA is shown in table-I.

Table II: Renewable Energy potential in India [2]

S.No	Energy source	Potential
01	Solar	20MW/sq.km
02	Wind	20,000 MW
03	Small Hydro	10,000MW
04	Ocean Thermal	50,000MW
05	Tidal	10,000MW
06	Biogas	12 Million plants
07	Bagasse based cogeneration	3500MW
08	MSW	1000MW

The standalone solar photovoltaic energy system cannot provide reliable power during non-sunny days. The standalone wind system cannot meet the constant load demands due to significant fluctuations in the magnitude of wind speeds throughout the year. Therefore, energy storage systems will be required for each of these systems in order to satisfy the power demands. Usually storage System is expensive and the size has to be reduced to a minimum possible for the renewable energy system to be cost effective. Hybrid power systems can also be used to reduce energy

storage requirements. By integrating and optimizing the solar photovoltaic and wind systems, the reliability of the systems can be improved and the unit cost of power can be minimized. In India the Solar-Wind Hybrid power plants are technically approved by the Ministry of New and Renewable Energy (MNRE). These Solar / Wind Hybrid power plants generate electricity and can be an alternate source for the costly diesel generators which are run during the power cuts and also in locations where continuous EB supply is not available. The Returns on Investment (ROI) of these projects are very less and also with the Central Financial Assistance provided by the governments it is much faster. With these systems we can generate, store and use the power as and when required and also for rural electrification.

III. SYSTEM CONFIGURATION.

The block diagram and schematic of solar wind hybrid system is depicted in fig.1 and 2 respectively. Solar-Wind hybrid power plant consists of mainly the solar cells and an alternative for solar i.e. wind mills. The energy is being produced from the two with a combination. Further the energy is fed to the hybrid controller. The energy from the battery is fed to the load as per the requirement. The functional block diagram of solar-wind hybrid power plant is shown in fig.2

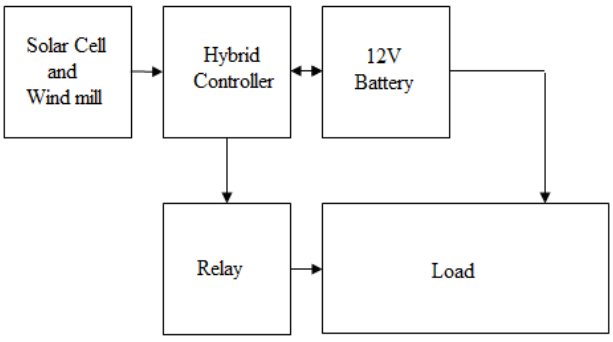

Fig.1 Functional block diagram of Solar-Wind Hybrid Power Plant

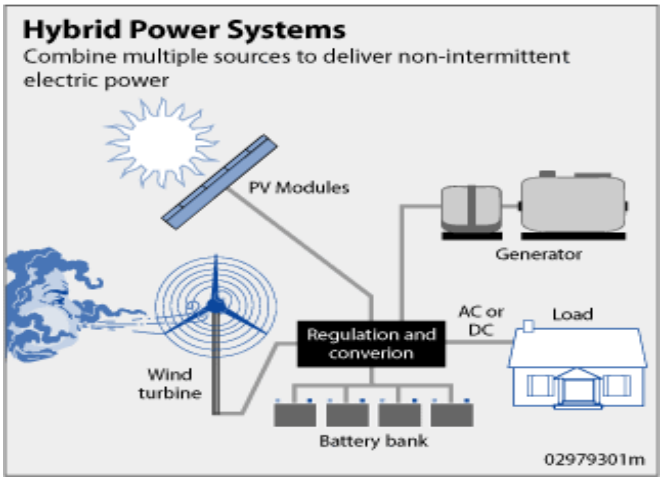

Fig.2. Schematic of solar wind hybrid system

A prototype model of hybrid controller is shown in fig.3. The hybrid controller consists of microcontroller ATMEGA8535, LCD display (+5 V (16X2)) and An IC ULN2803 for over current protection. The hybrid controller controls the amount of energy delivered to the 12V battery through the solar and wind energy. It is also connected to relay which gives alarm for over-current or overvoltage etc. The complete system configuration is depreciated in fig-3.

IV. CONCLUSION.

Rural distribution feeders are characterized by low voltage, low efficiency, non optimized distribution of electric power, and become burden for utilities hence suffers with least priority in operation and maintenance issues. There is the need for the provision of an alternative sustainable electric power supply system to provide electricity to rural and the unreached communities. There are several ways by which electricity can be generated using renewable sources such as solar, wind, biogas, etc. Individual generation of solar and wind energy is costlier. Solar and wind energy integrated technologies have great potential to meet bottlenecks of rural electric supply.

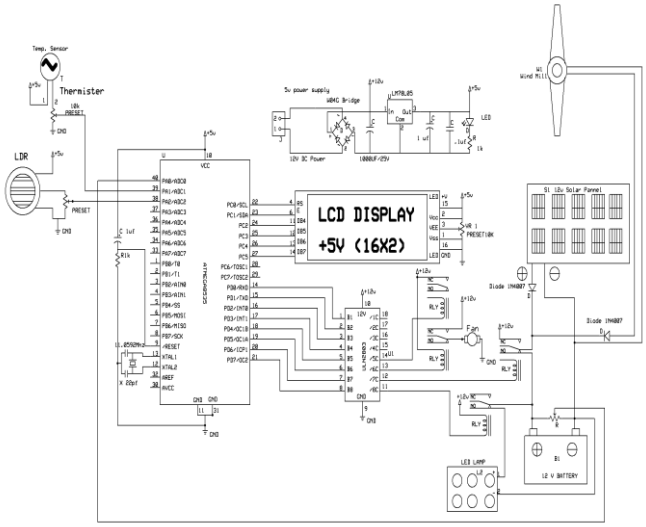

Fig.3. Prototype model of Solar-wind Hybrid power plant controller.

They can diversify our energy supply, reduce our dependence on imported fuels, improve the quality of the air we breathe, offset greenhouse gas emissions, and stimulate our economy by creating jobs in the manufacturing and installation of solar and wind energy systems. By using solar and wind integrated system we can electrify remote area also it is applicable for metro cities in future to avoid unwanted load shedding. This system can provide the effective, reliable and durable power system. Provides energy saving and un-interruptible power supply for rural electrification.

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