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SOLAR PV BASED SMART MICROGRID SYSTEM FOR RURAL AREA

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Abstract – In micro-grids are turning to be one of the most important factors for future power systems. In this research work, the considered system consists of recourse, namely Solar energy. These renewable energy sources are generally connected parallel in Micro-grid system. In order to get better performance from Micro-grid, the existing system has to be modified. This research work presents the modeling and control of PV Micro-grid. Selection of suitable wind turbine and AC or DC Micro-grid is clearly presented in thesis. Micro-grid concept integrates large amounts of micro sources without disrupting the operation of main utility grid. This hybrid Micro-grid consists of PV energy sources for DC and AC networks respectively. Energy storage systems may be connected to either AC or DC Micro-grids. The proposed hybrid Micro-grid operates in grid-tied or isolated mode. AC sources and loads are connected to AC network, whereas DC sources and loads are connected to DC network. Uncertainty and intermittent characteristics of wind speed, solar irradiation level, ambient temperature and load are additionally considered in the system model and operation.

Keywords— Battery Energy Storage (BES), Renewable Energy Resource (RERs), Solar Energy Conversion System (SECS), and Wind Energy Generation System (WEGS) etc.

I. INTRODUCTION

A Micro grids is a decentralized set of energy sources and loads that generally works linked to and synchronized with the standard large area synchronous grid (macro grid), but may alternatively detach to "island mode" - as well as function independently when physical or economic factors demand. Micro grids are best serviced by local energy sources if electricity transmission and distribution from a big centralized energy source is too remote and expensive to implement. In this case the micro grid is also are called autonomous, standalone or isolated micro grid.

In this way, micro grids improve the security of supply within the micro grid cell, and can supply emergency power, changing between island and connected modes. Rural electrification is also an alternative for distant regions or tiny islands. As a controllable entity, a micro grid can effectively integrate various sources of distributed generation (DG), especially Renewable Energy Sources (RES).A Micro grids is a decentralized set of energy sources and loads that generally works linked to and synchronized with the standard large area synchronous grid (macro grid), but may alternatively detach to "island mode" — as well as function independently when physical or economic factors demand. Micro grids are best serviced by local energy sources if electricity transmission and distribution from a big centralized energy source is too remote and expensive to implement. In this case the micro grid is also are called autonomous, standalone or isolated micro grid.

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A. Types of Microgrids

1. Campus Environment/Institutional Microgrids

The primary goal of campus micro grids is to combine current on-site production with numerous loads in a small geographic area where the owner can easily control them.

2. Community Microgrids

Thousands of users may be served by community micro grids, which encourage local energy penetration (electricity, heating, and cooling). One or more homes inside a community micro grid may be equipped with renewable energy sources that may meet their own needs as well as those of their neighbours.

Fig. 1 A typical scheme of an electric based microgrid with renewable energy resources in grid-connected mode

B. Basic Components in Micro-grids

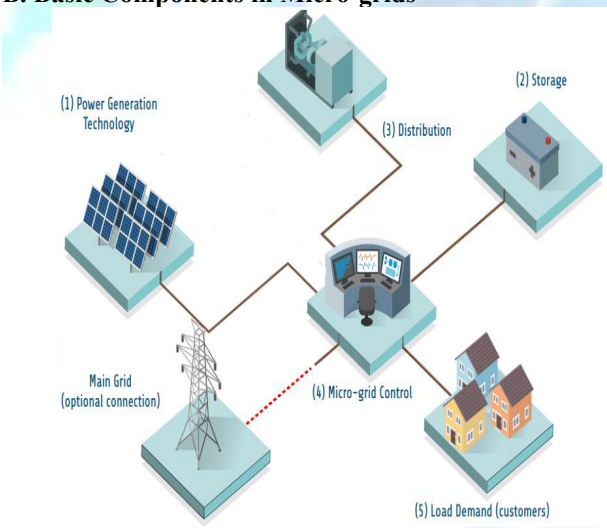

Fig. 2 Parts of Micro grids

1. Local Generation

Electricity, heat, and cold are all provided to the end user through a micro grid, which consists of a variety of generating sources. Thermal energy sources (e.g., natural gas or biogas generators or micro combined heat and power) are classified into two basic groups and renewable generation sources (e.g. wind turbines and solar).

2. Energy Storag

Power quality, including frequency and voltage control, may be ensured by energy storage in micro grids, which can also smooth the result of renewable energy sources providing backup power for the system and playing a crucial role in cost optimization.

II. MICROGRID & RENEWABLE ENERGY SOURCES

Renewable energy is defined as energy derived from naturally replenishing resources, such as sunshine, wind, rain, tides, waves, and geothermal heat. According to the most widely accepted definition, renewable resources are those that are replenished by nature at the same rate or faster than they are being used. Sustainable energy includes renewable energy as well.

A. Renewable Energy Development In India:

India has done a significant progress in the power generation in the country. The installed generation capacity was 1300 megawatt (MW) at the time of Independence i.e. about 60 year's back. The total generating capacity anticipated at the end of the Tenth Plan on 31-03-2007, is 1, 44,520 MW which includes the generation through various sectors like Hydro, Thermal and Nuclear. The power generation in the country is planned through funds provided by the Central Sector, State Sector and Private Sector.

The power shortages noticed is of the order of 11%. In the opinion of the experts such short fall can be reduced through proper management and thus almost 40% energy can be saved. It has been noticed that one watt saved at the point of consumption is more than 1.5 watts generated. In terms of Investment it costs around Rs.40 million to generate one MW of new generation plant, but if the same Rs.40 million is spent on conservation of energy methods, it can provide up to 3 MW of avoidable generation capacity.

About 80,000 villages still need to be electrified, and the Tenth Plan includes provisions to electrify 62,000 of them through grid supply. Specifically for electrifying distant villages, where village level organization will play an important role for the rural electrification programming, involvement of DE-centralised power producers is envisioned.

Evolution of power transformer technology in the country during the past five decades is quite impressive. There are manufacturers in the country with full access to the latest technology at the global level. Some of the manufacturers have impressive R&D set up to support the technology.

It has been felt that there is rising demand for energy, food and raw materials by a population of 2.5 billion Chinese and Indians. Both these countries have large coal dominated energy systems in the world and the use of fossil fuels such as coal and oil releases carbon dioxide (Co_2) into the air which adds to the greenhouse gases which lead to global warming.

III. PROPOSED METHOD

In this chapter discuss the proposed micro-grid. The micro-grid is a single-phase AC network. Energy sources are

an electricity network, a solar power generation system and a storage battery. The storage battery is controlled by a battery controller. When there is extra energy in the micro-network, it absorbs it, and when there is an energy shortfall in the micro-network, it delivers more power.

A. **Roof top Solar PV System -** A rooftop solar power system, or rooftop PV system, is a photovoltaic (PV) system that has its electricity-generating solar panels mounted atop the top of a building, whether it's residential or commercial. The various components of such a system include photovoltaic modules, mounting systems, cables, solar inverters and other electrical accessories. Rooftop mounted systems are small compared to utility-scale solar ground-mounted photovoltaic power stations with capacities in the megawatt range, hence being a form of distributed generation

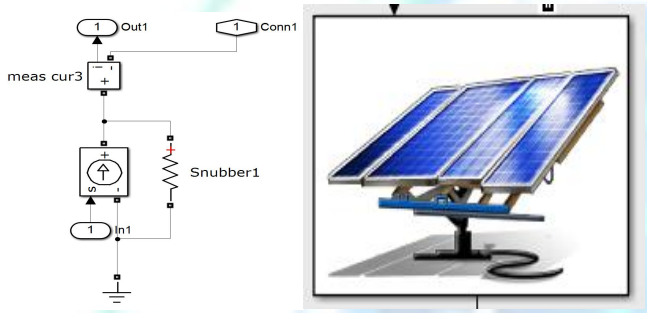

Fig. 3 Roof top Solar PV System

B. Battery

Saft has designed a range of battery systems to integrate with renewable, optimizing energy efficiency, increasing grid-management flexibility, reducing infrastructure investment and optimizing real-time power flow.

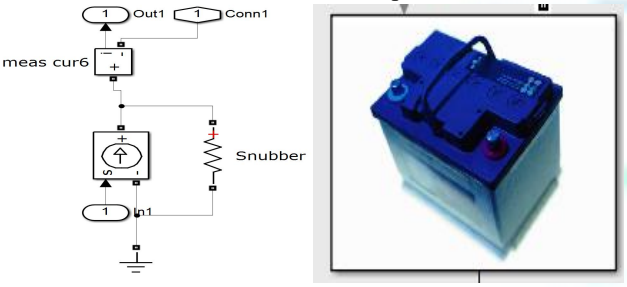

Fig. 4. Battery

C. House Load

It is a mode for a power plant when the facility is disconnected from the grid and also a tiny portion of its rated capacity is produced for the plant's auxiliaries. When a power outage occurs, this mode of functioning is activated.

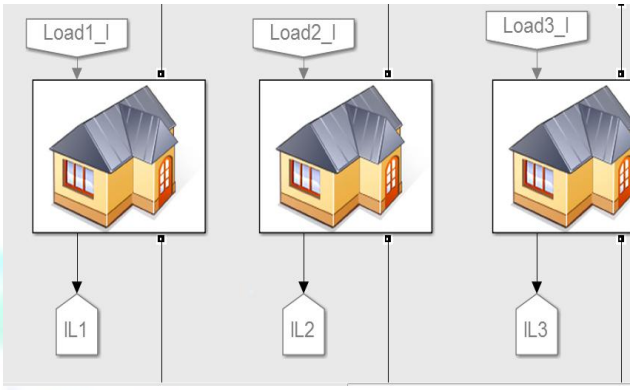

Fig. 5 House Load

D. Battery Controller

A charge controller, charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries[1]. Battery life as well as efficiency may be negatively affected by overcharging and over voltage, which is why this feature is so important. Depending on the battery technology, it may also execute regulated discharges or prevent a battery from being entirely depleted ("deep discharged")[2][3].

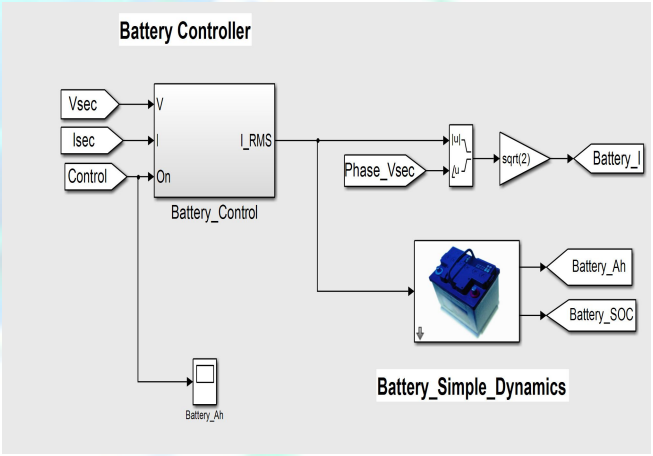

Fig. 6 Battery Controller

E. Micro-grid Grid Concept

Digital as well as other advanced technologies are used in smart grids to monitor and regulate the conveyance of power from all generating sources in order to satisfy the variable electrical needs of end users. By coordinating the demands and capacities of all the various producers, grid operators, consumers, as well as electrical market participants, smart grids aim to maximize the efficiency of the whole system minimising costs and environmental impacts while maximising system reliability, resilience and stability. Electricity networks (transmission and distribution systems) as well as its connections with power production, storage, as

well as end consumers are all included in this road map's definition of "smart grids."

IV. SIMULATION AND RESULT

Result Parameters

The Power block computes the active power (P), in watts, and furthermore the reactive power (Q), in, a voltage-current mix at harmonic. To perform this computation, the block initial determines the essential values (magnitude and phase) of the two input signals voltage and current.

The following P and Q are then calculated:

$$P = (V/2)2 \times (I/G)\ 2 \times \cos(\varphi) \quad (1)$$

$$Q = (V/2)2 \times (I/G)\ 2 \times \sin(\varphi) \quad (2)$$

$$\varphi = \angle V - \angle I \quad (3)$$

As this a running average window, one cycle of simulation should complete before the outputs provide the right value.

For the primary cycle of simulation, the outputs are control constant victimization the values such that by the Voltage initial input and current initial input parameters.

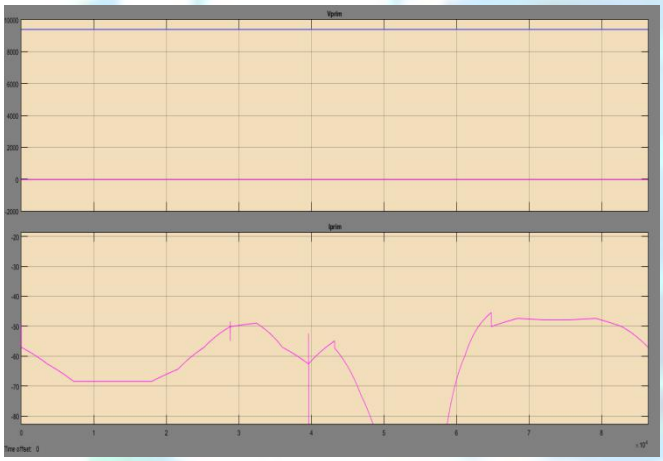

Fig. 7 Vprim

In the above figure 7 shows the Primary voltage and current of the proposed solar based micro-grid. In the figure 8 shows the battery life of the proposed simulation model. In the figure 9 shows the power by photovoltic (PV), power secondary (P.S.), power load (P.L.), power battery (P.B.), and backup hours (B.H.).

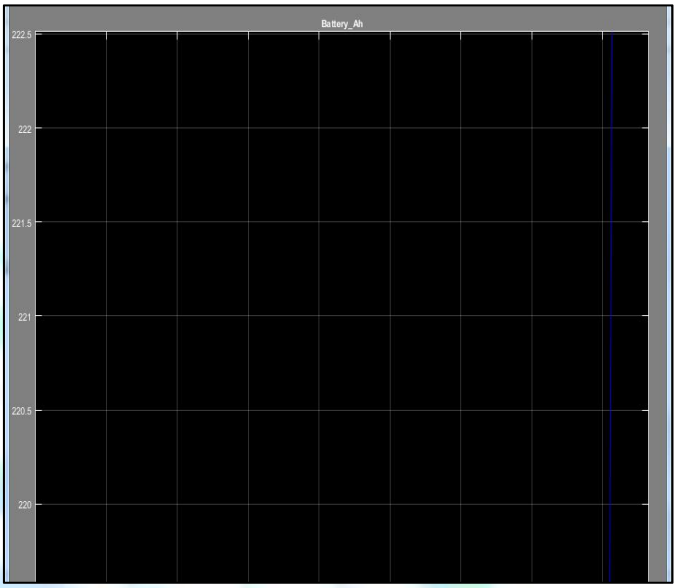

Fig. 8 Battery

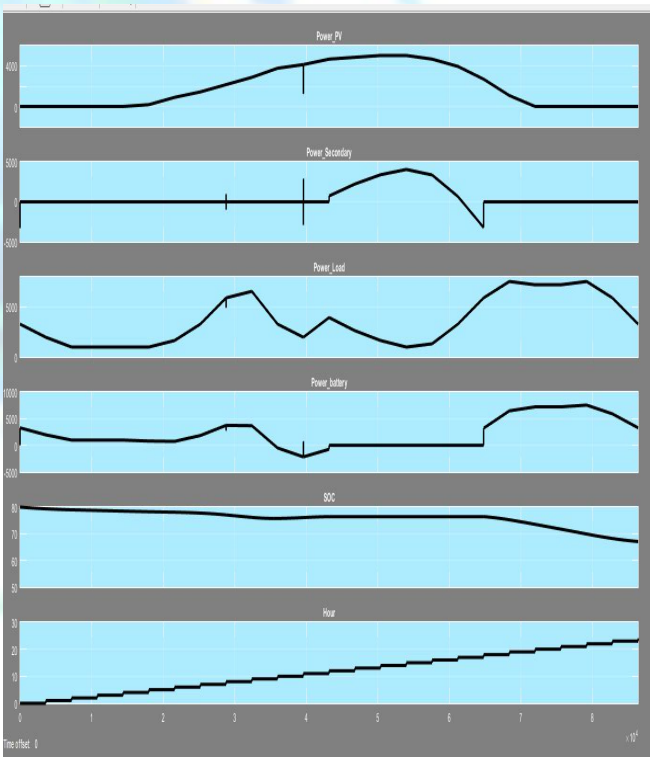

Fig. 9 Power PV

IV. CONCLUTION

In this presented work, presented is solar P.V. based micro grid system.Micro-grids are turning to be one of the most important factors for future power systems. In this thesis, the considered system consists of recourse, namely Solar energy. These renewable energy sources are generally connected parallel in Micro-grid system.The current system must be

altered in order to get the most out of Micro-grid. PV Micro-grid modelling as well as regulation are discussed in this thesis. The dissertation thoroughly explains how to choose an appropriate wind turbine as well as an AC or DC Micro-grid.

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