SOLAR PV- WIND HYBRID ENERGY SYSTEM TO MINIMIZE BLACKOUT IN COASTAL KARNATAKA

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***Abstract*—Thispaper proposes a solution to restore power systemwith environmental friendly hybrid system based on renewable green energy's after blackout in coastal Karnataka during summer and Monsoon days, to minimize economical losses. Investigation is done on the coastal Karnataka regions to study severe weather conditions with the help of meteorological data such as temperature, humidity, wind speed and Solar radiation. To address these issues environmental friendly green energy solar PV and wind energy hybrid system along with battery's as a backup for restoration of power to the consumer is formulated and developed as a service-centric aggregator that can minimize the total blackout. A Solar PV- Windhybrid generation module is simulated using MATLAB simulink.**

Keywords—PV; photovoltaicDFIG;Doubly Fed Induction GeneratorPFC; Power Factor Correction.

I. INTRODUCTION

In present day's fossil fuel is used to overcome blackout problem in coastal Karnataka which is costly and continuously decaying. The major power source for the coastal Karnataka Urban and Rural Areas is hydro power plant depends on the amount of water as there is dry season and flood season, so the generation of the hydro power is seasonal. Domestic farmers also need the water from reservoir of hydro power plant for agriculture. So the main issues are unstable power supply of hydro power, electricity shortage and the conflicts between irrigation and hydro power generation leads blackout in nearby communities. So, the distributed power system is very weak inherently. [1]

As Uttara Kannada is situated in West Coast of Karnataka, India, receives a mean solar insulation of 5.65 kWh/ m2/day annuallyand has in excess of 300 clear radiant days. This sunlight based potential can be used to meet the restoration of power system after blackout in Urban and Rural areas. Homegrown energy utilization of the family in provincial area is around 50 to 100 kWh every month, which in metropolitan district is a more modest sum than 150kWh/month in Uttara Kannada.This demand can easily overcome by using villages wasteland area which is sufficient to install solar PV panels to generate eminent electricity using MPPT tracker. [2]-[3].

Wind energy and its characteristics in coastal regions of Karnataka such as Kumta, Bhatkal and Karwar in Uttara Kannada District have been studied, with the help of Indian Meteorological Department. Wind energy conversion systems would be the most effective in coastal Karnataka, during May to August, as Karnataka is blessed with a coastline of about 280 Km which makes it seventh longest coastline has good prospects of harnessing offshore wind energy based on primary data collected at these sites for a period of 12 months. The data has been collected and analyzed, As India is a developing country every year power demand is increased which leads more power shortage, hence it is essential to adopt new resources and technology. Our proposed model i.e. integration of solar and wind energy system full fills the supply demand and minimize blackouts in coastal Karnataka Urban and Rural Areas during summer and Monsoon days.[4]

II. ANALYSIS GEOGRAPHICAL AND TEMPORAL AVAILABILITY OF SOLAR AND WIND ENERGY IN COSTAL OF KARNATAKA

According to the survey therenewable energy growth targets is set to 175GW by the end of 2040, this analysis is made by India's Ministry of New and Renewable Energy (MNRE). This target can be achieved by increasing solar and wind power by 15 times, hence new energy potential areas are in research.The coastal Karnataka fulfill the required criteria in addition to this study archives solution to urban and Rural blackout in Uttara Kannada whichis located at the western part of Karnataka statewith the geographical location of 10,291 km2 is located at 74°92 -75°102 E and 13°552 - 15°312. During May to August the wind energy is very effective in the coastal area of 280km as good opportunity to harness wind energy. The effective solar energy can be obtained in the month of December to March.[5]

III. METHODOLOGY

For analyzing the performance of the Solar PV and wind power in costal of Karnataka regions, following methods are applied.

A. *Sun Position Data Using Sun Locator*

The principle of the solar tracking system is done by Mini Solar panels. Two Solar Panels are connected to Arduino analog pin AO to A1 that acts as the input for the system. The built-in Analog-to-Digital Converter will convert the analog value of panel and convert it into digital. The inputs are from analog value of panels, Arduino as the controller and the Servo motor will be the output. Panel 1 and Panel 2 are taken as pair.

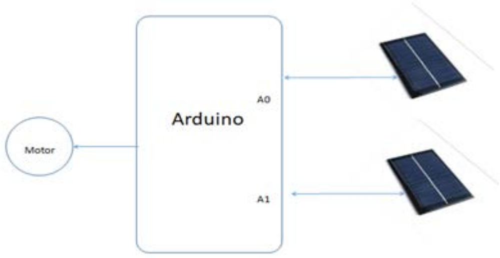

Figure. 1 Block Diagram of Single Axis Tracking System

Sun Position	Azimuth	Elevation	Sun Position	Azimuth	Elevation
6:00 AM	65.9°	-1.4°	12:00 PM	98.1°	78.7
7:00 AM	69.0°	12.0	1:00PM	1.4°	67.1
8:00 AM	70.9°	25.6	2:00PM	323.7°	53.6
9:00 AM	71.6°	39.4	3:00PM	294.4°	39.9
10:00 AM	70.2°	53.2	4:00PM	289.9°	26.1
11:00 AM	64.0°	66.7	5:00PM	289.0°	5.6

Table 1. Sun position in a day using Sun Locator

B. *Meteorological Department Average monthly wind speed and solar radiation per day*

S.no	Month	Daily radiation in (KWH/m2/d)	Average wind speed (m/s)
01	January	5.04	3.76
02	February	5.56	4.23
03	March	6.16	4.23
04	April	6.14	4.23
05	May	5.48	4.23
06	June	3.47	4.45
07	July	3.54	4.85
08	August	3.60	4.85
09	September	4.26	4.85
10	October	4.73	3.76
11	November	4.57	3.76
12	December	4.74	3.76

Table2. PV System and Wind Specification

The mean wind speed data for a period of one year at height of 50 m and for the period of 30 days the solar irradiance data is shown in table 2.

C. Hybrid Power System

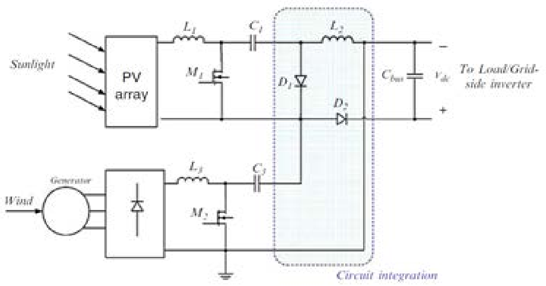

Figure-2rectifier stage of hybrid energy system

figure-2 shows hybridising solar and wind power sources adds a realistic form of power generation. The Inverter is the combination of two kinds of Inverters and it uphold both symmetric and asymmetricloads. System works on the presence of both or any one of the Renewable resources. The features of the presented topology are: (1) the inherent nature of these two converters wipe out the need of separate input filters for PFC (2) it can embed step up/down operations for each renewable source (can support wide ranges of PV and wind input); (3) System works on the potentiality of both or any one of the Renewable resources; (4) individual and contemporary operation is supported.when only the wind source is available.

In this case, D1 turns off and D2 turns on; the proposed circuit becomes a converter. On the other hand, if only the PV source is available, then D2 turns off and D1 will always be on and the circuit becomes a converter.In both cases, both converters have step-up/down capability, which provide more design flexibility in the system.[6]

State I (M1 on, M2 on)

$$i_{L1} = I_{i,PV} + \frac{V_{PV}}{L_1}t \quad 0 < t < d_1T_s$$

$$i_{L2} = I_{dc} + \left(\frac{V_{c1} + V_{c2}}{L_2}\right)t \quad 0 < t < d_1T_s$$

$$i_{L3} = I_{i,W} + \frac{V_W}{L_3}t \quad 0 < t < d_1T_s$$

State II (M1 off, M2 on)

$$i_{L1} = I_{i,PV} + \left(\frac{V_{PV} - V_{c1}}{L_1}\right)t \quad d_1T_s < t < d_2T_s$$

$$i_{L2} = I_{dc} + \frac{V_{c2}}{L_2}t \quad d_1T_s < t < d_2T_s$$

$$i_{L3} = I_{i,W} + \frac{V_W}{L_3}t \quad d_1T_s < t < d_2T_s$$

State III (M1 off, M2 off)

$$i_{L1} = I_{i,PV} + \left(\frac{V_{PV} - V_{c1}}{L_1}\right)t \quad d_2T_s < t < T_s$$

$$i_{L2} = I_{dc} - \frac{V_{dc}}{L_2}t \quad d_2T_s < t < T_s$$

$$i_{L3} = I_{i,W} + \left(\frac{V_W - V_{c2} - V_{dc}}{L_3}\right)t \quad d_2T_s < t < T_s$$

IV. SOLAR-WIND HYBRID SYSTEM IMPLEMENTATION TO MINIMIZE BLACKOUT USING MATLAB/ SIMULINK

The Wind and Solar energy systems are highly uncertain due to their unpredictable nature. None of these are available round the clock. Thus hybridizing solar and wind power sources provide a steadier source of power generation. When any of the two sources is unavailable or insufficient in meeting the load demands, the other energy source can compensate for the difference. The main requirement of power electronic interfaces for the PV systems is to convert the generated DC voltage into a suitable AC for consumer use and utility connection.[7]

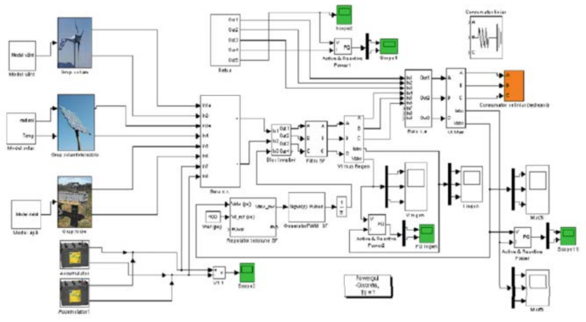

Figure-3- simulation model of a hybrid system based on renewable energy

Photovoltaic cell in Figure-3is converts photon energy into electrical energy. The PV cell contains PV module in protective lamination, by using MATLAB/Simulink software calculated sample load for the selected area variations & realistic characteristics.Wind energy is extracted from proposed modeling consist of Doubly Fed Induction Generator (DFIG) based wind turbine. DFIG has both field magnet windings and armature windings connected to the instrument individually outside the generator.to correct reactive power compensation using Capacitor Bank is connected with three phases of wind turbine. Battery's used as backup,the step-up transformer stepped up solar wind and backup powerfrom 400V to 11kV and fed to a Microgrid or substation.

V. SIMULATION RESULTS

A. *Hybrid Solar PV/Wind Energy System Using MATLAB/SIMULINK and Affiliations*

Figure- 4.1 and 4.2 the active and reactive power created by renewable energy sources are presented. It might be noticed that the power generated from alternative energy is utilized for charging the vitality storage devices, with the consumers as well.

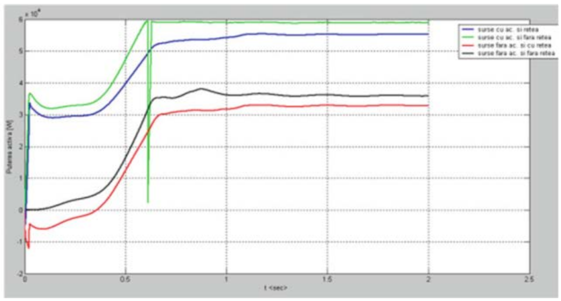

Figure-4.1 Renewable energy sources active power variation

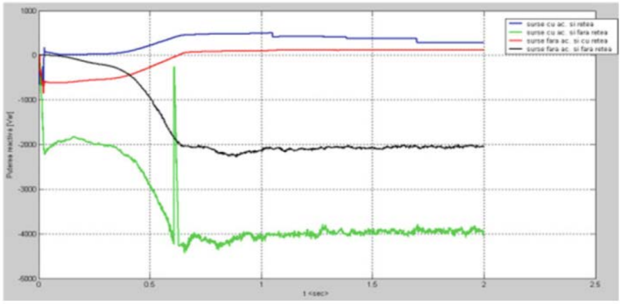

Figure-4.2 Renewable energy sources reactive power variation

as to cover losses plus the surplus is injected to the local public network. When theconsumer is isolated powerevolution is stabilized following an equivalent constantlevel in line with consumer power and losses. If consumer is isolated, the presence ofreactive power is caused by nonlinear elements utilized in the simulation model.power transformers and power converters determined by electronic switching components.

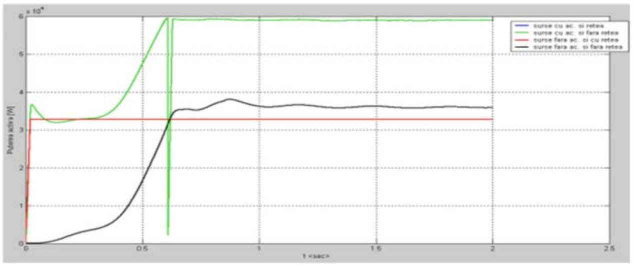

Figure-4.3 Consumer active power variation

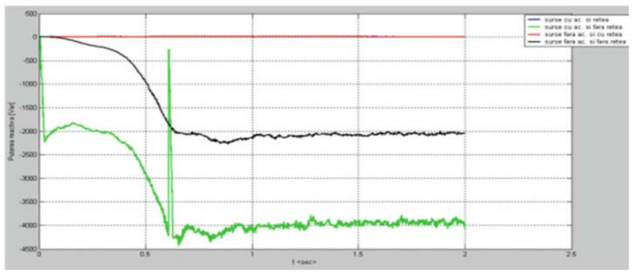

Figure-4.4 Consumer reactive power variation

Figure-4.3 and 4.4 that is definitely the active and reactive power at consumer terminals.

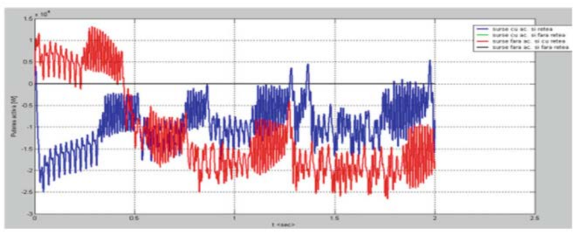

Figure-4.5Evolution of active power transit between the hybrid system based on renewable energysources and the public network

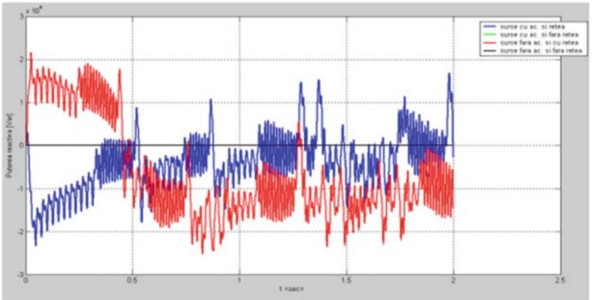

Figure-4.6 Evolution of reactive power transit between the hybrid system based on renewable energy sources and the public network

Figure-4.5,can even be seen the highly nonlinear nature of the consumer. Dark andgreen characteristics correspond to situation the location where the consumer isisolated.In Figure-4.6,is presented the reactive power variation from the power network. It could be observed that the renewable power hybrid system enables to produce reactive energy in the considered cases.

VI. CONCLUSION

This paper proposed a clean energy system to restoration of power system after blackout using combined solar PV-wind energy system minimize economical loses in coastal Karnataka. This renewable system is built by integration solar and wind system and obtaining the simulation result in MATLAB. The contingencies can be eliminated by analyzing the result. Hence, integrating solar PV- wind energy system is effective to reduce blackout in coastal region during summer, monsoon days. This has reduced the environmental pollution and help to improve the economy of the area. Overall from this study, would like to propose solar PV wind and backup system for urban and rural area as renewable energy system. In enhancement of this work to other areas with renewable resources using microgrid is more effective and challenging.

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