HYBRID MICROGRID SYSTEM USING RENEWABLE AND NON-RENEWABLE ENERGY

C.Sharan[1], Namrata Gupta[2]
[1,2] Student
Department of Electrical and Electronics Engineering
SRM Institute of Science and Technology

Abstract- The work exhibits the dynamic displaying and solidness examination of Low Voltage (LV) microgrids For the normal lack in the power required from future power frameworks Micro-network framework is by and by thought about a dependable arrangement. For future small scale framework frameworks Renewable power sources, for example, wind, sun based and hydro offer high capability of generous power. Small scale Grid is fundamentally a low voltage or medium voltage dispersion arrange which comprises of various called circulated generators, miniaturized scale sources, for example, photovoltaic cluster, energy unit, wind turbine, diesel and so forth. This paper shows a miniaturized scale framework system dependent on diesel vitality and power module stack sources and addresses issues identified with activity, control, and steadiness of the framework. Utilizing Matlab/Simulink, the framework is displayed and mimicked to distinguish the important specialized issues associated with the task of a small scale lattice framework dependent on sustainable power age units.

I. INTRODUCTION

The expanding requirement for vitality produced with clean innovations has driven analysts to create disseminated power age frameworks. The incorporation of an expansive number of dispersed ages into circulation systems is confined because of the impediment of the systems limit and unidirectional power stream behaviour. The approach for miniaturized scale matrix is drawn closer as a methods for coordinating appropriating ages into the conveyance systems. As we realize that sunlight based is just accessible amid the day and is frequently discontinuous, so vitality stockpiling is expected to enhance microgrid framework execution and financial matters. With high entrances of PV, the job of capacity has moved from providing medium-term burden to the need to catch overabundance PV vitality amid the day when load is low. This paper utilizes a custom time-arrangement model to talk about improvement of sun based, vitality stockpiling and on-request generators around then diesel generator will give vitality. This is a strategy composed for estimating of diesel generators in a confined microgrid based on discrete Fourier change (DFT). diesel generators have diverse reaction attributes and can integrally remunerate the age request unevenness at various time scales. The DFT-based composed dispatch methodology allots balance control between the two segments through recurrence time space change. The proposed technique guarantees that diesel generators work in their individual and generally productive. Diesel generators sequentially work at an abnormal state age while Energy Source repays little and regular power variances. At that point, the limits of Energy Source and diesel generators are resolved dependent on the organized dispatch methodology. The proposed strategy can likewise be utilized in the arranging of Energy Source with other dispatch able sources, for example, miniaturized scale turbine or power module. Increment in research introduction in the field of structure and control of micro grids assume a noteworthy job in consistent consideration of clean vitality into micro grids to get the job done the regular vitality prerequisites. a low voltage Direct Current micro grid fusing power module based dependable clean vitality age and super capacitor based transient vitality stockpiling gadget to shape a solid Direct Current hotspot for the nearby Direct Current loads is been exhibited in this paper. Power module stack and super capacitor bank are interfaced to stack terminals utilizing a DC-DC help converter and DC-DC bidirectional converter individually. Double circle control is utilized to build up control for these power electronic interfaces so as to encourage stable capacity to the heap regardless of the compelled working attributes of the energy unit and transient burden varieties. Power Management System is equipped for finding the best answer for satisfy the interest of customers totally, persistently and rapidly. Coordination of sustainable power source into regular power framework is expanding step by step which is spurring scientists to investigate new types of sustainable power source and use them effectively to satisfy age request hole, so with the assistance of diesel generator and energy component vitality miniaturized scale lattice framework is made. Changes made in controller design to encourage the irregular task of the power device is clarified in detail. The changed controller design improves the unwavering quality of the power module framework regardless of the discontinuous idea of the heap. Future power arrange is relied upon to an emphasis on a miniaturized scale matrix framework.

II. HYBRID MICROGRID SYSTEM AND ITS DESIGN

Crossover microgrid frameworks (HMGS) include a few parallel associated appropriated assets with electronically controlled techniques, which are competent to work in both islanded and network associated mode. HMGS dependent on sustainable power sources (RES) is the practical choice for taking care of the power supply issue in remote zones, which are situated a long way from lattices. In this paper, the breeze and sunlight based meteorological information for Sundarban (India) station are utilized to plan Islanded HMGS for giving fundamental power. Cost adequacy and framework unwavering quality are main considerations considered for structuring HMGS to accomplish better power the executives plot. Molecule Swarm Optimization (PSO) conspire is connected to distinguish the measuring of wind turbines (WT), photovoltaic (PV) module, battery vitality stockpiling framework (BESS) and diesel generator, and locate the ideal design of HMGS framework. The structure and ideal activity of HMGS framework has been created and approved through MATLAB programming.
The basic block diagram is-

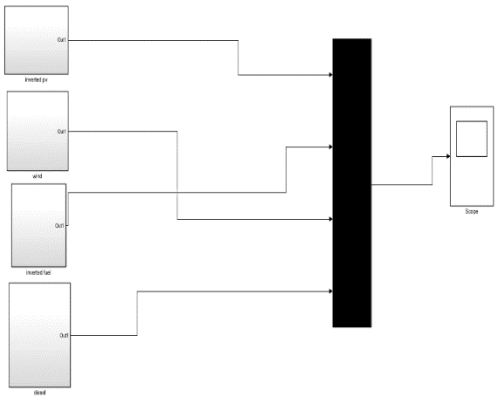

Fig 1 Block diagram

III. DESIGN OF MICROGRID USING SOLAR PLANT

Solar panels convert temperature and irradiance passing to the current . The output current of panel is calculated by using Equation

$I=I_{pv}-I_o[\exp(qV/akT)-1]$ (1)

Where

I_{PV}= current generated by the light

I_0= Cell saturation or the leakage current of the diode

q= electron

This model consist of solar panel, diesel cell,battery cell and the wind energy which has PEMFC60kW Generator Type PMSG V_{oc} 74.8 V Cell Number 1000 Number of pole pairs 4 V_{mp} 64.9 V [I_{nom}(A), V_{nom}(V)] 80 A 625 V Nominal Voltage 837 V Isc 5.10 A [I_{max}(A), V_{max}(V)] 280A 430V Nominal Speed 169 rpm Imp 5.58 A Nominal efficiency 55% Rated Power 53 kW Panel No. in Array 9 Nominal composition (%) [H2- O2- H2O(Air)] 99.9- 0.1- 1 Stator resistance 0.9585 Ω Array No. in String 6 average air passing rate (0.5pm) 2110 Phase L of 0.815 μH Number of String 4

The current depends upon the light entering the molecules. Furthermore, the voltage flows of board can be enhanced by connecting sequential or parallel of photo cells. The current delivered is directly proportional to the light incident on the molecules. The voltages and flows of board can be increment by interfacing sequential or parallel of the photovoltaic modules.

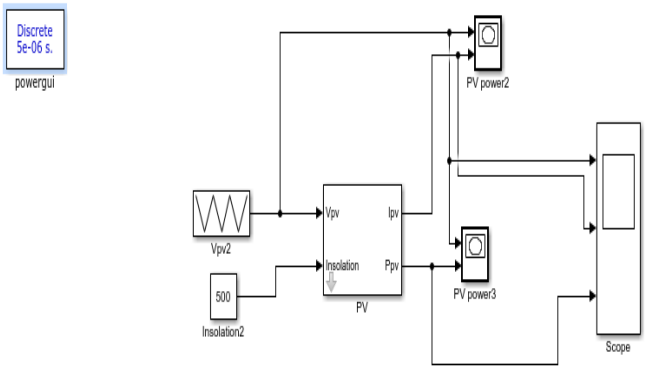

Fig 2 PV circuit

In this examination, high power per cell has been accomplished by utilizing HIT sun powered cells and higher effectiveness has been acquired. Steady conductance ‘s most extreme power point following calculation has been utilized to produce exchanging sign of lift converter associated with the PV board circuit. The light of PV plant extends in the middle of 802 W/m2 furthermore, 1007 W/m2 . In the Boost converter circuit, MOSFET has been utilized as the exchanging component and exchanging recurrence has been set to 65 kHz. The MPPT is a control technique following the most extreme control purpose of PV board which has non-direct trademark in view of shift irradiance and temperature tMPPT controller . The power device has been shaped by sequential association of two cells of 60kW.

IV. DESIGN USING WIND ENERGY

The wind turbine framework has been subjected to produce 55 kW control. The wind turbine has been utilized with non controllable rectifier. The wind turbine framework simulink configuration is appeared . The structure parameters of the lift converter associated with the framework . The inner structure of proportional integral controller is used in the turbine and energy component of the wind turbine. The active energy in the air makes mechanical energy at rotor by rotating the wings of the wind turbine. During this point, the mechanical energy is converted into electrical system. The yield control condition of a breeze turbine is appeared where Pm is mechanical yield intensity of wind turbine, Cp is coefficient of execution, α is pitch edge, β is top speed proportion, ρ is air thickness. In the present era there is maximum utilization of wind turbines and these turbines are made to give more productivity with more power factor.

Equation of Wind Energy:

$$\text{Power} = 1/2 \times \rho \times \pi \times r^2 \times C_P \times C_f \times v^3 \times N_g \times N_b \qquad (2)$$

P= power (w)
V= wind velocity
ρ= wind density
πr^2=swept area , where r is blade length in m
C_P= coefficient of the power
C_F=Capacity Factor
N_G= efficiency of the generator
N_B= efficiency of the gear box

The above equations tells the power produced Efficiency produced by the wind energy.The simulation shows the voltage and the statorCurrent produced by the wind energy.

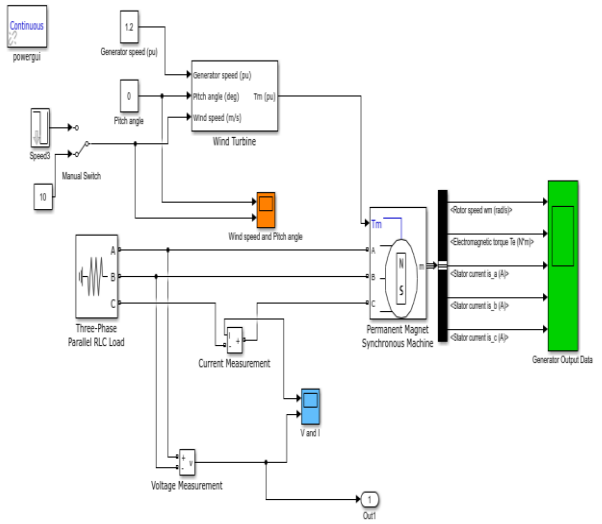

Fig 3 Wind energy circuit

V.DESIGN OF FUEL CELL MICROGRID

A power module changes over the substance essentialness direct into electrical imperativeness in the middle of the electro chemical reaction of hydrogen and oxygen can make essentialness in the steady way required. Since the process is in control it does not cause any harm to the environment. There are various energy present in the environment through which energy can be produced and utilized. Among all Fuel cells, the Proton exchange layer control module is supported by its basic structure, instant start, increased power thickness, reduced working temperature and variable horrible impacts. The fuel cell stacks have been needed to make 107 kW assessed control. PEM-613V-50kW present model has been used in structure. The lift converter Simulink structure is related with (PEMFC).

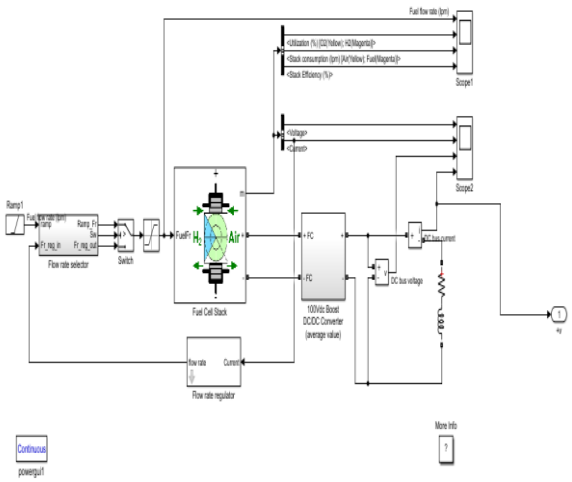

Fig 4 Fuel energy circuit

VI. DESIGN OF DIESEL ENERGY MICROGRID

The mix of electric generator and diesel motor produce electric viability. This is the process of motor generator. A diesel pressure starts motor runs the diesel fuel primary and it can be adjusted for other fuels and petrol. Diesel creating sets are utilized in spots without association with a power framework, or as crisis control supply if the lattice bombs, just as for progressively complex applications, for example, top cutting, network backing and fare to the power matrix

.

Burner temperature Ratio= $Tt_4/Tt_3=(1+fn_bQ/C_PTt_3)/1+f$ (3)

$f= (Tt_4/Tt_3)-1/n_bQ/c_pTt_3-(Tt_4/Tt_3)$ (4)

$m_f=fm_a$

m_f= fuel flow capacity

m_a=air flow capacity

f=fuel and air ratio

Tt=total temperature

C_p=specific heat(average)

Q=fuel heating valve

N_b=adiabatic efficiency

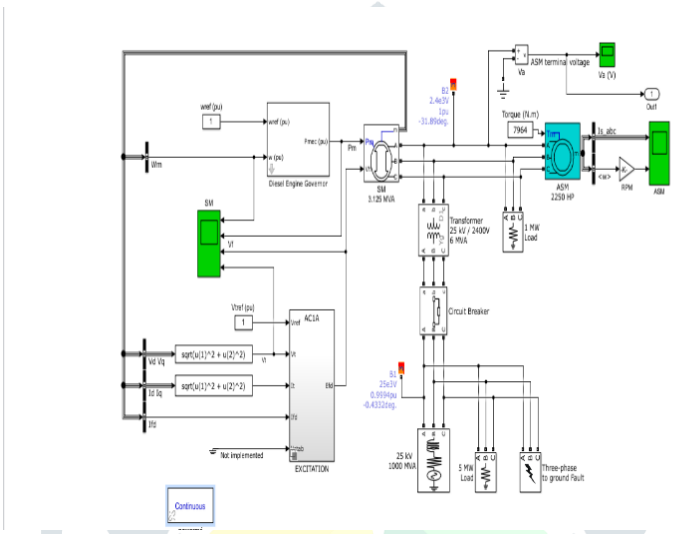

Fig 5 Diesel energy circuit

VII. INVERTER CIRCUIT

The inverter circuit used in this simulation isUsed to convert the dc voltages to the ac voltagesThe pv and the fuel microgrid systems have DC voltage as the output . But for the regular uses we need AC voltage sources. In order to convert DC voltage to the AC voltage inverter circuit is used and the input is the output of the pv and the fuel voltages.

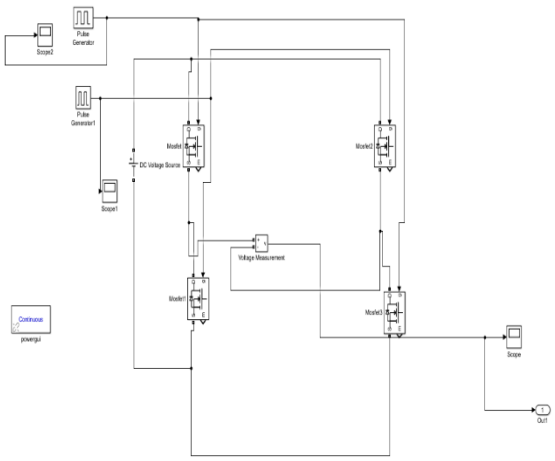

Fig 6 Inverter circuit

The input in the inverter is converted into AC form using pulse generator. The firing angle can be changed in the pulse generator and a square AC wave form is obtained. The square AC waveform obtained is shown below.

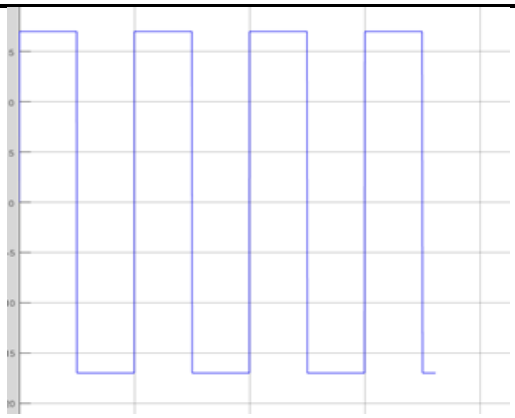

Fig 7 Inverted output

VIII. ANALYSIS AND SIMULATION RESULT

The whole analysis and simulation results are shown below according to the energies and the whole output (final result) is shown below-

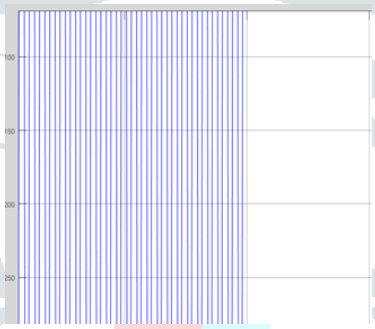

Fig 8 Simulation result of diesel energy microgrid system

The above figure shows the ac output of diesel energy system. It represents the ac voltage which is obtained by converting diesel energy into electrical energy.

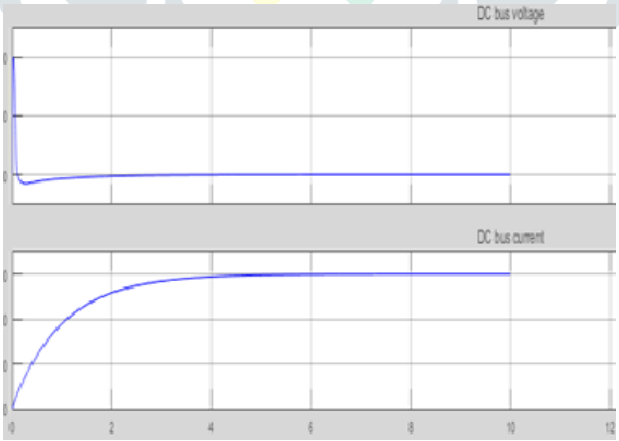

Fig 9 Simulation result of fuel cell microgrid system

The above figure shows the dc voltage and current obtained from the fuel energy. The dc output is converted into ac by inverter circuit.

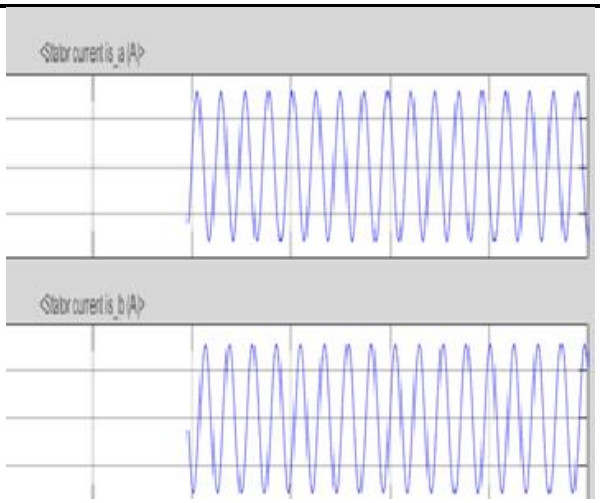

Fig 10 Simulation result of wind energy

The above figure shows the stator current and voltage produced by the wing energy which is ac.

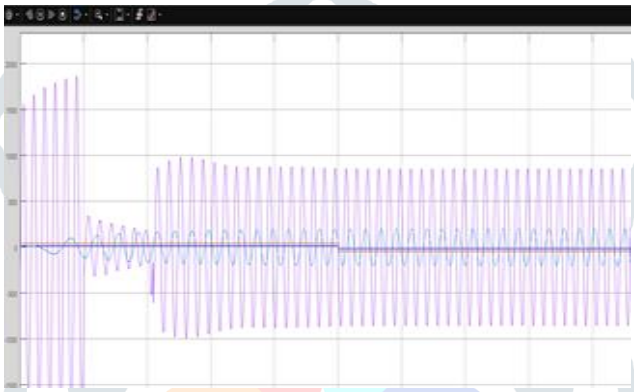

Fig 2.4 **Result obtained**

The above simulink result is the output obtained from the hybrid microgrid circuit.

IX. CONCLUSION

This work presents Hybrid micro grid which includes pv array ,wind eneregy,diesel energy and fuel stack. The simulation have been implemented in matlab simulink and got the output.The output obtained is the AC waveform.This hybrid microgrid have so much domestic as well as industrial use as an alternative to the current.The industries are located mostly near to the renewable energy resources, thus if the power is off , the current can be drawn from the hybrid microgrid or any of the micro grid. The hybrid microgrid usses less power with more efficiency.

REFERENCES-

[1] I. Çolak, E. Kabalcı, G. Bal, "Parallel DC -AC conversion system based on separate solar farms with MPPT control", 4th International Conference on Power Engineering, Energy and Electrical Drives, pp. 1071 -1075, May 13 -17, 2013, Istanbul, Turkey.

[2] E. Kabalcı, A. Görgün, Y. Kabalcı, "Design and Implementation of a Renewable Energy Monitoring System", IEEE 8th International Conference on Power Electronics, pp. 1469 -1475, May 30 -June 3 2011, Jeju Korea.

[3] E. Kabalcı, F. Batta, O. Battal, "Modelling of a Hybrid Renewable Energy Conversion System", 3rd International Conference on Nuclear and Renewable Energy Resources (NURER 2012), pp. 1 -6, May 20 -23, 2012, Istanbul, Turkey.

[4] M.H. Nehrir, C. Wang, K. Strunz, H. Aki, R. Ramakumar, J. Bing, Z. Miao, Z. Salameh, "A review of hybrid renewable/alternative energy systems for electric power generation: configurations, control, and applications", IEEE Transactions on Sustainable Energy, vol.2, no.4, pp.392 -403, Oct. 2011.

[5] E. Kabalc i, R. Bay ind ir, E. Hossain," Hybrid Microgrid Testbed Involving Wind/Solar/Fuel Cell Plants", 3rd International Conference on Renewable Energy Research and Applications, p. 880 -885, 19 -22 Oct 2014, Milwakuee, USA.

[6] E. Kabalc i, R. Bay ind ir, E. Hossain, "Microgrid test -bed design with renewable energy sources", Power Electronics and Motion Control Conference and Exposition (PEMC), 21 -24 Sept. 2014, Antalya, Turkey.

[7] E. Kabalci, "Design and analysis of hybrid renewable energy plant with solar and wind power " Energy Conversion and Management, vol. 72, 51 -59, 2013.

[8] R . K. Pandey, H . Kumar "Renewable energy sources operational performance evaluation with hybrid model" Power & Energy Society General Meeting, 16 -20 July 2017 , Chicago, IL, USA .

[9]R. Sekar, D . S . Suresh , H. Naganagouda "A review on power electronic converters suitable for renewable energy sources" , International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT) , 15 -16 Dec. 2017 , Mysuru, India

[10] A . M. Kassem , S. A. Zaid "Optimal control of a hyb rid renewable wind/fuel cell energy in microgrid application " , Nineteenth International Middle East Power Systems Conference (MEPCON) , 19 -21 Dec. 2017 , Cairo, Egypt .

[11] S . Tahir; A . Khaliq "Control of grid connected dc -coupled hybrid microgrid" International Multi -topic Conference (INMIC) , 24 -26 Nov. 2017 , Lahore, Pakistan .

[12] Y. Z Mohamed, M. S. Hamad , M. Abdel -Geliel "Design and control of a coupled AC/DC hybrid Circuits Systems (ACCS) Systems & 2017 Intl Conf on New Paradigms in Electronics & Information Technology (PEIT), 5 -8 Nov. 2017 , Alexandria, Egypt.