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Simulation of Wind PV System for Different Load Variation using Artificial Neural Networks

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Abstract:

The proposed system presents about the dynamic model and control strategy of micro grid mainly used by two sources are wind and solar energy. To combine the conventional energy sources through the main dc bus we are using current source interface multiple DC-DC converter. The potential applications are mainly available in housing area and communication places. A permanent magnet synchronous wind generator and control method is used for variable speed control in order to reduce the wind energy below the rated wind speed. The load power variations and power shortage in micro grid are observed in both wind energy and solar energy and solar irradiance. The feasibility reliability depends on proposed hybrid system based on micro grid application.

Keywords:

photovoltaic resources , wind energy ,power system modelling and multiple level dc-dc converters

I.INTRODUCTION

This article presents a dynamic model and control strategy used for a sustainable micro grid mainly powered in wind as well as photovoltaic (PV) energy. These sources are included into the main bus through a current-source-interface (CSI) multiple-input (MI) dc-dc converter. The proposed application for this micro grid is a communication places otherwise a residential area part of a future "smarter grid". The planned micro grid is with set with energy storage devices, such as batteries. A utility grid connection is providing in order to refill energy level in case of power lack from the renewable energy sources. Suitable to its diverse source, power supply availability of such system may surpass two of the grid [2]. In the power system outage possibility is close to zero because in this micro grid all energy resources are unavailable at the same time. Besides, the arrangement of wind generator and PV modules with local energy storage devices may reduce susceptibility to natural disasters [3], [4] because they do not require lifelines.

Between the previous works in the literature, the design of raising a sustainable micro grid used for telecommunication application using MI dc-dc converters was introduced in [4] and expended in. A alternate of such method with a different MI converter (MIC) topology was later on describe in [6] optional a telecommunication power system in which a diesel generator and an automatic transfer switch were replace by fuel cells with a micro-turbine using an MI dc-dc converter. The power systems in [4]–[6] have the following advantages: 1) The use of the MIC reduce needless redundancy of extra similar converters in each energy source, also 2) The investment within micro-sources is recuperate as the energy source into this power system can exist use during normal operation since as grid power outages [3]–[6]. However, one issue with such micro grid in [6] is to it still requiring fuel for the local source in normal operation.

During addition, the daily balancing generation profile of a wind turbine and a PV module include moved research on similar power systems with a dc link method other than an ac coupling method though, these similar power systems in [8]–[11] combine renewable energy sources with parallel single-input dc-dc converters which may lead to unnecessary redundancy in power system components. This problem can be resolve with an alternative combine method which uses MI dc-dc converters before proposed in grid. So an MI dc-dc converter has other advantage such as the option of decentralized control as well as modularity. Although these advantages, the study appear to have explore dynamic modeling technique for a wind and solar hybrid power system with MI dc-dc converters-in compare to those with parallel converters. while the hybrid power systems is consider a wind generator as a local source used for an MIC, they do not consider wind energy variation and ac system characteristics such as ac wind generators, local ac load power variations, and

As well as interaction with the distribution grid, which likely change the controllability also performance of the micro grid?

The dynamic model and operation strategy of a wind/solar hybrid power system by an MI dc-dc converter into which wind energy changes, and ac wind generator, and variations are occurred in local ac load power and transmit power to the distribution grid are consider. In wind energy turbine rotor speed determines the mechanical output power and at the same time the operating voltage of solar cell also produces the output power from energy. The direct-driven permanent magnet synchronous generator (PMSG) is used for the wind generator model because a direct-driven PMSG have drawn attention used for the residential-scale power level due to its gearless system. The wind energy variations consider the fast change solar irradiance that affects generated power from PV modules during the same day in the planned power system. Besides, in this proposed micro grid do not need any fuel for the local source as it is powered by essentially self sustainable energy source. Therefore, with enough local energy storage, it does not take place lifelines e.g., roads or pipe used for fuel otherwise normal gas delivery—for operation, which makes it a truly self sustainable power system best to provide power not only in normal condition however and during extreme events when lifeline operation is poor otherwise not expected. In addition, the proposed power system not only is able to produce electricity from the renewable energy source but may also insert excess power to the utility grid in normal operation.

II. Planned Sustainable Micro grid Architecture

It shows the general architecture of the proposed micro grid through wind with PV resources. Its main energy source, wind with solar radiation, be transformed within a wind generator and PV module. During arrange to combine these energy sources, a CSI MIC, such as an MI CUK converter or an MI SEPIC converter by a dc bus system, be used because a CSI MIC is more effective for maximum power point (MPP) tracking into PV module also for the input current control method used in this micro grid. So MICs were chosen as they provide a cost-effective and flexible method to interface various renewable energy sources. During adding, a dc power distribution system is select because dc power system can achieve higher ease of use with energy efficiency in a simpler way than equivalent ac power system.

A voltage level of 380 V be consider to be the main dc bus voltage within this power system because it is more suitable designed for bidirectional power flow between the intended power system and the utility grid as well as because it is the likely voltage to be chosen in a future standard for industrial application by dc distribution, such as in data center. But, a three-phase rectifier in the wind generator can be required for this dc distribution system since the output voltage of the wind generator is usually ac. since depicted inside, an energy storage system (ESS) is also attached to the main dc bus in order to overcome the irregular property of renewable energy source as well as to support local power production in an islanded mode particularly in blackouts or natural disaster.

Depending on application, the different voltage level of local dc loads such like 48 V telecommunication power system otherwise plug-in electric vehicle be able to be accommodate through an extra dc-dc converter as described.

The local ac load whose line-to-line voltage level is within this micro grid can be present connected by a PWM inverter with an LC filter used toward reduce harmonic voltages produced on the local ac bus. As this local ac distribution system may

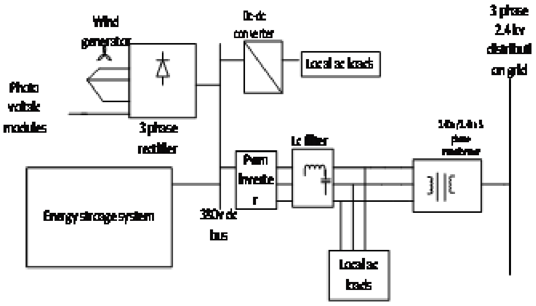

Fig .1.over all architecture of sustainable micro grid

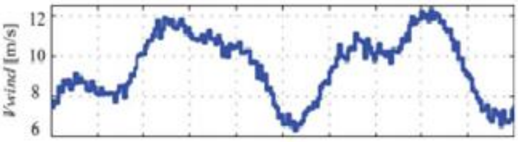

Fig.2.wind model used for the simulation study

Also be tied to the three-phase 2.4 kV distribution grid with a three-phase 240 V/2.4 kV transformer that also contributes to filter harmonic content in the inverter output and to reduce filter needs in the LC filter.

III. Model Component of the Proposed Micro grid

The major modeling components which are used in order to realize its system-wide micro grid model.

A. Wind Model

The use of a wind model presented in order to simulate the spatial effect of wind energy variations such as gusting, rapid ramp changes, and background noises. This wind model is defined by

$$Vwind = Vbase + Vgust + Vramp + Vnoise \quad (1)$$

$Vbase$ Is a constant wind velocity, $Vgust$ is a gust wind component which can be implemented by a cosine function, $Vramp$ is a ramp wind component used for mimicking wind changes, $Vnoise$ and is background noises of wind.

B. Wind Turbine Model

A wind turbine within the proposed micro grid model study is model by an aerodynamic input torque which drives a wind generator. Here order toward explain the wind turbine model now the mechanical power (Pm) capture by the blade of a wind turbine is described as follows

$$Pm = \frac{1}{2Cp(\beta\ \boldsymbol{\lambda})\boldsymbol{\rho\pi R2V3wind}} \quad (\mathbf{2})$$

Where cp power coefficient and β is a blade pitch angle, **λ** be a tip-speed ratio (TSR), ρ be an air density, R be the radius of a wind turbine blade, $vwind$ and is a wind speed. The rotor power coefficient cp is defined by the fraction.

Specifications and Parameters used in Wind Turbine Model

Parameter name	Value	Unit
Rated power	20	K w
Rated wind speed	12	m/s
Rated rotor speed	27.5413	Rad/s
Blade radius	3.7	M
Blade pitch angle	0	Degree
Air density	1.225	Kg/m^3

Of the obtainable wind power to be able changed to the mechanical power by a rotor. This rotor power coefficient cp depends on the blade aerodynamics, which is the function of a blade pitch angle (β) with a Torque speed ratio (β). The type of a wind turbine rotor may and be another factor affect the rotor power coefficient (cp). But, the cp of in which a common blade type was implicit is use in this study for the sake of simplicity

$$Cp = (\mathbf{0.44 - 0.0167}\boldsymbol{\beta})\boldsymbol{sin}\frac{\boldsymbol{\pi(\lambda-2)}}{\mathbf{13-0.3}\boldsymbol{\beta}} - \mathbf{0.00184}(\boldsymbol{\lambda} - \mathbf{2})\boldsymbol{\beta}\ \mathbf{(3)}$$

The **λ** TSR can be defined as the function of a wind speed written as

$$\lambda = \frac{wmR}{Vwind}(4)$$

Where wm is the rotor speed of a wind turbine? Then, from and considering that, $Tm = Pm/Wm$ the aerodynamic input torque (Tm) by which a wind generator is driven can be obtained as follow

$$Tm = \frac{cp\,(\boldsymbol{\beta\lambda})\boldsymbol{\rho\pi R5}}{\mathbf{2\lambda 3wm3}}\mathbf{(5)}$$

The wind turbine in the simulation study is model by which the input variables are the wind turbine rotor (Wm) and the torque speed ratio that can be calculated with wind speed. According to (3) and (5), the aerodynamic torque is maximized at a given wind speed when the pitch angle of a blade is (β) 0. So, a constant pitch angle (β=0) is used in this study.

C. Direct Driven Permanent Magnet Synchronous Generator

The wind generator consider on this time is a gearless direct-driven PSMG. This PMSG do not require common mechanical maintenance as it does not use gears among wind blades with the generator. An additional advantage of the direct-driven PMSG is to a permanent magnet eliminate the dc excitation circuit that may complicate the control hardware. The table 2 shows the terms of the direct-driven PMSG model used in the simulation study. For the simulation study, the internal mode of a PMSG in MATLAB is used with the specifications provided in Table 2.

Specifications of Direct Driven Permanent Magnet Synchronous Generator Model

Parameter name	Value	Unit
Rated power	20	KW
Rated line voltage	519.6	Vrms
Stator phase inductance	8.5	MHz
Stator phase resistance	0.35	Ω
Number of poles	12	
Rated mechanical speed	263	Rpm
Electrical base frequency	26.3	Hz

D. PV System Model

This learn use the PV model that is depict with was proposed in since it is suitable for simulate practical PV system which are composed of various PV module as well as since it only require a few parameter, such as the number of PV modules, PV array open-circuit voltage an Short-circuit current. Additionally, this model can represent solar Irradiance and temperature change which may happen commonly during the day. However, a reader may refer designed for explanation of such model derivation. The rated power of the PV system in this paper is 10 kW, which is collected of 50 KC200GT module manufactured by Kyocera Solar Energy Inc. The simulated PV system configuration is an array of 5 10 modules, and its voltage and current at the MPP with the solar irradiance of are 261.3 V and 38.1 A, respectively.

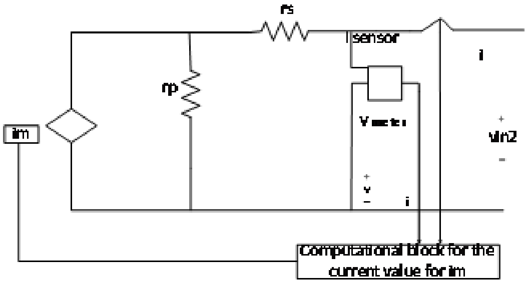

Fig.3. Simulation Study of PV Model Circuit Based

E. Energy Storage System Model

These studies consider battery as energy storage devices. But, this battery can require a dc-dc power converter in arrange to step up their $Vbatt$ to the main dc bus voltageVdc as their nominal voltage whose level is 240 V in this micro grid is typically lower than the main dc bus voltage. One cause used for using a lower battery voltage is to improve their reliability with life-time by avoiding issue found in higher voltage configurations, such as cell voltage equalization. For this reason, a bidirectional boost/buck converter is considering in the proposed micro grid. If the power generation as of the renewable micro-energy sources is inadequate demand power at the load side, this bidirectional converter operate within a boost mode during order to discharge energy from batteries to the main dc bus as depicted. But, once the renewable power production exceed the load-side demand power, this power converter works in a buck mode in which power flow from the main dc bus to charge the battery with the extra local power production.

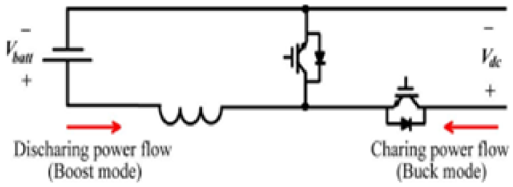

Fig.4 Energy storage system

Artificial Neural Networks

Various advance contain be through in developing intelligent systems, some stimulated in biological neural network. Researchers beginning several scientific disciplines are designing artificial neural network to explain a range of problems in model recognition, prediction, optimization, associative memory, as well as control. Conventional approach contain been proposed for solve these problems. Although successful applications can be real found during certain well-constrained environment, nothing is flexible enough to perform well outside its domain. ANNs supply moving alternative, with much application can help from use them. This object is designed for that reader by little or no information of ANNs to help them know the new article within this topic of *Computer*. We converse the motivation after the development of *A* ” *s* , state the fundamental organic neuron with the artificial computational model, outline network architectures with learning process, and present some of the most commonly used ANN models. We close by character recognition, a winning ANN application.

The artificial neuron is a simple summing unit. It adds its weighted inputs and produces an output which is a function of the sum of the all weighted inputs. It is developed to take off the performance of the biological neuron in the human brain which forms a powerful information processing system when interconnected with large number of neurons. The imitation of this massive parallelism of this neuron architecture in the human brain leads to the development of the artificial neural networks. Here is simple model of an artificial neuron.

F. Multiple Input Current Source Converters

The multiple input current source converter topologies are used in CUK converter in this micro grid. These MI CSI converters supply nearly continuous input current waveforms due in the direction of their CSI input legs. Therefore, these converters supply other operational suppleness than an MI buck- boost converter

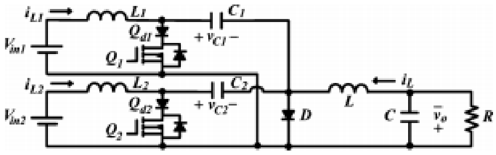

Fig.5 mi CUK converter

Since they allow the addition of input source with the intention of require a relatively constant current, such as the input current control that is used in this power plant as well as is explained. An MI CUK converter is similar to an MI SEPIC converter except for the output voltage inversion. Though, since there are more past works focusing exclusively on the MI SEPIC the analysis here focuses on the MI CUK converter.

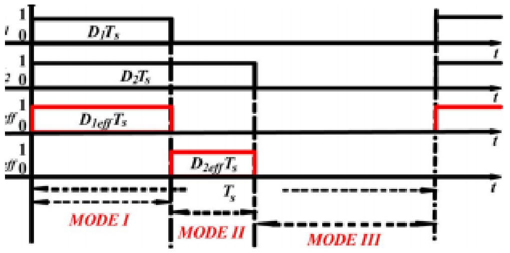

Fig.6. Switching diagram of CUK converter

The switching operation of an MI CUK converter. Is to be operate into a continuous conduction mode, because circuit operation within a steady state can be describe based on the following three operational modes

1) Mode1 ($0 < t < D1Ts$): It is assumed that the voltage level of the first input source ($Vin1$) is high than that of the second input source ($Vin2$) . Active $Q1, Q2$ switches as well turned on in this mode as depict in. Only$Q1$ conducts current since the diode$Q2$ is reverse-biased due to the assumption that is $Vin1$ greater than $Vin2$. The diode D at the common output stage is also reverse-biased

2) Mode 2 ($D1Ts < t < D2Ts$): The only an active switch$Q2$ is turned on and conducts current in this mode as the diode ($Qd2$) is also turned on. The diode$D$ at the common output stage is still reverse-biased.

3) Mode 3 ($D2Ts < t < Ts$): All switch except the diode D are turned off in this mode. so, the diode only conducts current.

Base on the described operational mode, the switched dynamic model of this MI CUK converter is governed by

$$L1di^{L1}/dt = Vin1 - q2eff(t)(Vc1 - Vc2) - \left(1 - q2(t)\right)Vc1$$

$$L2^{dil2}/dt = Vin2 - q1(t)(Vc2 - Vc1) - \left(1 - q2(t)\right)Vc2$$

$$L^{dil}/dt = q1(t)Vc1 + q2eff(t)Vc2 - V0$$

$$C1\frac{dvc}{dt} = \left(1 - q1(t)\right)il1 - q1(t)(iL + iL2)$$

$$C2\frac{dvc2}{dt} = \left(1 - q2eff(t)\right)iL2 - q2eff(t)(iL + iL2)$$

$$C\frac{dv0}{dt} = iL - \frac{V0}{R}$$

$$\begin{bmatrix} Vc1 \\ Vc2 \\ V0 \end{bmatrix} = \frac{1}{1-D2}\begin{bmatrix} (1 - D2eff)Vin1 + D2effVin \\ D1Vin1 + (1 - D1)Vin2 \\ D1Vin1 + D2effVin2 \end{bmatrix}$$

$$\begin{bmatrix} IL1 \\ IL2 \\ IL \end{bmatrix} = \begin{bmatrix} \dfrac{D1IL}{1 - D2} \\ \dfrac{D2effIL}{1 - D2} \\ \dfrac{P0(1 - D2)}{(D1Vin1 + D2effVin2)} \end{bmatrix}$$

Where $q1$ and $q2$ are the switching functions of the MI ĆUK converter, and $q1eff(t) and q2eff(t)$ are the effective switching $q1(t), q2(t) and q2eff(t)$ functions of each input cell that equal and respectively. In an average sense, the derivatives of an inductor current and a capacitor voltage are zero. In addition, switching functions, with can be considered as duty cycles $D1, D2 and D2eff$, and respectively in the average model. Then, the average model of this MI CUK converter is

Where $Vc1 Vc2 and V0$ and$V0$ are the average voltages on capacitors $C1$ $C2$ and$C1$, $IL1$ $IL2$ and IL are the average currents of inductors $L1$ $L2$ and L respectively, and$P0$ is the output power of the MI CUK converter. Therefore, the steady-state output voltage of the MI CUK converter is

$$VO = \frac{D1Vin1 + D2effVin2}{1 - D2}$$

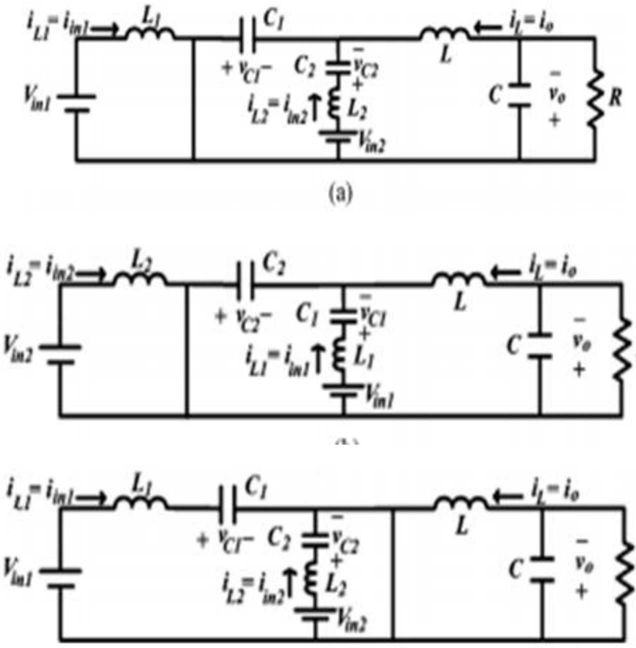

Fig.7. Operational modes of the MI CUK dc-dc converter. (a) Mode I Q1 (only conducts current). (b) Mode II Q2 (only Conducts current) (c) Mode II only diode D conducts current

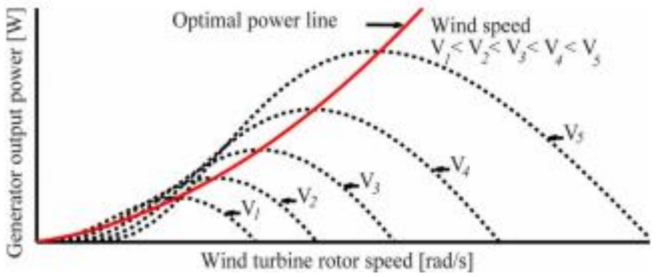

Fig.8. Wind turbine of mechanical power at various wind speeds

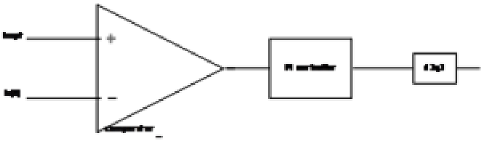

Fig.9. Current mode controller

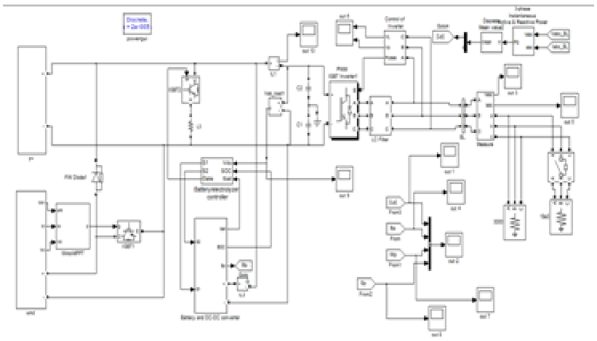

Fig.10.Simulation model of proposed hybrid system

IV. Control Strategies

A. Wind Turbine: Variable Speed Control

This paper uses a variable speed control method whose strategy is to capture the maximum wind energy below the rated wind speed. Shows mechanical power captured by wind turbine blades at each rotor speed of the wind turbine(Wm) and various wind speeds ($Vwind$) . As mechanical power from the wind turbine depends on the wind turbine rotor speed (Wm). In addition, the optimal power line can be obtained by connecting MPPs at each wind speed because a single MPP exists at each wind speed as shown. Hence, the operation of the wind turbine at the optimal rotor speed ($Wmopt$) on the optimal power curve ensures that the wind turbine capture the maximum wind energy below the rated wind speed.

One feasible method to operate the wind turbine on the optimal power line below the rated wind speed is to control the three-phase rectified output current (Ir) by the wind turbine rotor speed (Wm) . In order to describe such control method, the optimal mechanical power ($Pmopt$) of the wind turbine is considered to be

$$Pmopt = \frac{Cpmax\rho\pi R5}{2\lambda 3}wm3$$

$$= Koptwm3 \text{ With}(Kopt = \frac{Cpmax\rho\pi R\ \ 5}{2\lambda 3}wm3$$

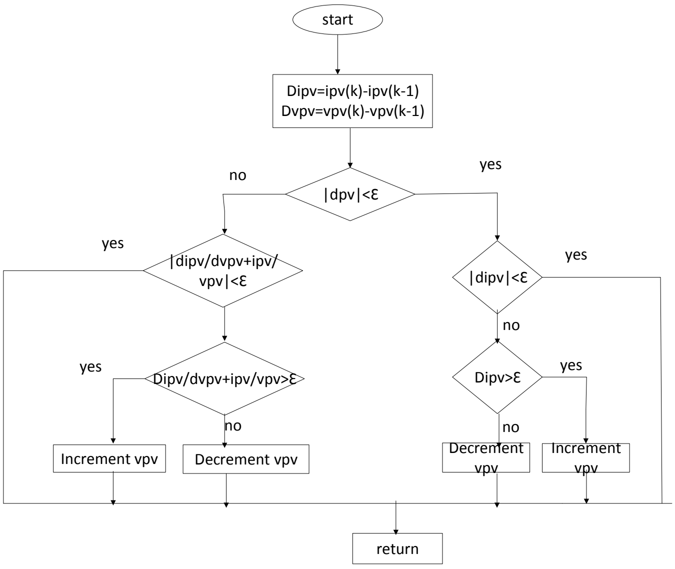

Fig.11.flow chart for incremental conductance method

Fig.12. D-q inverter current controller

a. Current controller b. Active power controller

Where $Cp$is the maximum rotor power coefficient,λopt is the *the* optimal TSR, $Kopt$ is an optimal power constant is air density, and R is the radius of a wind turbine blade. If power efficiencies of the wind generator and the three-phase rectifier. They assumed toward exist constant at ῆG and ῆR respectively, the optimal real power$PRopt$ at the three-phase rectifier output.

$$PRopt = VRIR = \text{ῆ}G\text{ῆ}RPmopt = \text{ῆ}G\text{ῆ}RKoptwm3$$

Where VR and IR is the rectified output voltage and current respectively. But a PMSG is assumed to be an ideal generator, the line-to-line voltage is

$VLL(t) = Kvwesin(wet)$ With $(we = P/2wm)$

Where Kv is the voltage constant of the generator, $we$is the electrical angular frequency of the generator, and P is the number of poles in the generator. Then, the three-phase rectified output voltage VR is

$$VR = \frac{3}{\pi VLLP} - \frac{3}{\pi WeLsIR} = \frac{3pKv}{2\pi} - 3PLs/2\pi WmIR$$

Where $VLLP$ is the peak line-to-line voltage, and Ls is the stator phase inductance of the PMSG. By solving the quadratic equation that be able to be obtained from with respect to, the reference rectified current $IRopt$ results to be equal to

$$I_{R_{\rm opt}} = \frac{3pK_v - \sqrt{(3pK_v)^2 - 24p\pi\eta_G\eta_R K_{\rm opt} L_s\omega_m^2}}{6pL_s}.$$

Hence, the wind turbine can be operated along the optimal power curve if $IR$is controlled to its reference value by$IRopt$ adjusting the duty ratio of the MIC at each Wm according towards. This paper uses a PI controller, in order to achieve this target current ($IRopt$).

B. PV Module: MPP Tracking:

The PV system is too controlled so that it operates at its MPP. An incremental conductance method is selected for this purpose. It use the PV module output current and voltage information based on polarity change in the derivative of power by respect toward their voltage, which is zero at the MPP, positive at the left of the MPP, and negative at the right of the MPP. These voltage polarity change characteristics lead to the following

$$\frac{dp}{dv} = d(vi) = I + \frac{vdi}{dv} = 0 \text{ (At the MPP)}$$

Principle that identify whether PV panel reach their MPP or not. Once the MPP is calculated with this method, the MIC controller regulates PV modules' output voltage towards the obtained reference voltage by adjusting the MIC's duty ratios. The detailed flow chart of this control method is provided. A toleranceε which equals zero is used for this condition during the model study as this tolerance allows PV modules to remain at their MPP once they reach their MPP. Or else, PV modules may oscillate around their MPP when they reach their MPP, thus producing steady-state error at the operating points of the PV system.

C. ESS Control:

The ESS in this micro grid is controlled to regulate the main dc bus voltage Vdc mutually when there is not sufficient power production from the wind generator and PV module with when there is excess local power production to charge the battery. A bidirectional boost/buck converter shown is used with the hysteresis control in. If vdc is higher than an upper voltage limit, $vdcup = 390v$ ESS will be charged in a buck mode so that Vdc is in time toward. If $vdc$is lower than a lower voltage limit, ($vdclow = 370v$) ESS will be discharged in a boost mode in order to regulate vdc toward $vdclow$. Otherwise, ESS will be in a float mode.

D. PWM Inverter Control

The primary aim of a PWM inverter controller is to regulate three-phase local ac bus voltage and frequency in this micro grid and to dispatch target active power$Pgridref$ to the distribution grid, which may be set by user or grid operator. For these purpose,$d, q\ ref$ based current control is used in the PWM inverter a local ac line-to-linevab voltage is regulated by the component $d$of the reference inverter current $Iinv\ dref$ in thedq frame. Dispatch active power to the grid $pgrid$ can also be controlled by the q component of the reference inverter $iinv\_qref$.

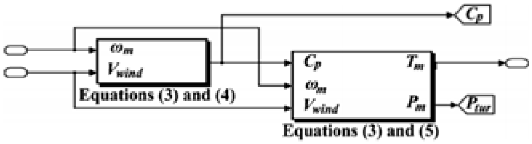

Fig.13. Wind turbine block diagram

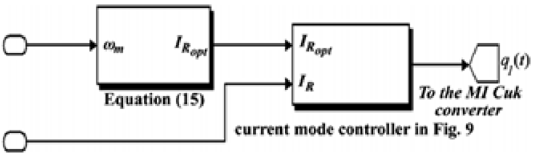

Fig.14. Block diagram of wind turbine controller

V. Results and Discussions

A. Control Performance of the Wind Turbine

A wind model presented is considered to simulate the spatial effect of unreliable wind component. When wind speed increases, the wind turbine rotor speeds Wm accelerate so that the output power from the wind turbine$Ptur$ increases. On the other hand, when wind speed decreases, the wind turbine rotor speed slows down so the output power from the wind turbine decreases. The wind turbine is also operated at the optimal rotor speed$Wmopt$ and harvests the maximum power

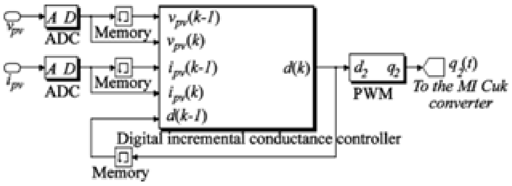

Fig.15.Block diagram of the PV pannel controller ADC-analog to digital converter PWM-pulse width modulation.

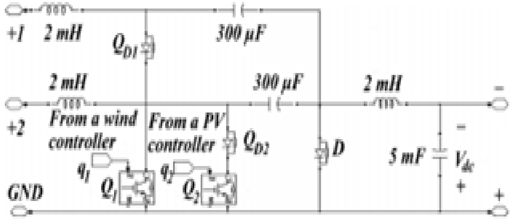

Fig.16. Detailed schematic of the MI CUK converter

from wind energy at each wind speed since a rotor power coefficient Cp keeps constant at 0.44, which is its maximum possible value as shown in and shows the output terminal electrical characteristics of the three-phase rectifier with wind energy variation. The reference input current elevates when wind speed increases. Thus, the rectified output current Ir is controlled toward the reference current, and the terminal rectified output voltage increases as indicated. Therefore, the output power from the wind turbine increases when the wind speed also increases. Similarly, when wind speed decreases, the reference input current declines, thus decreasing the rectified output current and the terminal rectified output voltage.

Hence, the output power from the wind turbine $ptur$declines when wind speed decreases. so, it can be done that the wind generator operate in the optimal power point despite different environmental condition such as sudden increase or decrease of the wind speed, which likely happen during the day. Additionally, the wind generator controller expeditiously reacts to such rapid changing environmental conditions.

B. Control Performance of The PV Module

This study also investigates the system performance with solar irradiance variation. The PV panel surface temperature is assumed to be fixed at during the entire simulation period. It show the control performance of PV module with solar irradiance variation whose data sets [29] were collected at Golden, CO, by NREL from 12:41 pm to 1 pm MST on July 31, 2008. The PV module operating power point are well-followed toward the MPPs because described is almost zero even when the solar irradiance changes as attested in. Thus, this PV system controller tracks the MPPs of solar energy regardless of the rapidly changing wind energy. Specially, these PV system controllers immediately locate the MPP since this PV system is independently controlled. Considering that the performances of these wind and PV controllers illustrated it is verified that the discussed control strategy is an adequate one for a wind/solar micro grid with a CSI MIC.

C. Control Performance Of The MI CUK Converter

It shows the control performance of the MI CUK converter when wind speed and solar irradiance change in the same manner than within shows the input current waveforms of the MI CUK converter presented from a hardware experimental prototype. It shows the input current waveforms of the MI CUK converter to be continuous so that it can provide operational flexibilities this show the input(Pi) and output power(Po) of the MI CUK converter, the wind turbine power, by the PV modules’ power. Present appear to be difference betweenPi withPo due to the switching with conduction losses in active circuit apparatus.

D. Inverter Results with Variable Load and Power Source

The study of micro grid performance with variable source with load power conditions on the grid-side of the inverter. When the input source power is changed as the demand at the local ac bus is also changed as depicted In addition, the target dispatch active power to the distribution grid is modified from 10 to 5 kW at the 10 minutes mark. The grid-side PWM inverter generates enough power required for the variable local ac load and dispatch power to the grid

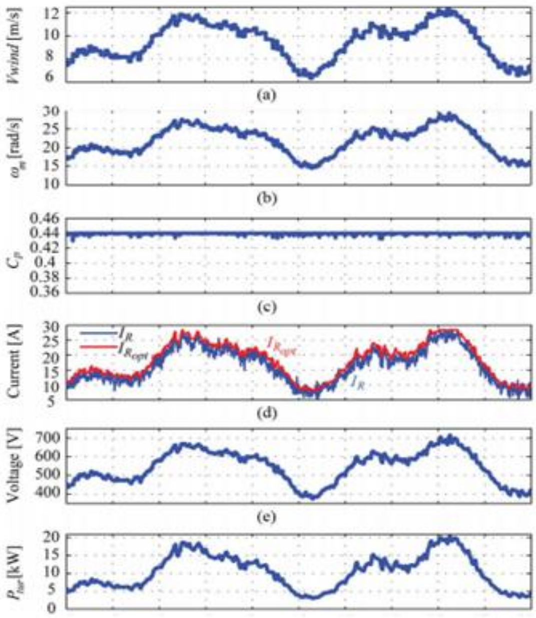

Fig.17.Wind turbine control performance. (a) Wind speed(Vwind) (b) Turbine rotor speed(wm). (c) Wind turbine rotor power coefficient(Cp). (d) Reference current(Iropt) and three-phase rectified output current(Ir). (e) Three phase rectified output voltage(Vr). (f) Wind turbine power(Ptur).

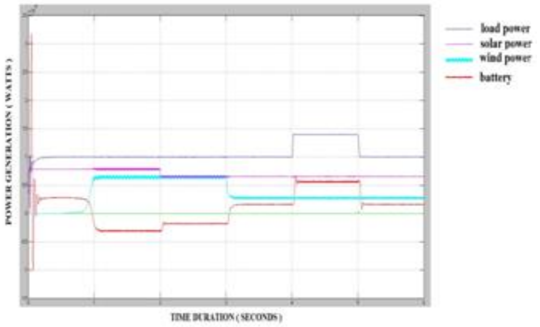

Fig.18.Load Sharing Action Performed by the Hybrid Energy in Polycrystalline Solar Panel TSP 230

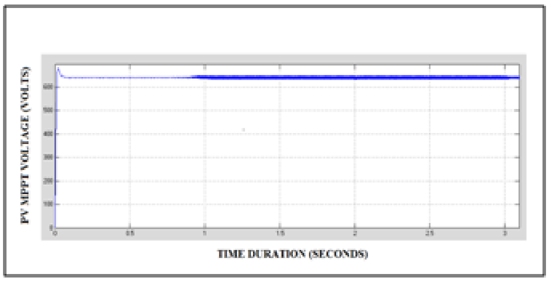

Fig.19. Phase Voltage observed at the PV array

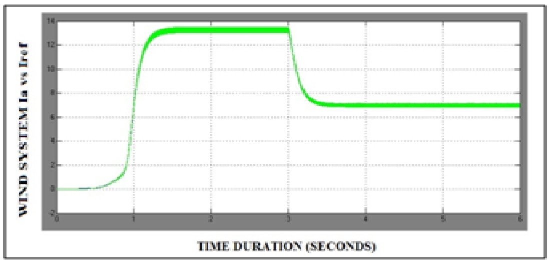

Fig.20.The relative variation curve of Actual Current (Ia) and Reference Current (I ref)

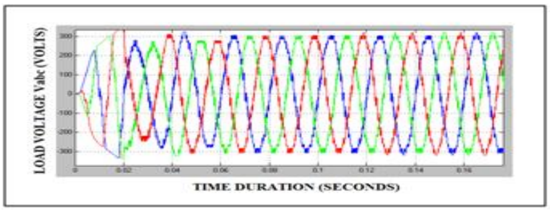

fig.21. AC Line Voltage and Phase Voltage given by the Inverter

CONCLUSION

This paper presents the dynamic modeling with operational strategy of a sustainable micro grid mainly powered by wind as well as solar energy. These renewable sources are integrated into the main dc bus during an MI CSI dc-dc converter. Wind energy variation with rapidly changing solar irradiance was considered in the effect of such environmental variation to the intended micro grid. In adding, the proposed micro grid is equipped with an ESS also is connected with the distribution grid. These varied micro-energy resources can improve the micro grid performance and reduce power generation variability and vulnerability to natural disaster. Its power converter can also be designed in a smaller size with low production costs because MICs can remove unnecessary redundant components.In the proposal load demand is meet since the combination of PV array, wind turbine with the battery. An inverter is use to change output from solar & wind system into AC power output. Circuit Breaker is used towards connects an additional load of 5 KW in the given time. This hybrid system is restricted to give maximum output power under all operating condition to meet the load. Each wind otherwise solar system is support by the battery to meet the load. And, simultaneous operation of wind and solar system is supported by battery for the same load.

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