

Fault Ride Protection of the Motor-Generator Pair System for Renewable Energy Systems

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Abstract- Now days the world has reached to a point when integration of renewable energy sources like the wind energy, solar energy etc. with the electricity grid of the country will have a greater role. As such when the global warming rate has reached to distressing rate in the world. Also there will be problems while implementing the connection of wind turbines and any other renewable energy sources with grid. One of the problems related to this is called 'Fault ride through disturbances' this work proposed asynchronous Motor and Generator Pair (MGP) system as a probable solution for the integration of renewable energy to recover inertia and improve network stability. In this work analyze briefly the Fault Ride Through scenario of wind energy conversion system (WECS) and solar system with this work establish the Dynamic Voltage Restorer (DVR) configuration or manage strategy. To compensate for power for each phase disjointedly, a closed loop PI manage law is proposed in d-q reference frame. The proposed technique provides fast response and effectual case recompense functions and run a MATLAB/SIMULINK simulation of such type of Low Voltage Fault Ride through Scenario, as well as analyzing the results.

Keywords- Dynamic Voltage, DGP etc.

I. INTRODUCTION

As an important part of the green energy revolution, the world is determined to shift from traditional fossil fuels to renewable energy. India is one of the largest coal users in the world. The use of renewable energy such as solar power plants (PV) and wind energy is the highest priority for the Indian government to meet India's growing demand for fuel and renewable energy.

Grid metering allocate private or business customers who produce electricity from RE to send electricity that they do not use back to grid, and utilities can provide grid measurement plans voluntarily or as a result of regulatory decisions.

This is a billing mechanism that credits electricity that owner of the renewable energy organization adds to the grid. For example, if a private customer installs a photovoltaic system on roof of a home, it may generate more electricity than it uses during the day.

If consumer's electricity connection is mains metering, meter runs backwards to give credit for the amount of electricity consumed at night or other household electricity consumption that exceeds the system output. Customers only pay for their "net" energy consumption. On average, only 20-40% of production from photovoltaic systems is integrated into the grid. The exported photovoltaic system serves the load of nearby customers.

Grid metering allows utility customers to produce electricity cleanly and efficiently. During day, most solar cells manufacture more electricity than they use; grid metering tolerate them to export electricity to grid or reduce their future electricity bills. Government institutions or schools in California will use grid metering to save billions of dollars in electricity bills over the next 30 years.

In the following centuries, great advances were made: the perfection of induction motors or motors, electric meters, high -speed transmission, gas turbines, nuclear

reactors, turbines or solar cells. These technologies focus on the development, improvement or evolution of network. A large central power generation arrangement that connects to energy users through a transmission or allotment network. Despite seemingly endless effort and money put into the "biggest machine ever", other research trends have begun in recent years, as people have begun to look for the benefits of turning to the other way around.

Distributed, distributed, local plates: micro grid. Although the idea of a Micro grid network (i.e., small) has been around for a long time, researchers at the University of Wisconsin-Madison thought of the first modern Micro grid type: a series of energy and loads, usually including storage or control. free The system allows connection to the grid or "Island" to operate. In 2012, the U.S. Department of Energy's Micro grid communication group provided a legal definition. Micro grid is a load-bearing unit constant or circulating power sources within clear electrical limits. They function as a single and suitable component.

The Micro grid can be connected and removed from a large power source to power a camera or island. At the University of Wisconsin-Madison's first vision, the primary reason for the idea was to create a distributed energy system (DER) that could coexist peacefully with the environment. Major Prior to the analysis of microgrids, when power supply problems were identified or frequent, different industrial users forced customers to use DER to separate these sources. These measures are considered to shelter online employees or other customers create barriers for them to use such assets, make meetings or inspections difficult or costly and reduce their needs.

II. LITERATURE REVIEW

Yan Li et.al (2020) in recent years, renewable energy representatives of wind power and photovoltaic's have expanded rapidly around the world. Renewable energy in China is the country with the fastest growth in wind power and photovoltaic power generation. 174 million kilowatts, totaling about 19% of China's electricity capacity, renewable energy has become the second largest source of energy. In Gansu, Ningxia, Xinjiang, Hebei, Inner Mongolia and the provincial pipelines with high renewable energy input rates, total renewable energy capacity and renewable energy from 41.4%, 36.5%, 32.2%, and 30.1%. , 28.8%. According to the 2015 report of the

Commission for Development and Reform "Research on the Majority of the Renewable Energy Sector in China by 2050", by 2030, the amount wind and solar power capacity is more than 2.05 billion kilowatts, accounting for about 51% of the country's total installed capacity. %.

With the rapid increase in the fraction of wind power, the wind force must change from auxiliary force to main force, actively participating in the control of the work- work, and reach the connection between the air cords. In the process of wind power, in order to effectively solve the problem of wind power transmission related to high wind power, it is urgent to make a request analysis on the nature of wind power transmission and know the process of feeding wind power. Dynamic control technology.

Youjie Ma et.al (2020) as a renewable natural energy source, energy from wind is spreading around the world. It is one of most widely used green energy sources or can be used to build energy systems. Thus, the Wind Energy Transformation System (WECS) has attracted the attention of renewable energy in recent years. In order to recover short-term stability and to deal with the irregularities, variable parameters, strong compositions and various problems, the WECS abrasion resistance control (LADRC-CL) strategy based on long-lasting magnetic fusion is proposed Generator (PMSG).

LADRC-CL is accompanied by a law governing traditional PD control, a permanent monitor (LESO) and a correction link. Compatibility, stability, and resistance to interference are examined in the field frequently. The mathematical model of WECS is further analyzed, or part of model information is written in the LESO matrix, which significantly reduces the burden of the LESO analysis. In the experiment, control performance of LADRC-CL under different operating conditions was tested by a fully-ventilated chemical testing platform of a 3.6MW unit, and the efficiency was verified. Accuracy and effectiveness of the control against the interference with the correction link.

III. PROPOSED SYSTEM

Renewable energy sources are compulsory to have reliable fault ride-through capability to avoid large-scale detachment of renewable power plants due to grid faults. Structure of Motor-Generator Pair and

Power Grid with High Penetration and mitigate fault ride capability to prevent from overvoltage and overloading current. The proposed MGP system based on asynchronous machines and Renewable Energy. The motor and the generator of MGP are asynchronous machines. Power generated by renewable energy, converted by the inverter, and then converted used to drive the asynchronous motor. The shafts of the two machines are coupled so the motor can drive the generator, which means that the synchronous motor replaces traditional steam turbine and water turbine. Both machines operate in the same rated speed, so the generator can be directly connected to the power grid similar to a traditional power plant.

Motor Generator Pair (MGP) organization is identification of grid failures. This is completely different from traditional obstacle ride-through methods. First, in this paper, we introduce the structure or model of MGP system and then show a new control technique of the MGP system based on DC link voltage feedback. This is very important for an impaired ride-through of control power balance on both sides. DC bus Separation mechanism dumping and reactive power maintain function of grid disaster MGP classification.

Wind, solar energy or other renewable energies themselves have irregular fluctuations and the load on the power system is not constant. The high penetration control system solves the problem of cause load fluctuations. Otherwise, arrangement will not run stably. Fundamentally, wind or solar power modify over time, but nesting of wind and solar power in other areas is essentially stable. On many days solar and wind farms compensate each other. Although the load in load side area is not stable, the total power in world is basically stable. Global power grids can be connected together for suppression. Equipment used to mitigate variability in this work.

IV. RESULTS AND DISCUSSION

Figure 1 shows the configuration of an MGP system that connects renewable energy or the grid to asynchronous and generator pair. This method can provide inertia to have asynchronous machines that can connect renewable energy to the power grid. Given that the grid capacity of renewables typically reaches the MW scale, both generator or motor are designed using an asynchronous system. DVR fact

device used to mitigate fluctuations. The results attain are imitation in Matlab/Simulink. This shows that the planned technique can efficiently reduce voltage fluctuations or imbalances in allotment complex.

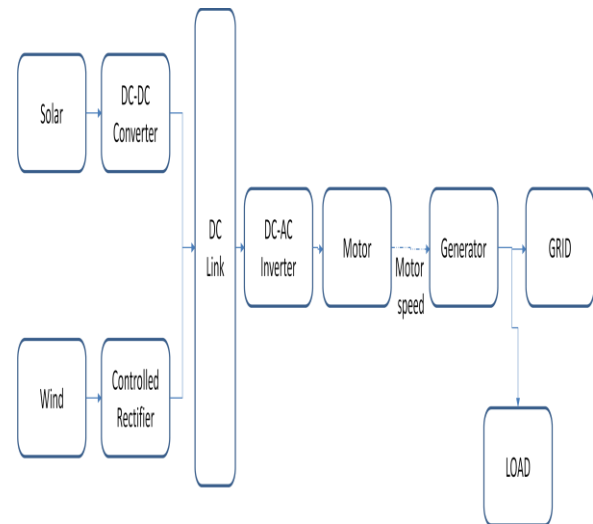


Fig 1. proposed block diagram.

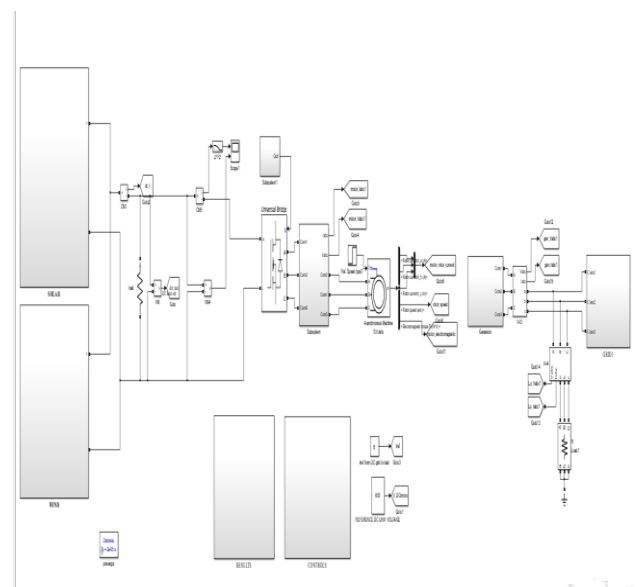


Fig 2. proposed simulink model.

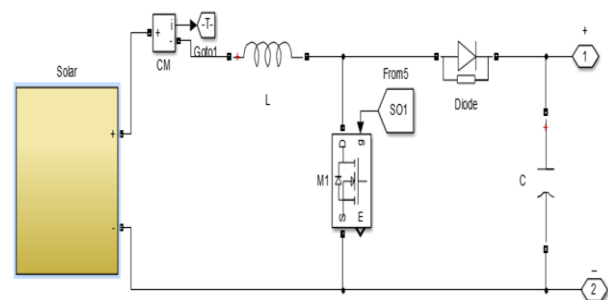


Fig 3. Solar equivalent circuit.

1. Solar:

Solar micro grid systems are calculated to control in 2 modes: network interaction or island mode. In interactive state of complex, battery system or solar power organization work in parallel. Solar cell classification is commonly used as grid-connected solar cell systems. At the peak of the day, the battery system is not very active, but when solar power system does not use most of inverter influence (that is, at night), it can actively contribute in rapid response of the incidence adjustment.

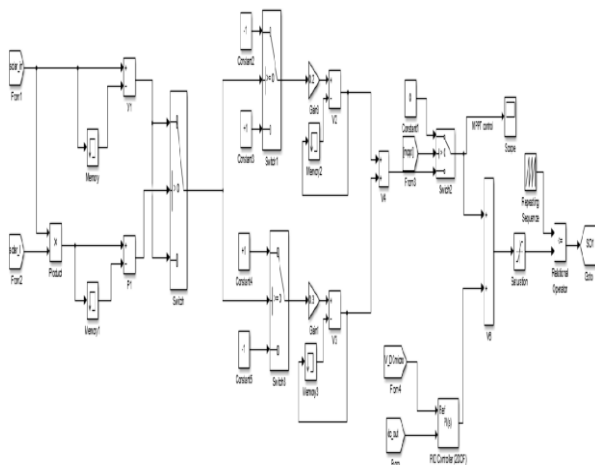


Fig 4. MPPT subsystem.

The maximum capacity tracking (MPPT) is a practical algorithm with photovoltaic inverter (PV) to set the endless impedance, which is set by an optical system in the conditions to switch to the system in the system PV, or near the photovoltaic systems.

Figure 4 shows organize diagram of the hybrid PV Battery energy storage organization. There are 2 control loops in this system: a power stress and loop. The voltage loop is located in the external section or current loop is located in internal section. In addition, the two current loops within the current control ring for the battery and another round are the DQG-jBat (surgery battery switch).

VDC the DC voltage of DC voltage must remain the same when the start value is the same, and the external voltage control ring maintains this constant voltage. This instruction ensures that energy balance is electrical energy with loads by loading link DC connection voltage and the DC connection source line similar to the load flow controller. Therefore, the VDC Dc link voltage creates IDC reference diab *. The current PV reference output extends except for reference Dc link line. It produces the reference

battery line, corner frequency of ring in a larger manner the angle frequency of the outer loop. Therefore, the loop is faster than the outer loop. Basically, speed of the response depends on corner frequency of controller. Here, the installation of the KD value of the PID controller is 0 the obtained angle frequency ($32/2 = 16$) and for the PI controller of the internal loop $0.4165 / (8, 33) 50$. Thus, the corner frequency of the inner ring is more.

As the outer loop. Therefore, it can be completed that the current loop first reaches the installation value, and then the DC voltage reaches reference value. Therefore, the capacity can be controlled both in load fluctuations and in the fluctuations in the source fluctuations / scaling conditions of the irradiation of PV cells.

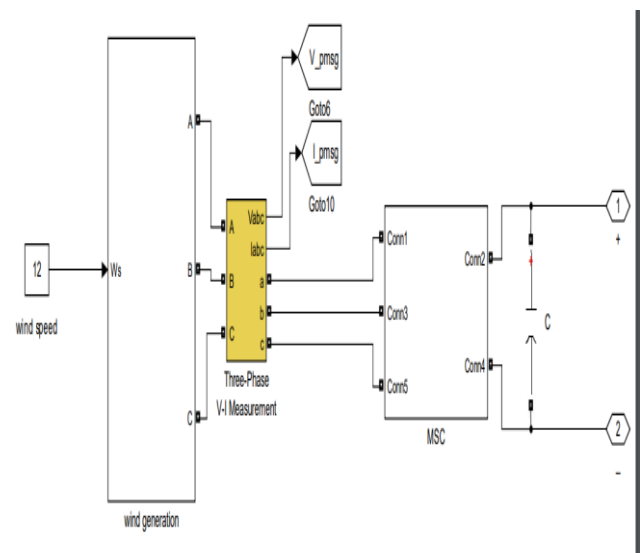


Fig 5. wind subsystem

2. Wind Turbine

Wind is formed by sun unevenly heating surface of earth. Wind turbines convert the kinetic power of wind into clean electricity. When wind rotates the blades of a wind turbine, the rotor captures kinetic power of the wind or converts it into rotational motion to drive the generator. Most turbines have an automatic speed organize system to prevent the rotor from spinning out of control in very strong winds. Small wind classification can be connected to the grid through a power supplier or can be alone (off-the-grid).

This makes small wind power systems a good choice for rural areas that are not yet connected to electric grid. Wind turbines can operate in both fixed and inconsistent speed modes. Fixed speed turbine

generators can be connected directly to the grid or load. With variable speed turbine power, electronic devices convert variable frequency, inconsistent power into constant frequency and power. The use of variable speed wind turbines has made it possible to incessantly adapt the rotational speed of the wind turbine to the wind speed.

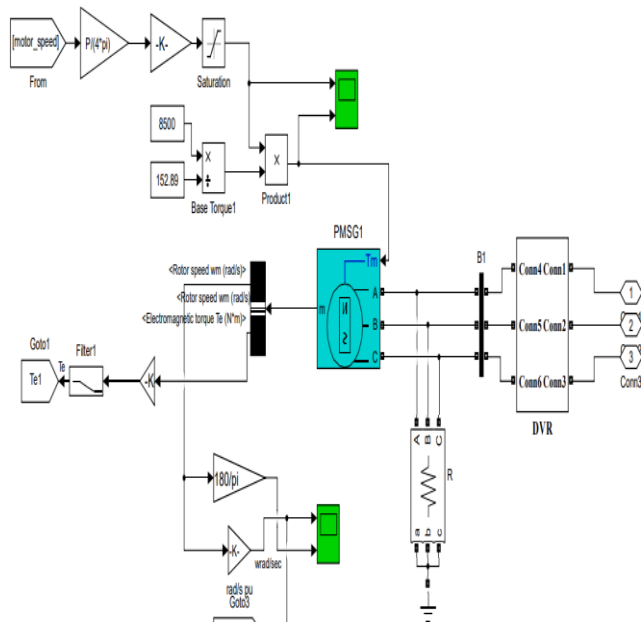


Fig 6. PMSG Block.

Electric wind systems consist of wind turbines installed in towers for easy access to stronger winds. In addition to turbines and towers, small wind power systems also require balancing of organization components.

3. Turbine:

Most small wind turbines produced today are horizontal wind machines with two or three blades. These blades are usually made of complex materials such as fiberglass. The frame of the turbine is a structure in which a rotor, a generator, or a tail are installed. The amount of energy a turbine generates is primarily resolute by diameter of its rotor. The diameter of the rotor defines its "sweeping area", i.e. the amount of wind blocked by the turbine. Because wind speed increases with height, tail hits the turbine wind tower.

A small wind turbine is installed in a tower. In general, taller tower, more power the wind system can produce. With a moderately small investment in increasing the height of the tower, you can make

very high profits in electricity production. For example, raising a 10kW generator from a 60-foot tower height to a 100-foot tower would increase the overall cost of the system by 10%, but could produce more than 25% of electricity.

Most turbine producer offer wind energy system packages that comprise towers. There are 2 basic types of towers. It is a self-supporting type (standalone) and this Ding Hyun. There is also a tilt-down version of Man's Tower. Most home wind systems use guide towers, which are the least costly or easier to install than self-contained towers. though, this radius should be 1/2 of the height of the tower and 3/4, so the guide tower needs enough space to accommodate it.

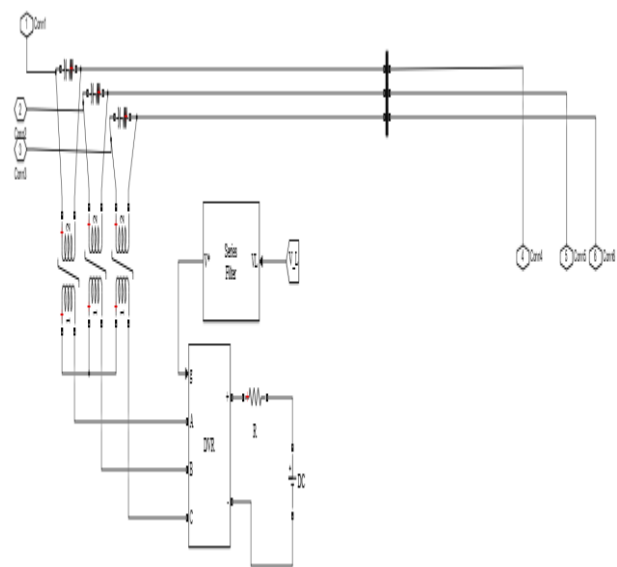


Fig 7. DVR Subsystem.

4. DVR:

(Dynamic Voltage Restorer) is a set of printers included with a great power arrangement. A schematic diagram of DVR is shown in Figure 1.16, including the VSC (1920) with a DC power supply. The major principle of the DVR is to recompense for the power drop / development of the flow cable to converter.

Adaptation is procedure of adjusting power or duration of a generator or other power source to a running network. Alternators cannot power the grid unless they are performed with the same measurements. Once both parts of the power cord are separated, the AC power source can no longer be replaced until it returns to a common operating state.

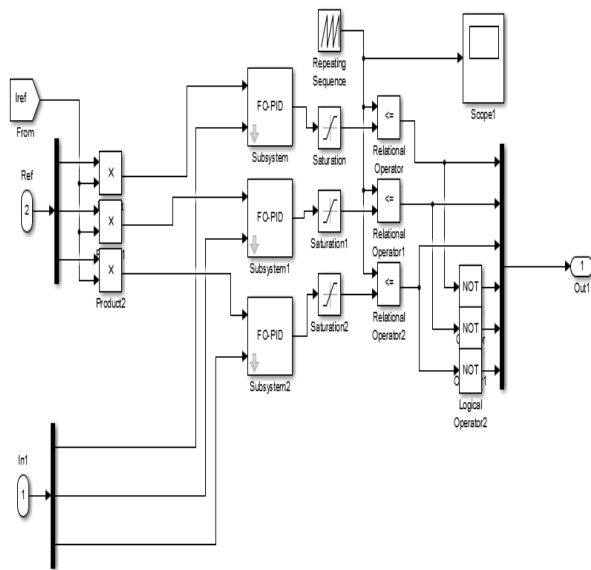


Fig 8. FOPID Subsystem.

5. Simulation Results:

Solar and wind-driven power generation is alternative sources of green energy that can alleviate the problem of power demand, and are conceivable enough. In this paper, we introduce a stand-alone hybrid power generation organization consisting of a solar generator and a permanent magnet synchronous generator (PMSG) wind generator or an AC load.

Supervisory controls designed to run maximum power point tracking (MPPT) are introduced, simultaneously maximizing energy harvesting throughout generation in a variety of climatic conditions. Two events are measured and classified according to the power generation and load requirements of each energy source. The PV system uses the Hill Climb Search (HCS) algorithm as the MPPT organize logic for wind power system, where the Perturb & Observe (P&O) algorithm is used as control logic of highest power point-following (MPPT) controller to maximize power is created.

6. Initial Parameters

It implements a three-phase asynchronous machine (wound rotor, squirrel cage or double squirrel cage) modeled with a selectable dq reference frame (rotor, stator, or synchronous). The stator and rotor windings are Y-shaped and related to the neutral point inside.

- Nominal power, voltage (line-line), or frequency [$P_n(\text{VA}), V_n(\text{Vrms}), f_n(\text{Hz})$]: --[4391.5 230 60]
- Stator resistance and inductance [$R_s(\text{ohm})$ $L_s(\text{H})$]: [0.5 1.9894e-3]

- Rotor resistance and inductance [$R_r'(\text{ohm})$ $L_r'(\text{H})$]: [0.25 1.3262e-3]
- Mutual inductance L_m (H): **0.26525**
- Inertia, friction factor, pole pairs [$J(\text{kg.m}^2)$ $F(\text{N.m.s})$ $p()$]: **0.005752 3]2)**
- Initial conditions [1 0 0 0 0 0 0]
- Mechanical power (W) **1.492e+006**

5.1 PMSG:

- It implements a 3 or 5stage permanent magnet synchronous generator. The stator windings are Y-shaped with internal neutral connection. A three-phase device can have a sine wave or trapezoidal back EMF waveform. For the sine system, the rotor is round or round. If computer is trapezoidal, rotor is circular. The sinusoidal back EMF model is pre-prepared for the computer. A sinusoidal back electromotive force waveform and circular rotation are possible on a 5-phase machine. This type of machine cannot use the preset model.
- Stator phase resistance R_s (ohm): **0.425**
- Armature inductance (H): **0.000395 0.433**
- Inertia, viscous damping, pole pairs, static friction [$J(\text{kg.m}^2)$ $F(\text{N.m.s})$ $p()$ $T_f(\text{N.m})$]: [0.01197 0.001189 5]

5.2 Solar panel:

- Short circuit current—7.34 A
- Open circuit voltage-----0.6 V
- Voltage at P_{max} 12
- IRRIDANCE -1000 W/m²
- QULAITY FACTOR ,- 1.5 N

5.3 FOPID:

In fact, the fountain integration operator ($1s^\lambda$ lambda) is a non-local operator that owns infinite memory and is considering recording the entire input sign of all integer car glasses.

Different from the transfer function $G\{I\}$.

- Proportional (P)- 1.2
- Integral (I)--1
- Derivative (D)-0
- Order (1 0 - first, 1 0 0- second....,)
- Filter Coefficient(N) 100

5.4 Universal bridge:

This block apparatus a bridge of preferred control electronics devices. Series RC snubber circuits are related in parallel with each switch device. Press Help for recommended snubber values when model is

discredited. For most applications interior inductance L_{on} of diodes or thyristors should be set to zero

- Snubber resistance R_s (Ohms) $1e5$
- R_{on} (Ohms) $1e-3$

5.5 Phase Locked Loop (PLL):

This phase-locked loop (PLL) system can be used to synchronize to a sinusoidal signal of variable frequency. When automatic gain manages is enabled, input (phase error) of the PLL regulator is adjusted according to magnitude of the input signal.

Set the regulator gain for optimal performance $[K_p \ K_i \ K_d] = [180 \ 3200 \ 1]$

- Input: Normalized input signal (pu)
- Output 1: Measurement frequency (Hz) = $w/(2\pi)$
- Output 2: Ramp weight varying between $0-2 * \pi$ synchronized to the zero crossing (rising) of the fundamental wave of the input signal.
- Minimum Frequency (Hz): 45
- Initial Input [Phase (degrees), Frequency (Hz)]: $[0, 50]$
- Regulator Gain $[K_p, K_i, K_d]$: $[180, 3200, 1]$
- Time of derivative action (s) $1e4$
- Maximum rate of change of frequency (Hz/s): 12
- Frequency measurement filter cutoff frequency (Hz): 25

5.6 Micro grid:

- Nominal Power-->1000
- Frequency----->60Hz
- Active power-----> $10e3(W)$

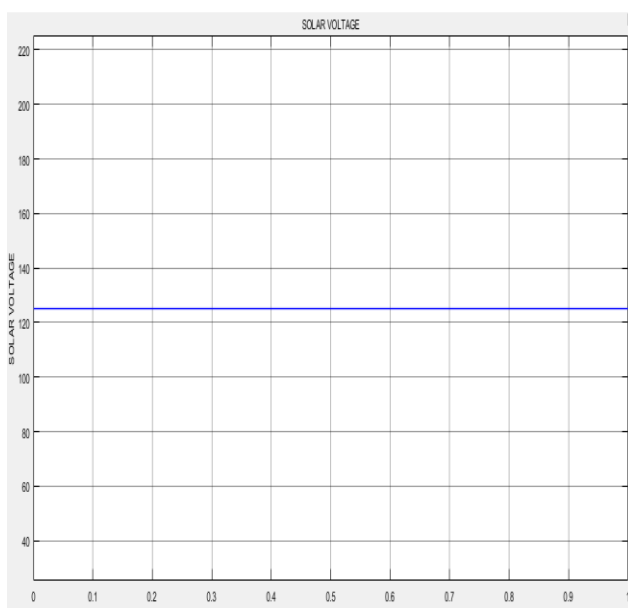


Fig 9. solar voltage.

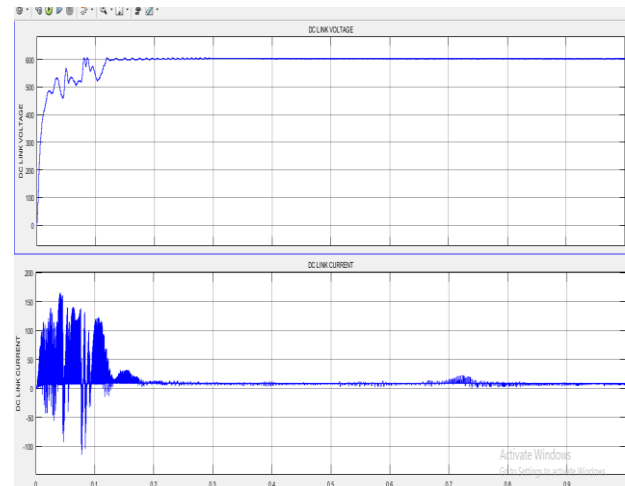


Fig 10. DC LINK voltage and current.

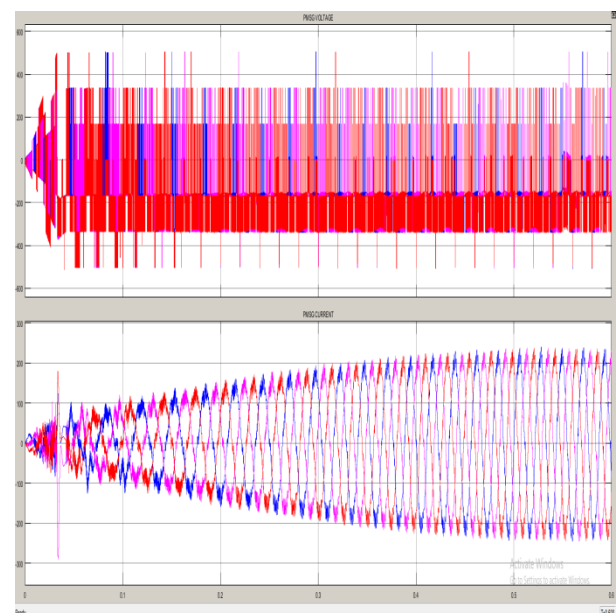


Fig 11. Permanent Magnet Synchronous Generator voltage and current.

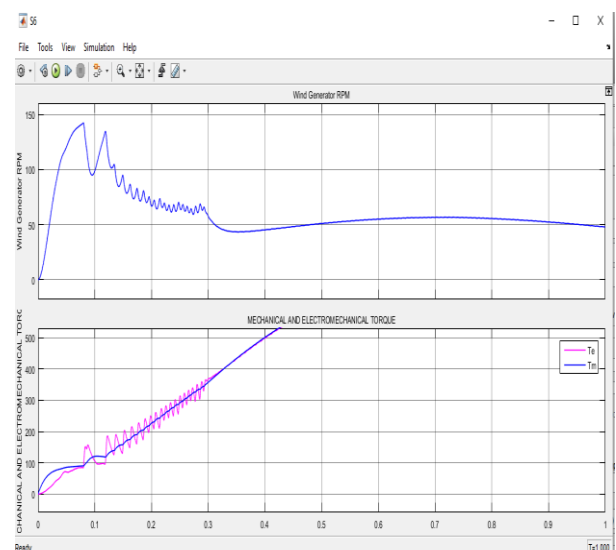


Fig 12. wind Turbine rpm and torque.

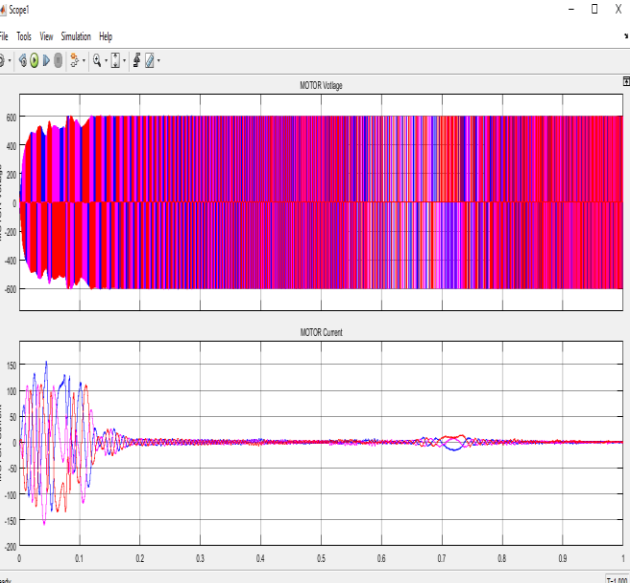


Fig 13. motor voltage and current.

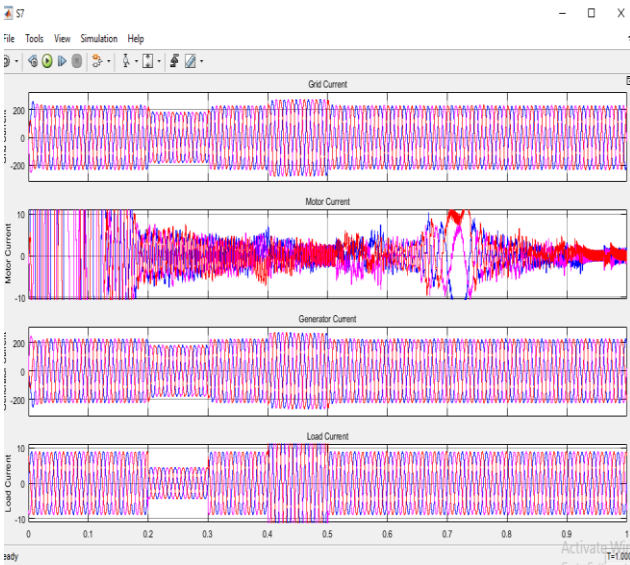


Fig 16. motor, grid, load, generator current.

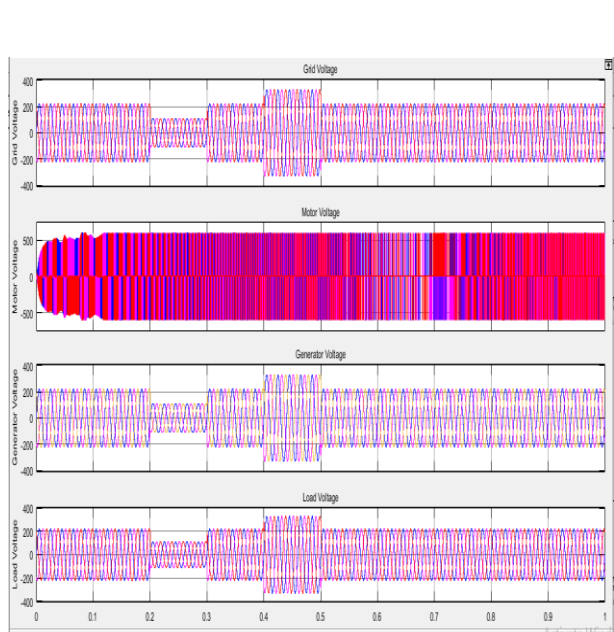


Fig 14. motor, grid, load, generator voltage.

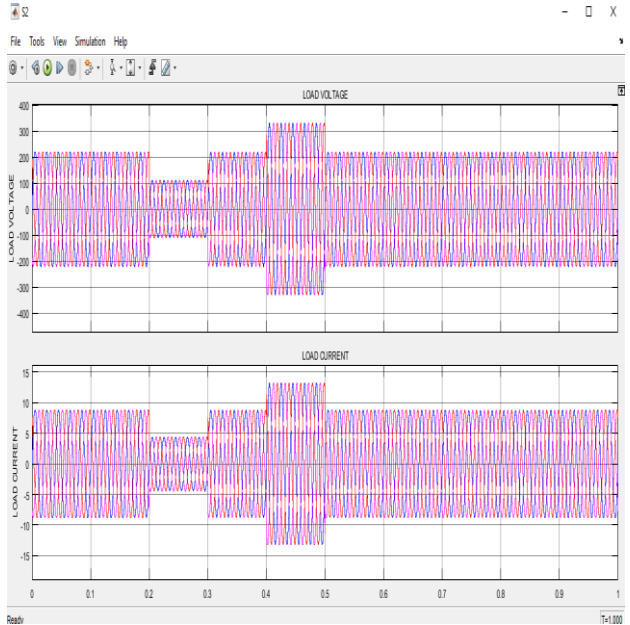


Fig 17. load voltage and current.

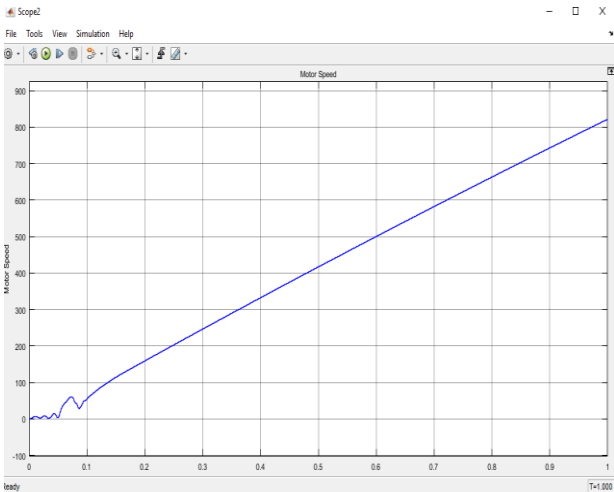


Fig 15. motor, speed.

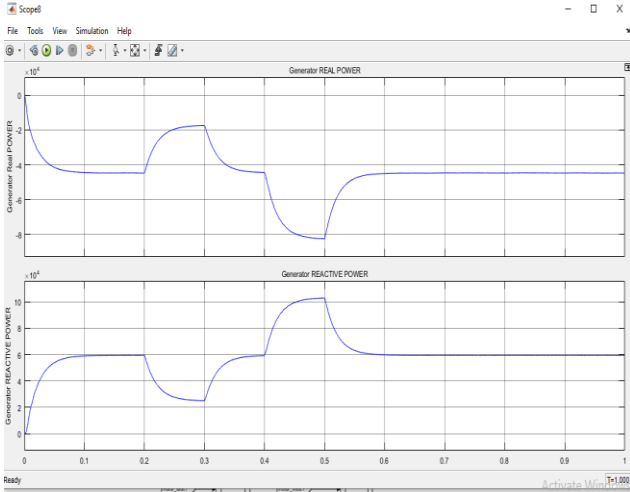


Fig 18. Generator real and reactive power.

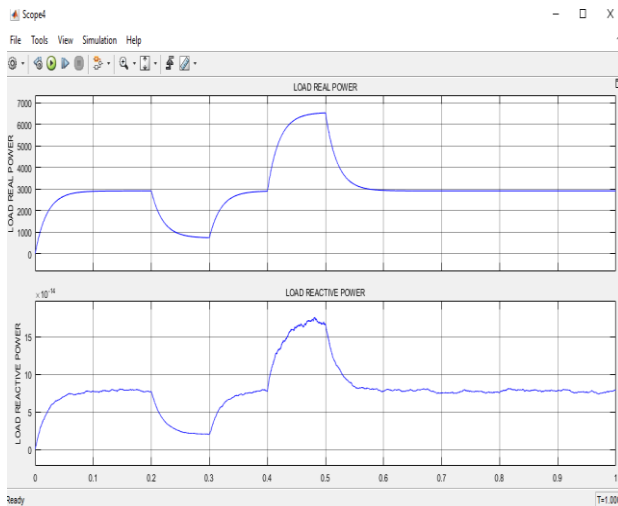


Fig 19. load real and reactive power.

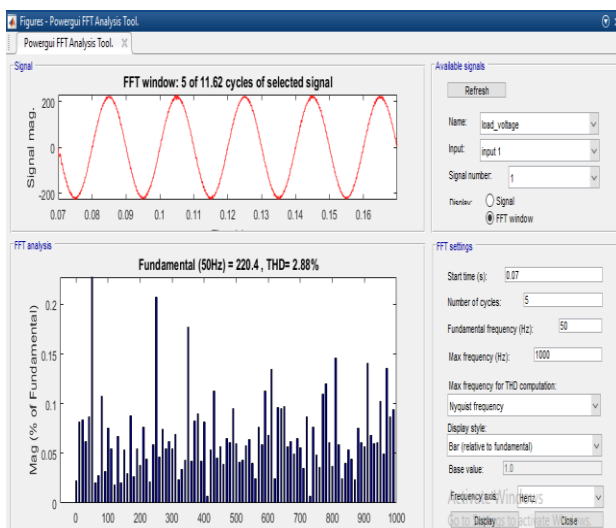


Fig 20. Total Harmonics Distortion.

V. CONCLUSIONS

This work proposes a synchronization machine based on the MGP system, provides a future power grid solution with high penetration of renewable energy, and improves reliability. First, we describe the inertia and damping levels and effectiveness of MGPs. In the event of a grid failure, the MGP system can engrave the failure on the generator side and protect the regenerative unit from cutting.

1) MGP is feasible in principle due to its solid physics base to operate in steady state with load and grid-connection. MGP can make a significant contribution to the stability of the grid. Its inertia and damping level, which actually exists, is about 65% of thermal power unit under the same capacity. It can effectively provide inertia for frequency response and improve small signal stability.

MGP has acceptable cost and high efficiency. 4) MGP has some other distinct merits. A power grid dominated by synchronous machines makes it reliable and more capable of supporting higher short circuit current and voltage control. MGP is a possible technical solution for the stability of renewable energy power systems with high penetration levels.

Further studies will focus on, for example, stable operation and feedback control strategies of MGP to deal with random of renewable energy, quantitative cost estimation compared with other solutions, capacity optimization for renewable energy using MGP to achieve grid-connection, excitation system and reactive power control for both sides, coordination control of MGPs, and models and analysis of small signal and transient stability for large grid and a range of different cases.

This work may be extended in the future to include the following aspects.

- Optimization and reliability estimation for a hybrid combination of photovoltaic (PV), wind energy conversion system and diesel system.
- Optimization of hybrid system by considering maximum power point tracking costs of externalities and future demands in order to minimize battery capacity and excess power produced.
- The implementation of hybrid systems in rural areas is fraught with practical difficulties.

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