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SOLAR GRID CONNECTIVITY WITH AUTO LOAD COMPENSATION TECHNIQUE

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Abstract: *Even though the photovoltaic (PV) industry is expanding quickly, fossil fuel power plants still provide the majority of India's energy needs. The fact that PV is non-dispatchable, or dependent only on sunny days, is one of the main causes of this. Because of this, utilities must maintain a dependable grid infrastructure to meet demand at periods when PV is not available, such as in the evening when the sun has set yet power demand is at its highest. Due to this, electrical infrastructure is frequently underused, wasting precious resources at the same time that fossil fuel power plants continue to harm the environment. The amount of PV that can be linked to the grid is constrained by its non-dispatchable nature grid. In order to overcome this constraint, PV systems can be upgraded with energy storage, or deferrable loads can be moved from periods of high electricity demand to those when the sun is shining. Batteries can be charged during the day when the sun is shining and discharged at night when there is a strong demand for electricity. Instead of importing energy from the grid or exporting extra PV production to the grid, energy storage and load shifting enable greater loads to be met locally. This action is referred to as self-consumption. v The self-consumption rates in a PV self-consumption system with and without the usage of battery-based energy storage are compared in this study. Additionally, it contrasts a baseline load profile without load shifting with four distinct load shifting load profiles.*

Keywords: Solar,Pv,Grid,Autoselection.

1. INTRODUCTION

As power technology and distribution companies compete inside the market place, we've visible an increasing hobby in renewable and alternative electricity resources. In addition to this opposition, groups are seeking demands from customers for higher best and purifier electricity. Also, thinking about the worlds coal stocks are decreasing and the advent of legislation which is pushing for greener electricity solutions, we are brought about seek new energy generation methods. One solution that's currently attracting interest is Micro-Grid systems [1]-[2]. A Micro-Grid is a low voltage or medium voltage distribution community which includes a cluster of micro sources/dispensed mills, power garage structures and masses, running as a single controllable device. In a MG, the allotted generators need to have sufficient ability to hold all, or maximum, of the weight related to the MG. Distributed mills are located at strategic factors, usually on the distribution degree, close to load centres, and used for capability support, voltage aid and regulation, and line loss reduction [2]. The micro-sources or allotted mills are commonly product of many new technologies, e.G. Gas cell, photograph-voltaic device and several varieties of wind generators. These gadgets having small capacities are interfaced with energy electronics and are positioned at the client websites. Power electronics gives the control and flexibility required via the micro grid device. The inclusion of strength storage structures (batteries/flywheels/outstanding capacitors) in a Micro grid gadget lets in the excess electricity produced, to be stored or alternatively the excess energy could be put into the main grid [3]-[4]. Micro-grid is inevitable in destiny due to its obvious blessings in reduced imperative generation ability , multiplied usage of transmission & distribution capability ,greater machine security and reduced CO2 emission. However, micro-grid adds a number of complexities on top of things and protection elements in a conventional distribution system.

Fig. 1.1 suggests that the global Solar-PV installation ability has been exponentially growing over the last decades, recording 237.3 GW in 2015. This represents extra than tripling of its worldwide ability in 2011[2]. Utilization of Solar-PV systems has won global reputation for several reasons, i.E., availability of solar irradiance in many regions, absence of transferring parts within the era machine, decline of PV panel's value, and occasional operation and upkeep charges. However, Solar-PV devices are intermittent source of power because of the sudden sun irradiance alternate and temperature. Strategically, Battery Energy Storage System (BESS) can play a salient position in a microgrid by using addressing any mismatch between the intermittent Solar-PV era and power call for. BESS can also offer ancillary services such as voltage and frequency regulation, reactive electricity guide, load leveling, height shaving, and electricity best development [3].

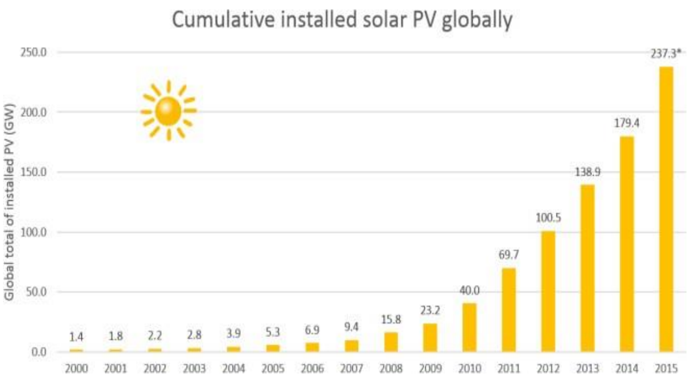

Figure 1. 1: Total installed Solar-PV around the world for the past 15 years [2].

2. LITERATURE REVIEW

In **[30] Gupta et al**. Supplied a move-linked supply primarily based multilevel inverter (CCSMLI), which consists of two remoted input dc sources in each cell as proven in Fig. 14. The DC sources are related in this sort of way that the better pole terminal of the upstream source is connected to the decrease pole terminal of the downstream supply via a transfer and vice versa. This topology carries less number of switches as compared to the conventional MLI. This topology may be powerful in which isolated dc assets are to be had [3] .

A new magnificence of MLI become offered via **Youssef Ounejjar et al. In [31-35]** as "packed U-mobile (PUC)" The circuit configuration of this topology with 4 dc assets is shown in Fig. 15, it consists of four dc assets and ten energy switches. Each U-cell consists of one dc input level and strength switches [17]. The good sized advantage of PUC is that the transfer which have to help the very best voltage operates at the lowest switching frequency, and vice-versa. That configuration has the simplicity of changing the quantity of the voltage level, reduces the switches pressure and improves the performance of the converter. However This topology does no longer support the asymmetric supply configuration.

A new class of MLI topologies turned into offered by using **Babaei et al. In [36]** as "cascaded bipolar switched cells (CBSC) primarily based MLI" The circuit configuration of this topology when using four dc resources is proven in Fig. 16. It includes a 4-dc supply, and ten-bidirectional strength switches have that the potential to provide voltage levels in each polarities. Although each bi-directional switch requires two IGBTs, the whole variety of gate force circuits is equal to the number of bi-directional switches. That configuration consequences in lowering the value and typical complexity of the converter. The disadvantage of this topology is that it cannot function with uneven source configuration due to the fact many subtractive and additive mixtures of the enter dc resources can't be acquired .

In [37] Mokhberdoran et al. Present a new elegance of MLI as Mokhberdoran Topology .It includes the fundamental unit consist six switches, two symmetric dc voltage sources and eight extra diodes as proven in Fig. 17. In this topology, none of the switches paintings in a complementary style of a primary unit. For higher voltage degree the basic unit cascaded in series [3] . This topology has a few advantages in comparison to the traditional topologies MLI. It has fewer semiconductor switches, and the switching operation is separated into parts "excessive frequency" and "low frequency" so, the performance of this topology can be accelerated. Also, the size and the price of this topology could be reduced. Mokhberdoran topology is a great desire for multilevel inverters used in excessive strength packages [37].

This topology presented with the aid **of Babaei et al. In [38, 39]** The Hbridge primary unit of this topology includes six unidirectional power switches and symmetrical dc voltage sources as proven in Fig. 18. The developed H-bridge may be duplicated and connected in series To boom the output voltage degree [3].These strategies carry out one or commutations of the energy semiconductor-switches thru each cycle of the output voltages, producing a staircase waveform [41, 42]. The switching frequency (fsw) is low as compared to the alternative modulation techniques so that switching losses are reduced. In the FSFM technology, increasing number of tiers may be actually finished by using including greater devices with out complication in generating switching alerts. In the following part, the unique FSFM strategies are discussed.

H. S. Patel and R. G. Hoft proposed a generalized harmonic elimination and voltage manipulate theory in 1973 [43, 44]. Selective harmonic elimination (SHE) is a technique of figuring out the precise angles for semiconductor switches inside the inverter. The switching perspective is pre-calculated forming the fundamental output voltage waveform and remove the maximum dominant low order decided on harmonics. As a result, the THD may be minimized. Moreover, the output clear out size may be decreased. Since the switching angles are pre-calculated off-line, it is considered an open loop control approach [45, 46].

Amit Kumar Gupta, et al. [49], provided in this literature a trendy SVPWM algorithm for multilevel inverters based on standard -stage SVPWM. The proposed technique uses a easy mapping to reap the SVPWM for a multilevel inverter.

Ahmed M. Massoud et al. [50], addressed two one of a kind area vector modulation (SVM) techniques viz., segment-shifted SVM and hybrid SVM, are used for multilevel inverter PWM era.

Amit Kumar Gupta et al. [54], cautioned a simple SVPWM set of rules for a multilevel inverter for operation within the over modulation variety. The proposed scheme easily determines the vicinity of the reference vector and calculates on-instances.

Óscar López et al. [51], brought a new SVM set of rules for multilevel and multiphase voltage supply converters with switching kingdom redundancy. The algorithm utilized in a area-programmable gate array. Anish Gopinath et al. [52], centered a view that the space vector places of multilevel inverters possess a fractal structure, which simplified the algorithm to generate the SVPWM. The proposed method is having no lookup tables for zone identification.

Aneesh Mohamed A. S. Et al. [53], used a generalized approach for the era of SVPW) indicators for multilevel inverters. A new method is brought on this literature, by which these -level vectors are converted into the output vectors of the multilevel inverter through adding the centre of the sub hexagon to the two-level vectors. Mohan M. Renge, et al. [58], provided on this literature an method to reduce commonplace-mode voltage (CMV) on the output of multilevel inverter using 3-D area vector modulation (SVM) .

3. PROPOSED METHODOLOGY:

3.1 Grid-Connected Mode Control Strategy:

The utility grid controls the microgrid's voltage and frequency while it is in a grid-connected mode of operation. Any power shortages are filled by the grid, and any excess power is absorbed by the microgrid system. Through the current controller of their VSC systems and while monitoring their MPPs, the suggested control strategy regulates the solar-PV units to exchange actual and reactive electricity with the microgrid. In order to meet its SOC requirements, the control strategy additionally regulates the BESS, while the active and reactive power are controlled by the VSC system's current controller. There are two primary purposes for the control approach in the grid-connected mode. I utilizing the three Solar-PV units' MPPT settings to get the most power out of them. ii) maintaining a specific level of battery SOC can support the microgrid voltage and frequency in the islanded mode. In order to minimize the number of charging/discharging cycles and maximize battery life, the proposed control method aims to maintain the BESS in the grid-connected mode in an idle state, that is, neither charging nor discharging [33].

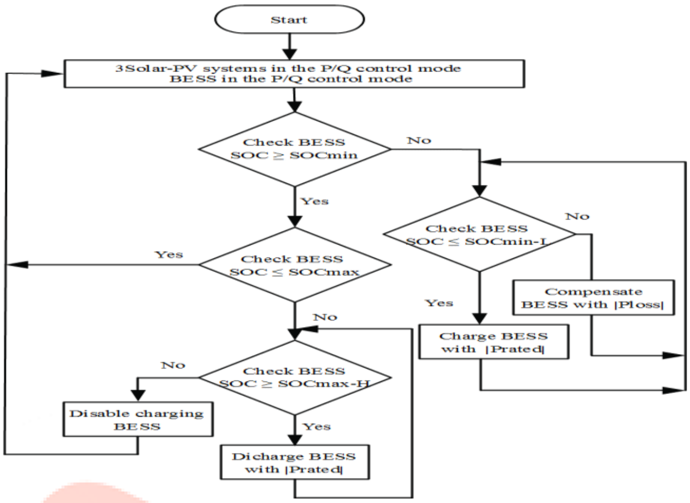

Figure 2: The proposed control strategy for the microgrid system in the grid-connected mode.

3.2 Solar-PV Unit Control

Each Solar-PV unit's LC, which is depicted in Figure 3, has controls for the Maximum Power Point Tracking (MPPT), the DC Voltage, and the VSC system. The DC voltage controller receives the reference DC voltage from the MPPT. The reference actual power (Ps ref) for the VSC system control is produced by the DC voltage controller. By providing the modulation indexes for the SPWM scheme of the VSC, the current controller of the VSC system controls the VSC output power to track the AC power reference generated from the DC voltage controller. The reference reactive power (Qs ref) of the Solar-PV units is set to zero by the SC because it is assumed in this thesis that the Solar-PV units do not provide any reactive power assistance.

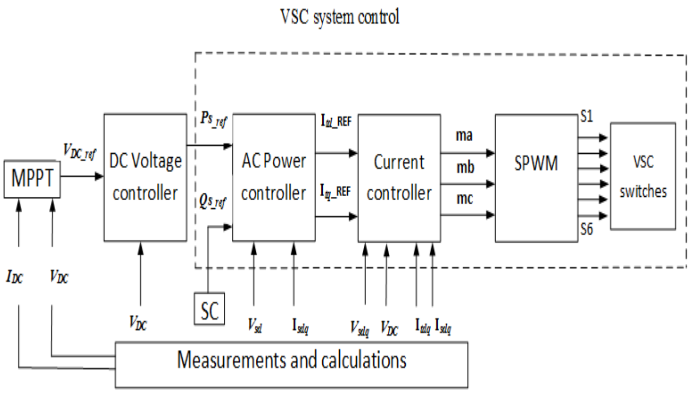

Figure 3: Schematic diagram of the control system of each Solar-PV unit.

3.3 BESS Control

Figure 4 depicts the control structure of the BESS. The LC comprises a SOC constraints logic and the VSC system control. The SOC constraints logic provides the reference real power while the SC

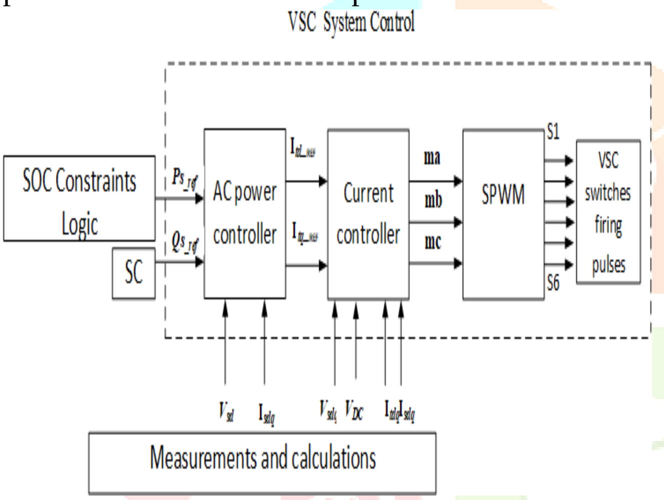

Figure 4: Schematic diagram of the control system of the BESS.

provides the reference reactive power to the VSC system. In this thesis, it is assumed that there is no reactive power support provided by the BESS in the grid connected mode, therefore, the SC sets the reference reactive power (Qs_ref) of the BESS to zero.

4. RESULT

Figure 5 Show the microgrid model of the system with 1mw solar plant , BESS controller and power grid. All the output can be seen in Scope of the system.

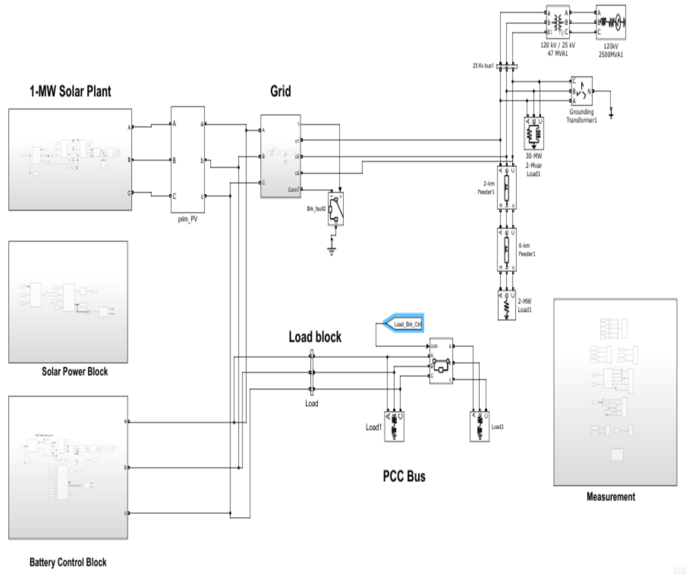

Figure 5: Simulink model of microgrid

Only the voltage between the battery's terminals is chosen because the battery has been modelled as a source of variable voltage. According to the power range that the converter operates on, the value is set to EDC B = 800 V. The inductance equivalent resistances for the battery system's VSC converter are also rl = 0,5 Ω and the inductances are ll = 5,4 mH. The battery's function will determine the active power reference values, which will be detailed for each simulation.

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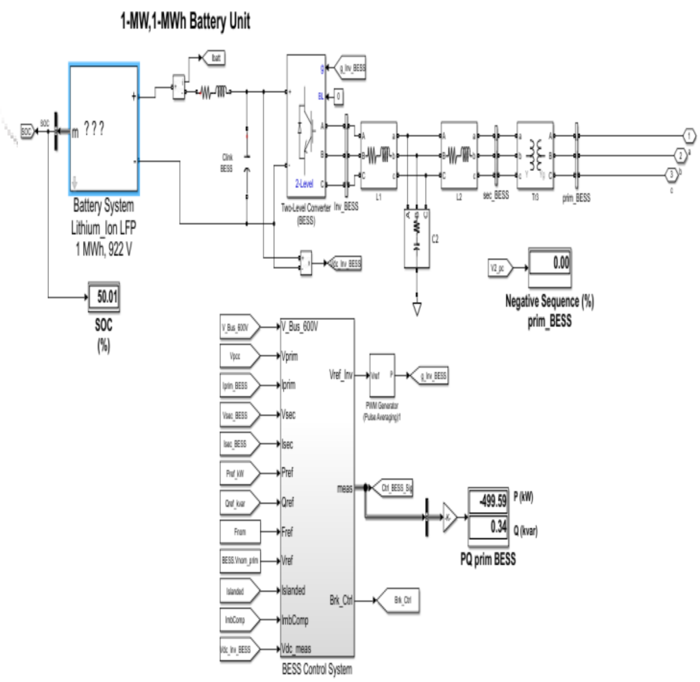

Figure 6 Battery back Unit

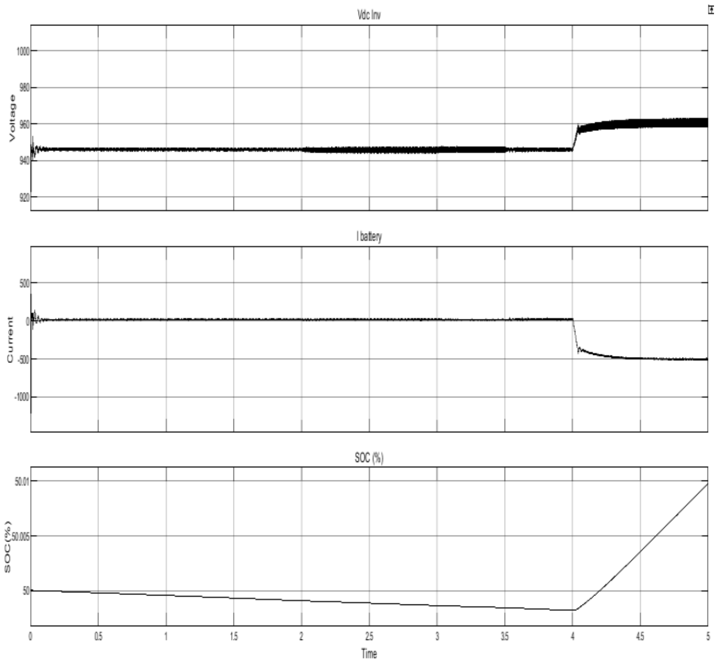

Figure7 Voltage, current and SOC of the battery.

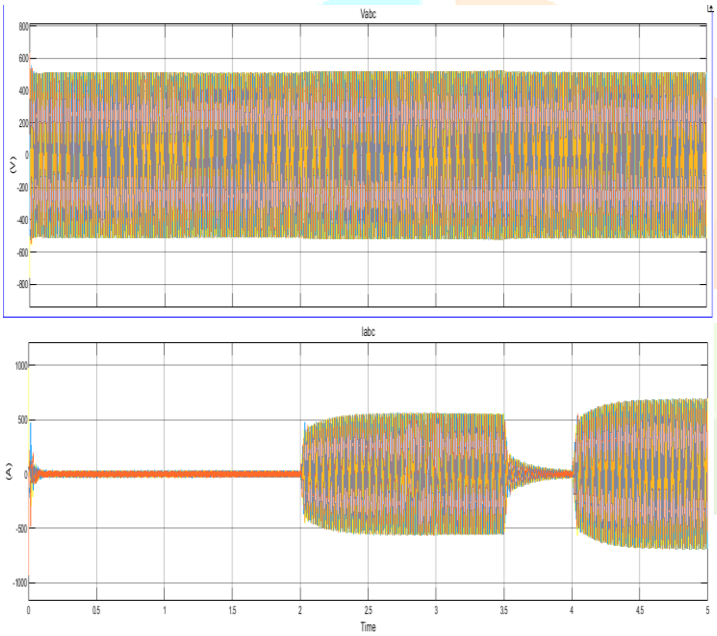

Figure 8 Voltage, current Of BESS inverter Output

Figure 9 Shows over all working of the system along with load Current remain constant . to maintain this system, compensate the error by taking current in account using from available source of the system.

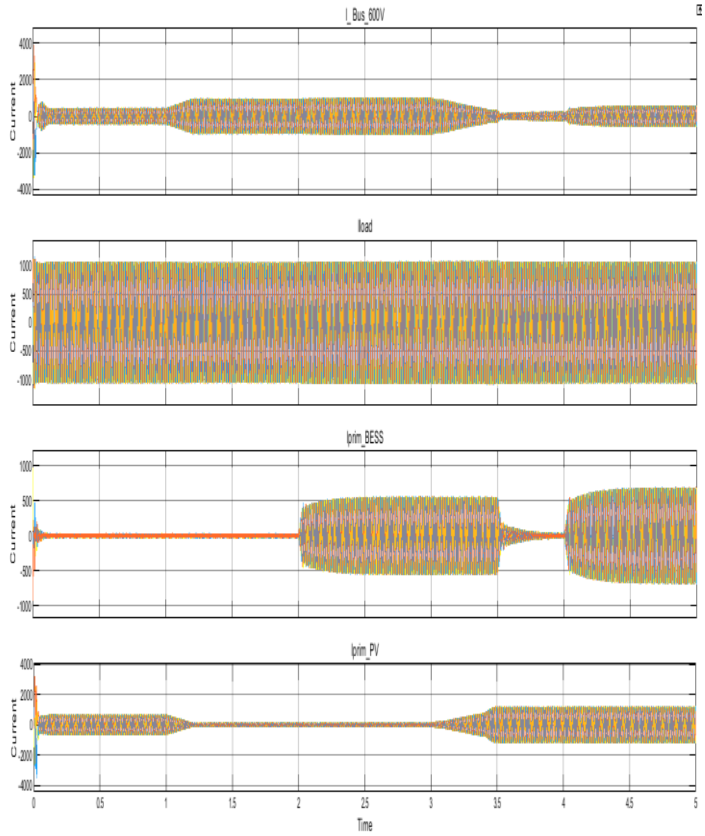

Figure 9 Current Variation of system Solar, grid, BESS to maintain load current.

5. CONCLUSION

This Paper proposes a control strategy for a microgrid system integrated with multiple Solar-PV units and BESS when it is disconnected from the utility grid. The control strategy enables the transfer from the grid-connected mode to the islanded mode, assigns the BESS to maintain the voltage and frequency of the islanded microgrid and reconnects to the utility grid.

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