

# A Survey on Photovoltaic Grid System under Voltage Stability of Power Grid

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**ABSTRACT:** The concern for ever-increasing demand for power, reformist exhaustion of petroleum products, decrease in carbon impression, improved framework unwavering quality, and so forth have empowered the force service organizations to receive sustainable power sources in regular force frameworks. The improved entrance of non-dispatchable sustainable power sources, for example, solarlight based photovoltaic (PV) and wind energy into existing circulation and transmission networks had prompted different issues of concern with respect to framework voltage dependability. This paper presents the significant issues, for example, voltage soundness based ideal areas and measuring of distributed generation (DG) units, voltage dependability evaluation, and improvement methods. The effect of force framework gadgets like fixed capacitors, flexible AC transmission system (FACTS), and energy stockpiling system (ESS) on voltage strength of transmission and circulation networks are likewise researched. The audit results give an extensive foundation to the voltage solidness examination in non-dispatchable sustainable incorporated force frameworks with significant results and discoveries of future examination work in the field of force framework security.

**Keywords:** Power system stability; wind energy; solar photovoltaic systems; static VAR compensators; energystorage systems.

## I. INTRODUCTION

Governments and public bodies are currently stressed over energy creation with as perfect innovation as could really be expected. Therefore, the necessities for future energy improvement are drawn up after the Kyoto Protocol, which empowers the European nations '2020' plan. Solarlight based, wind, photovoltaic, and geothermal energy-centered energy creation frameworks are manageable and sustainable options in contrast to non-clean customary petroleum derivative and atomic splitting based

advances. Photovoltaic (PV) is one of the spotless innovations that has filled essentially as of late, very nearly 60% in Europe. PV frameworks are not, at this point disengaged from the lattice yet associated with it as a component of electrical age. Such plants are monetarily attainable, even without government appropriations for environmentally friendly power, and the photovoltaic plant's latent capacity is developing impressively. Subsequently, the creation of framework associated PV plants keeps on growing around the world, surpassing many megawatts, making these plants an imperative piece of things to come electrical energy framework and savvy matrices. Because of the plentiful accessibility of solar powered brilliant energy, the effect of photovoltaic (PV) energy on environmentally friendly power sources can be considered as an imperative and essential economical fuel[1]. PV frameworks have as of late been perceived as a main path in the creation of sustainable power. This can deliver direct energy when presented to solar powered radiation with no natural impacts of contamination. The PV framework is fixed, quiet, liberated from mechanical parts, and has low running and assembling costs contrasted with other sustainable assets. The utilization of photovoltaic as a wellspring of electrical energy shows a developing pattern both in the execution of the worldwide energy area and in the presentation of different mechanical plants. This pattern is spurred by numerous elements, for example, the lessening in the expense of delivering photovoltaic power per kW and the ascent in petroleum product costs and the improvement of compelling photovoltaic energy change innovation. With energy issues turning out to be progressively critical, the world requirements to begin growing new innovation and related advances. Today, huge scope photovoltaic age and the size of sustainable power have become center parts of the advancement plan, yet the advancement of the photovoltaic business is the route ahead. Be that as it may, because of its

attributes, which vary from customary force age, the lattice associated PV power plant and its exhibition and solidness, another test has emerged[2].

The network based PV frameworks are frameworks associated with an enormous, free lattice that typically give direct capacity to the principle matrix. Such matrix associated frameworks can be utilized both for decentralized PV and focal lattice applications. Decentralized matrix associated photovoltaic applications remember photovoltaic generators for condo rooftops and a coordinated structure network that fuses photovoltaic frameworks into homes [3]. For PV networks associated with private or business lattices, the interest for business power is served by the PV organization, and the abundance is provided to the framework, normally in lower kilowatt limit. A normal half breed framework associated PV framework, as demonstrated in Figure 1, comprising of solarlight based PV boards, power conditioner, net metering and an inverter. frameworks have as of late been perceived as a main path in the creation of sustainable power. This can deliver direct energy when presented to solar

powered radiation with no natural impacts of contamination. The PV framework is fixed, quiet, liberated from mechanical parts, and has low running and assembling costs contrasted with other sustainable assets. The utilization of photovoltaic as a wellspring of electrical energy shows a developing pattern both in the execution of the worldwide energy area and in the presentation of different modern plants. This pattern is persuaded by numerous elements, for example, the reduction in the expense of creating photovoltaic power per kW and the ascent in petroleum derivative costs and the improvement of viable photovoltaic energy change technology[4]. With energy issues turning out to be progressively pressing, the world necessities to begin growing new innovation and related advances. Today, enormous scope photovoltaic age and the size of environmentally friendly power have become center segments of the advancement plan, however the advancement of the photovoltaic business is the path ahead. Nonetheless, because of its qualities, which vary from traditional force age, the network associated PV power plant and its exhibition and security, another test has arisen.

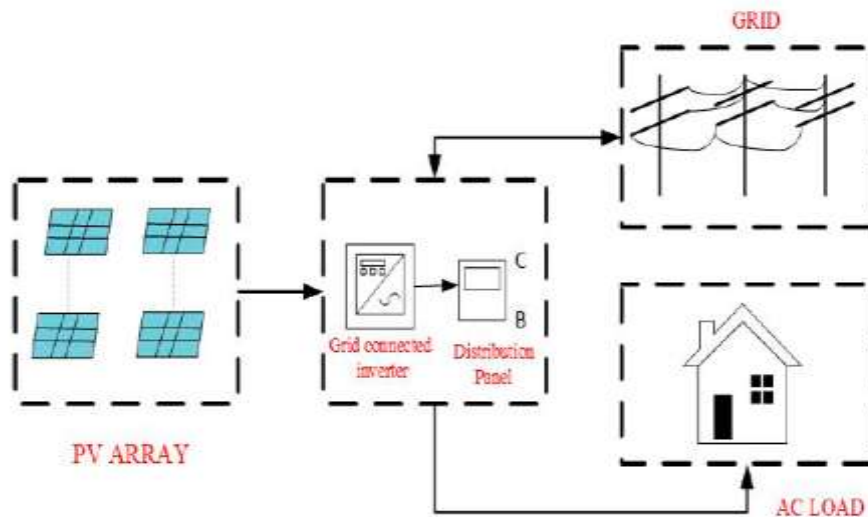


Figure 1. Grid-Connected Photovoltaic (PV) System.

At the point when overflow power gets back to the matrix and is bought from the framework when there is a force shortage through a net metering framework, overabundance power is siphoned into the power network when PV creates more than the necessary interest. Truly, when this occurs, the meter runs the alternate path round. As in the past, when the framework doesn't produce sufficient energy, it very well may be drawn from the utility. The "to and fro" between the framework and your organization implies that overflow limit is

as yet being utilized and that deficiencies are being tended to. Because of the changing idea of solarlight based energy transmitted as an outcome of unusual and sudden varieties in climate conditions that modify the pace of solar oriented light and the estimations of cell-working temperature [5], the electrical gadget worked by solar based clusters requires uncommon plan contemplations during early days, PV frameworks were fundamentally utilized as force hotspots for specific purposes, like interchanges and satellites.

With the improvement of the force hardware organization, the job of the PV source in all homegrown and few business areas has been expanded. Sustainable power, for example, the PV organization, is connected to the matrix in various manners [6].

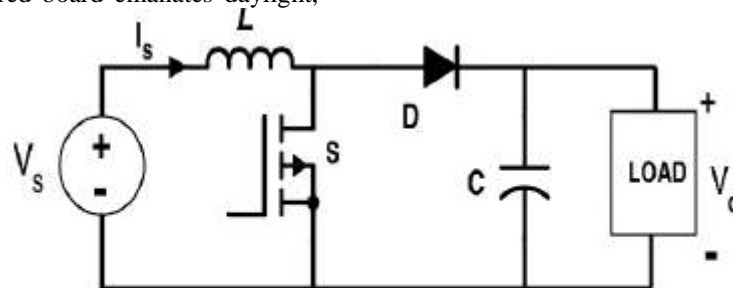
**PV SYSTEM**

**Working of PV panel:** Solar based boards act by burning-through light from the solar PV cells or battery, delivering Direct current after that change interaction the produced energy into usable exchanging current (AC) (since the usable type of energy is in AC power structure) power by should be an appropriate evaluated inverter . Substituting current is then ventured up or ventured down for reasonable rating in like manner. The concise working system of solar powered board is a PV cells are a combination of silicon n-type and semiconductor material p-type silicon. P-type semiconductor material is gently doped while the n-type semiconductor is a vigorously doped semiconductor material where their association will be a possible obstruction. It creates power by causing electrons to energize across the intersection (possible obstruction) between the different degrees of doped silicone by utilizing daylight. At the point when the solar powered board emanates daylight,

photons contact the upper surface. Their photons convey the energized energy down the cell. The photons in the lower, p-type semiconductor layer, surrender their energized energy to electrons. The electrons assimilate this energy and prepare to move into the upper, n-type layer around the expected hindrance and get barraged. Since the progression of electrons is power the invigorated electrons will stream, and the energy will be generated[7].

**BOOST CONVERTER**

The control of the most extreme force point, as expressed in the presentation, is fundamentally a difficult that suits the heap. To change the board's information protection from match the heap obstruction, if a DC – DC transformation measure (utilizing buck converter) is required (by changing obligation cycle). The Buck transformation productivity has been read to be top for a DC – DC change measure converter, so a buck-support converter and negligible for a lift converter, however as we mean to utilize our framework either for lattice joining or for a siphoning stations framework that requires 230 V at the finishes of a creation, we are utilizing a lift converter[8].



**Fig 1: Circuit diagram of a Boost Converter**

Mode 1 of the Boost Converter process: Whenever the switch is activated, the inducer is charged, and the energy is stored through the battery. In this mode the inductor current rises (exponential rate), so we assume that the inductor

charging, and discharge is linear for accuracy. The diode prevents the current from flowing and therefore the charge current remains static due to the discharge of the condenser.

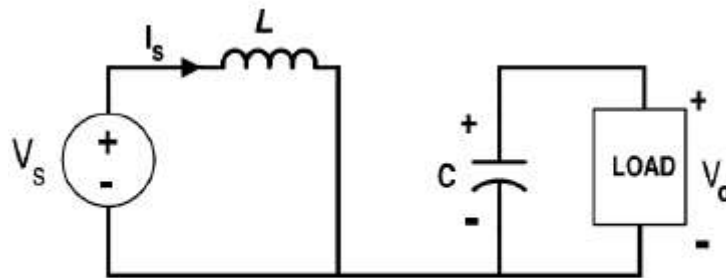


Fig 2: Mode I operation of boost converter (DC - DC)

Mode II of the Boost Converter process: Available Type II the button exists disconnected as well as therefore a diode short circuited. Power supply collected around-the inducer is released by reverse polarity from condenser. The flow current of load stays steady during service.

**GRID CONNECTED INVERTER**

An electronic control system or circuitry is a power inverter or inverter that converts direct current (DC) to AC. Input voltage, output voltage and frequency voltage as well as overall power

handling depend on the specific device or circuit model[9].

An electrical grid is a network that is interconnected to provide power to customers from producers. This consists of following things as shown in Fig:5. 1) generating stations supplying electrical power; 2) electrical substations for stepping up electrical voltage for transmission; or down for distribution; 3) high-voltage transmission lines carrying electricity from remote sources to demand centres; 4) distribution lines linking individual customers; 5) Power stations can be placed

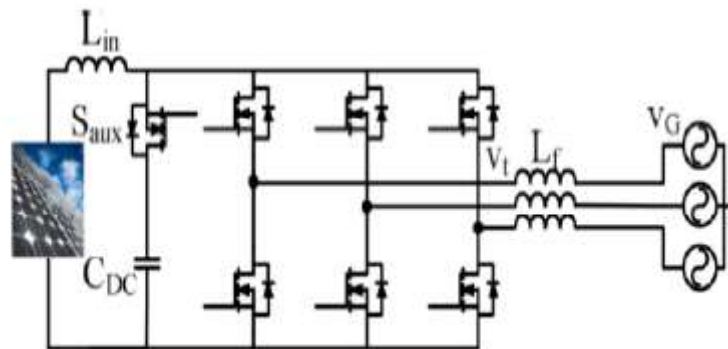


Fig 5: Block diagram of Grid connected inverter

This effective as well as reactive energy pumped to substation is independently operated. So it is considering this 3  $\phi$  alternating current outgoing in 2 dimension dq structure combined with altering the parameter of the q-axis to be zero. By considering that point, the next step of the investigation is to decide how to make this active power or reactive power to disconnect can be accomplished by regulating the output inductor current. Since the current outgoing inductor will run regulating inverter's function, the document will discuss acceptable methods of inverter control. It is believed that the switches of the converter and

the generation of the output are lossless. The above figure represents the block diagram of the circuit.

**CONTROL MECHANISM OF GRID CONNECTED INVERTER**

A criticism the board conspire, also calling Closed-circle Management Scheme, remains as observing methodology that uses by thought a totally open ring framework is Called as advances heading despite the fact that keeps 1 or many control circle bearings among the creation just as I/p. Reference to a "reaction" it's called as a little part to thatproduction remains "in reverse" in the source through produce parcel in gadget's

excitement. Input control techniques were expected through regularly accomplish just as keep required execution circumstance through differentiating. This will be accomplished by delivering a mistake sign which makes up the hole between the reference creation just as inclusion. Or then again put it another way, a "shut circle framework" is a whole framework. To give a variable irradiance and variable temperature we are utilizing shut circle control way which was one of the ideas in control frameworks so the two information boundaries irradiance, temperature could be changed in the Simulink and the individual yields will be created [10].

Electrical framework comprises of different segments. The different segments associated with the network can be addressed in fig 6 the types of feeders by supplanting them with appropriate impedances and naming them get named as the feeders and reasonable 3-stage loads are planned by computing the first loads impedances and getting them planned. The above figure addresses the recreation of electrical framework utilizing subsystem block and other reasonable burden portrayals for a network comprising of burden.

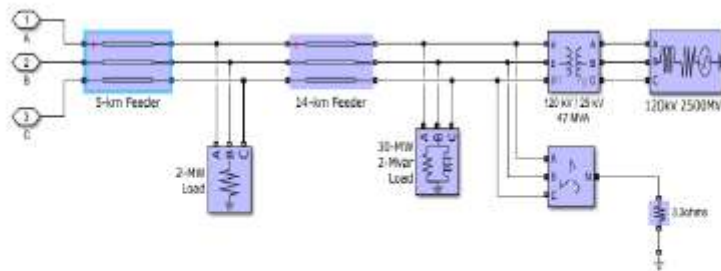


Fig6: Electrical grid simulation

**ENHANCEMENT OF VOLTAGE STABILITY FOR SYSTEMS WITH NON-DISPATCHABLE RENEWABLE ENERGY RESOURCES**

Many countries in the world are developing or modifying the existing grid codes for integration of large scale renewable energy sources. The risk of voltage instability due to shortfall of reactive power support is one of the critical issues under severe contingencies in power systems. Each country has a different LVRT

capability requirement of wind farm and fundamentally it demands that the wind farm must remain connected to the grid during voltage dips in the system. Fast control of reactive power from reactive power compensation devices is an essential requirement for LVRT capability of the wind farm [11]. Various techniques used in literature for enhancement of voltage stability of power system with intermittent renewable energy (IRE) sources are as shown in Figure 8.

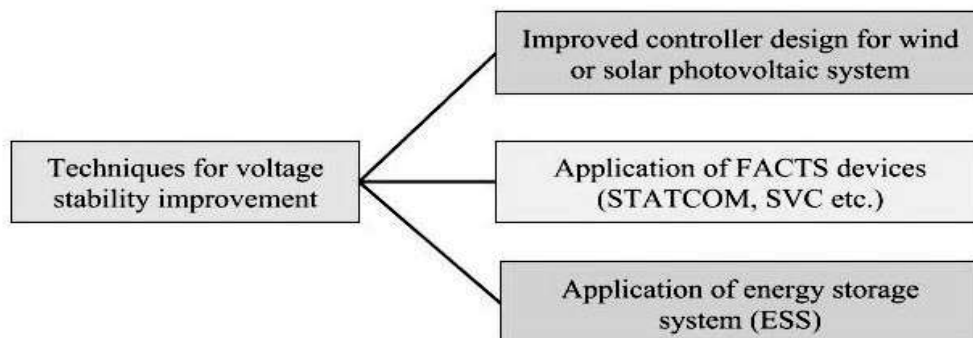


Figure 8. Voltage stability improvement techniques for system with renewable energy resources.



Integrating the STATCOM as compared to SVC can enhance the LVRT capability of a wind farm with squirrelcage induction generator [12]. In static and dynamic VAR planning are proposed based on reactive power margins for enhancement of dynamic voltage stability of the distribution system with windDG. To calculate the margin between the current operating point to voltage collapse point, a reactive power index (Qloadability) is used. The use of energy storage systems (ESSs) and their coordination with IRE sources (i.e., wind and solar) has been emerging as

a solution in the recent years. The concept of ESS is to mitigate uncertainty in wind and solar PV generation. In this regard, the ESS technologies that have been investigated are pumped storage hydro plants, battery energy storage systems (BESS), super capacitors and superconducting magnetic energy storage systems (SMES), etc. A significant improvement has been shown in grid voltage stability with ESS based wind farm integration. Different energy storage systems, which could be utilized with renewable energy sources, are shown in Figure 10.

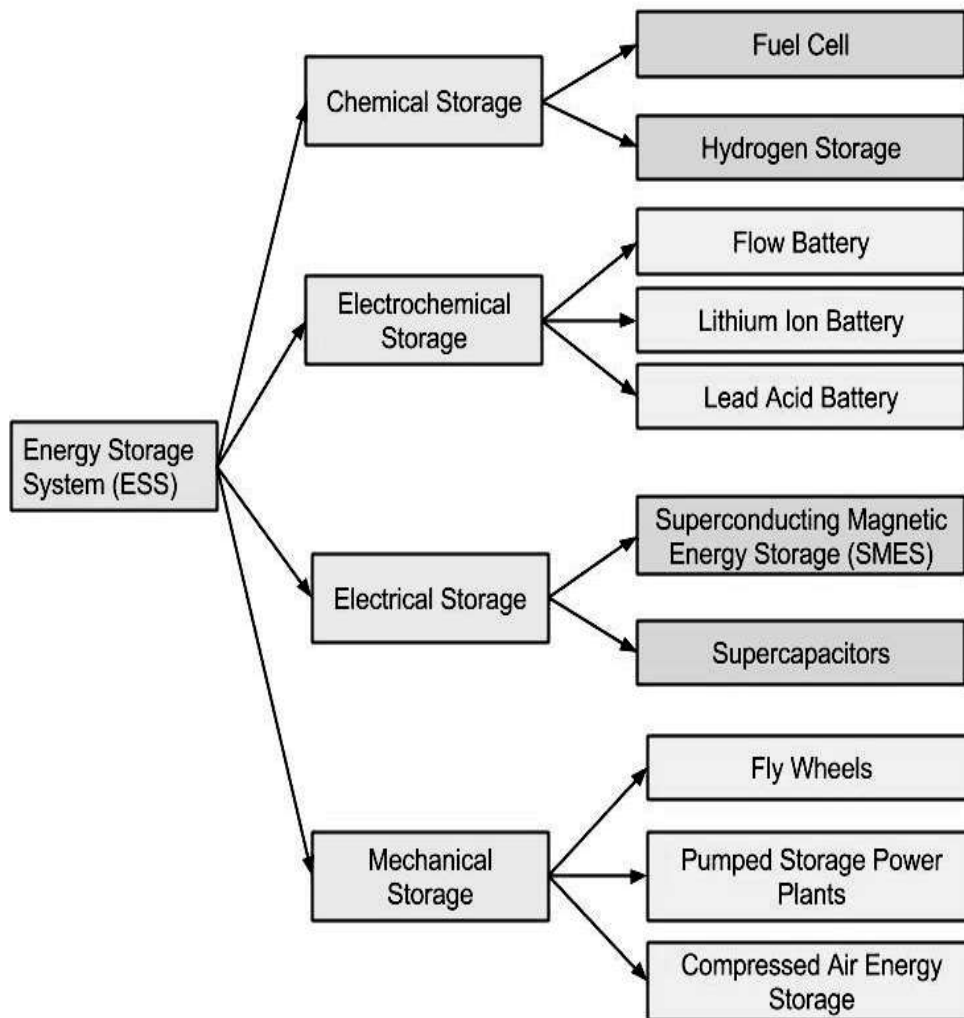


Figure 10. Energy storage systems used in renewable energy systems.

## II. CONCLUSION

In this work, a complete survey of framework voltage steadiness considering non-dispatchable environmentally friendly power sources, i.e., wind and solar oriented PV, has been attempted. The significant results from the accessible writing uncovers the accompanying realities: 1. Albeit traditional voltage steadiness

appraisal strategies as P-V/Q-V bends, modular investigation, CPF, and so on are being utilized by different analysts for ideal DG position and measuring, because of questionable force yields from wind and solar based PV, probabilistic based investigations would give more precise outcomes in discovering ideal areas and sizes of DGs. 2. In writing, different improvement procedures, e.g.,

PSO, GA, NLP, dynamic programming, and so on, have been explored for ideal area and estimating of DG. Further, the exploration region can be investigated by utilization of different blends of mixture advancement strategies as this will amalgamate the qualities and uniqueness of streamlining procedures and produce better outcomes. 3. The exploration on framework voltage soundness with huge entrance of wind/solar oriented PV age is attempted principally for either issue conditions or/and voltage sag whereby diverse control procedures have been applied to the control circle of wind/solarlight based PV generators. In any case, whenever composed control of FACTS gadgets, e.g., SVC, STATCOM, and so on, is consolidated with wind/solar powered fuel sources, at that point it would improve the voltage dependability edge of the framework. 4. The new writing in the space supports the utilization of cutting edge estimating procedures, for example, phasor estimation unit, which works with the online evaluation of voltage strength in wide territory estimation frameworks. 5. Aside from FACTS gadgets, energy stockpiling gadgets like BESS, SMES are likewise demonstrating this determination for improving framework voltage strength. Thus, there is a need to investigate the FACTS gadgets alongside ESS for obvious improvement of voltage security of the framework.

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