Photovoltaic Based Power Quality Improvement in Distribution System Using D-STATCOM

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Abstract: The cost of electricity derived from fossil fuels is rising day by day and photovoltaic electricity is a viable substitute for fossil fuels has increased in the development of electric power. The main transmission and distribution stage operating need for the power grid. As photovoltaic cell electricity penetrates through the dispersed low-voltage system. The key challenge from grid and end consumer transmission lines is power efficiency. The following paper is used to boost the reliability of the power network with one Information controller unit D-STATCOM. DSTATCOM is a device compensating for the service loss that corrects the issues of electricity supply, such as voltage drop and swell in high voltage transmission lines. In an extension and as an option to massive traditional central power plants, the usage of centralized energy infrastructure is being sought. DSTATCOM is suggested as the reactive control mitigation and unbalance induced by varied delivery network loads.

Keywords: D-STATCOM, FACTS Controller, Photovoltaic Systems, Voltage regulation.

1. Introduction

In recent years, many improvements in power networks have been noticed aimed at growing the proportion of distributed energy sources (DESs) in total energy generation. Cost and performance are primary considerations that affect the growing implementation of DESs. Although investment costs remain large, DES energy can be cheaper than traditional energy sources. The cost of investment is still large. Various DG innovations are presently in operation. The fuel may be categorized in combination with: petrol, photovoltaic, solar, hydro or hydro-energy-based micro turbines, combustion cells or reciprocal engines. DG energy management technology involves interconnection with the grid, transfer and delivery of usable electricity to the grid. It is possible to potentially create difficulties in preserving the necessary power quality (PQ) by integrating a large amount of DERs into a grid. DER's may cause chaos such as changes in voltage, asymmetry or harmonics. If mounted in the system, the issues can be compounded by distracting loads. The overall obvious (complex) power injecting into a transmission line consists of two active and reactive elements. The active energy P factor is the energy variable that is converted into physical energy. For rural areas, the microgrids are the unified option for providing power to households. The key benefits are comparatively lower operating costs and improved resource discovery. Solar panels from photovoltaic plants are being recognized as a significant source of electricity. And over the next 40-50 years, the output volume will increase to ten giga watts. This photovoltaic (PV) conversion solution is also, compact, conveniently scalable and rapidly built in the division of renewable energy and in contrast to wind conversion. Maintenance is necessary for photovoltaic systems (cell, module and grid). Photovoltaic components may be almost completely recycled at the end of the life cycle. Photovoltaic modules carry power into remote areas without an energy infrastructure to maximize their life value. Further growth as a crucial element in the generation of electrical resources for the homes and buildings in general should begin with photovoltaic systems. Actually, photovoltaic panel terrestrial systems provide auxiliary energy generation means. While its expansion is restricted by its high costs of capital and poor performance, ongoing work is gradually lowering these obstacles and growing usage of PV electricity. The biggest obstacle for building the megawatts of PV farms and for that its usage is the work into dispersed electrical energy linked to the grid. It is really critical that these networks are constantly tracked as it provides guidance on how communication is enhanced, how performance is increased and how the management mechanisms can be optimized.

2. Power Injection Principle

The active energy P factor is the energy variable that is converted into physical energy. The Q reactive power portion contributes to the development of the magnetic medium needed for most electromagnetic energy conversion systems of today. For starters, until it is powered by the AC source, the electrical AC engine absorbs active and reactive power supplies. The absorbed reactive portion generates the necessary magnetic field for the transfer of energy within the engine. The active control portion is consumed, transformed, and transfers the attached mechanical load, such as a mechanical transducer, into
mechanical strength. The active control portion is consumed, transformed, and transfers the attached mechanical load, such as a mechanical transducer, into mechanical strength. As long as the transfer cycle proceeds, the electric motor retains the reactive strength as a fluctuating magnetic energy in its turns. Many industrial and commercial systems need active and reactive control components. In order to meet the needs of the electric converter connected with the AC source, both P and Q are necessary instantly and in different quantities.

3. D-STATCOM

In recent years, many improvements in power networks have been noticed aimed at growing the proportion of distributed energy sources (DESs) in total energy generation. Cost and performance are primary considerations that affect the growing implementation of DESs. Although investment costs remain large, DES energy can be cheaper than traditional energy sources. The cost of investment is still large. Various DG innovations are presently in operation. They can be classified according with the fuel used: carbon, photovoltaic, wind or hydro-powered systems using green energy. They are gasoline-driven turbines and fuel cells. DG energy management technology involves interconnection with the grid, transfer and delivery of usable electricity to the grid. It is possible to potentially create difficulties in preserving the necessary power quality (PQ) by integrating a large amount of DERs into a grid. DER's may cause chaos such as changes in voltage, asymmetry or harmonics. If mounted in the system, the issues can be compounded by distracting loads. There are two active and reactive portions of the completely obvious (complex) power which is pumped into a transmission line. The active energy P factor is the energy variable that is converted into physical energy. For rural areas, the microgrids are the unified option for providing power to households. The key benefits are comparatively lower operating costs and improved resource discovery. Solar panels from photovoltaic plants are being recognized as a significant source of electricity. And over the next 40-50 years, the output volume will increase to ten giga watts. This photovoltaic (PV) conversion solution is also, compact, conveniently scalable and rapidly built in the division of renewable energy and in contrast to wind conversion. Maintenance is necessary for photovoltaic systems (cell, module and grid). D-STATCOM is a dual voltage control system consisting of a buffer, a dc power storage unit, a coupling transformer, and a linking transforming unit that is connected by a coupling transformer in the shunt with the distribution network. The source of tension transforms the dc voltage to a range of three-phase ac voltages around the storage unit. Such voltages are in contact with the ac system by the coupling transformer's reaction.

4. Hardware Implementation

Thanks to the rising cost of energy derived by fossil fuels, photovoltaic systems are widely used in power production and photovoltaic technology is an alternate option appealing to fossil fuels. The main technical necessity for both transmission and delivery in the electricity network. If photovoltaic cell electricity is infiltrated through the dispersed low voltage system. Power supply is the key issue with transmission lines from the grid and end customer. For this article, one FACTS D-STATCOM controller is used to increase the voltage balance, thereby increasing the reliability of the power network. DSTATCOM is a power quality compensator that rectifies the power quality problems that exist in high voltage lines such as voltage drop and swell. Both a substitute and as an option to massive, traditional power plants, the usage of renewable energy systems is gradually being utilized. DSTATCOM is recommended for compensating reactive control and variance due to various loads in the delivery grid. Network Static Compensators.

Hybrid wind-PV renewables linked to load with just one flexible turn, for the right control of electricity. Wind power output is AC that is first transformed to the DC and then used to transform the DC-DC Boost. The DC added specifically to new conversion similarly falls from PV. The PI / PID interface powers this multiport DC-DC booster adapter. This Hybrid Network generates power, based on where the site is used, for private residences, companies, houses, street lights... I am attempting to link the wind PV to dc interface condenser and to fulfill all customer requirements. Many PV cells are attached to a high-powered column, a PV board, in series and parallel circuits. A PV array is described in series-parallel combinations as a group of many modules connected to electricity to produce the current and the voltage needed. In order to increase the voltage of solar electricity, the solar panel transforms solar energy into electric energy with the DC-DC converter. The current source can be described broadly as a photovoltaic cell with a parallel to the diode [2]. The identical circuit often blends serial resistance to R_10, the value of which is big and R_1 is low. Photovoltaic cells are semiconductor devices, which use solar radiation and temperature as a source of energy to convert light energy into electricity. The corresponding identical circuit, The source impedance is aligned with that of the charge impedance when the service cycle of the buck converter is
adjusted accordingly with PWM. Different MPPT approaches are proposed. The P&O and gradual behaviour (INC) approaches are common in these strategies, but they have some problems such as MPP oscillation and uncertainty via quickly changing circumstances. This suggested approach integrates the MPPT algorithm. In this type, the controller adjusts the voltages by a small amount of the sequence and checks the output by growing the strain and testing out further side adjustments before power increases. It's also P&O. Thanks to its quick deployment and cost effectiveness, it is the most commonly used MPPT solution.

Fig. 2. Equivalent circuit of PV model

5. Operating Principle

The DSTATCOM system consists basically of three key components: a VSC, a sequence of connecting reactors and a transmitter. The fundamental theory of the DSTATCOM mounted on a power device is that an active voltage source (VSI) is created with a solar panel connected to an MPPT battery (energy storage unit). The AC root occurs usually behind a transformer leakage reaction. The active and reactive flow of power between the DSTATCOM and the power supply network is attributed to the voltage differential in this reaction. The DSTATCOM is related to a PCC power grid, where there is an issue with the voltage-quality network. The required pressures and currents are calculated and fed into the controller for comparison with the controls. The device then conducts input control and exits a variety of switching signals to operate the power converter's main semiconductor switches (IGBT switches which are used on the delivery level). The basic diagram of the DSTATCOM is illustrated in Fig. 3.

Fig. 3. Voltage source converter based D-STATCOM

The power of the ac voltage is dictated by the angle of fire. The VSI output voltage is preferably in line with the bus voltage (in relation to the DSTATCOM). The dc side capability is kept at a set voltage in constant state so there is no direct sharing of power but losses. The DSTATCOM varies from other reactive (for example shunt capacitors, static var compensators etc.) This is in the sense that power storage capacity is not a static requirement but is just sufficient to stabilize the device or to consume harmonics. The DSTATCOM sets two monitoring goals. One is the ac tension regulation of the power network on the bus with DSTATCOM and the second is the dc tension regulation via the condenser within the DSTATCOM. Shunt reactive power injection is widely used to regulate bus voltage. There are two regulators of voltage configured for such purposes in the standard control system: a voltage sensor for a regulation of the bus and a dc voltage sensor for a condenser function. Both regulators are PI-type proportional controls in the simplest technique. The shunt current is separated into components of the d axis and q axis. Separate PI regulators from dc voltage and ac-bus voltage errors respectively receive the reference values for this current. These reference currents are subsequently controlled by a set of PI control systems whose outputs are the voltages of the DSTATCOM's d-axis and q-axis.

6. Conclusion

For this paper the power network for the low voltage delivery grid was modelled and tested at the end of the customer using Distributed Statcom to offset the harmonics from both the grid side of Inverter, so now we have loads from the other side as most non-linear loads deliver harmonic currents on the source side. Their loads are harmonic currents. The function and efficiency of DStatcom has been studied and evaluated in this paper at different charge levels, for example balanced & unequald linear and non-linear charges. Matlab Simulink software is used to apply this proposed model, and the resulting waveforms are evaluated and device stability and power system output effectiveness have been established.

References


