# A Review on PMSG Based Grid Connected Wind Energy Conversion System using Vector Control Strategy

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**Abstract:**

This work explore a review of synoptic control strategy of active power, reactive power and DC link voltage for the PMSG based wind power conversion system (WECS) under various countries grid code requirements, where grid side converter (GSC) DC link voltage and Used to control the machine, power flow control for the side converter grid (msc) is responsible for the Invitation deactivated and reactive power).

**Keywords:** MPPT controllers, Direct Current, Grid Side Converter, Permanent Magnet Alternating Current

## 1. INTRODUCTION

Wind power is one of the traditional sources of energy used by mankind for the last thousand years; to mix grains, pump water and sail the oceans. Wind power used to replace fossil fuel-derived electricity reduces bumper, renewable, widely distributed, clean, and greenhouse gas emissions.

The modern wind power industry closed in the late 1970s when mainly companies in Denmark started serial production of wind turbines. Since the 1980s, wind energy conversion technology has matured enough to produce clean, efficient and reliable energy. In today's world, it has become one of the most used sources of power generation.

**Fig. 1: Wind energy system**

Wind power is the conversion of wind energy into electric or mechanical energy using wind energy wind turbine. The power in the air is removed by allowing a torque to blow the last

running blade on the rotor. The amount of power transferred is dependent on the rotor size and wind speed. Early wind turbines were smaller than today's standards, but the size of wind energy systems has increased in some megawatt machines for wind farms and offshore from a few hundred watts generators for residential use. Small people have direct drive generators, direct current output, agrological glade, and lifelong bearings and use a van to indicate in the air; while older people have generally prepared electric trains, the current production has changed, and flaps are actively indicated in the air.

Direct drive generators and aerological blades are being researched for large windturbines and currently the generator is used directly. Since the speed of the wind is notstable, the wind power of the wind converter is dependent on the efficiency factor.

A well-ventilated generator will possess around 35% capacity caliber factor. It comparesthe usual capacity factors for 90% for nuclear plants, 70% for coal plants, and 30% forthermal plants. As a general rule, wind generators are practical where the average airspeed is 4.5 meters / second or more.

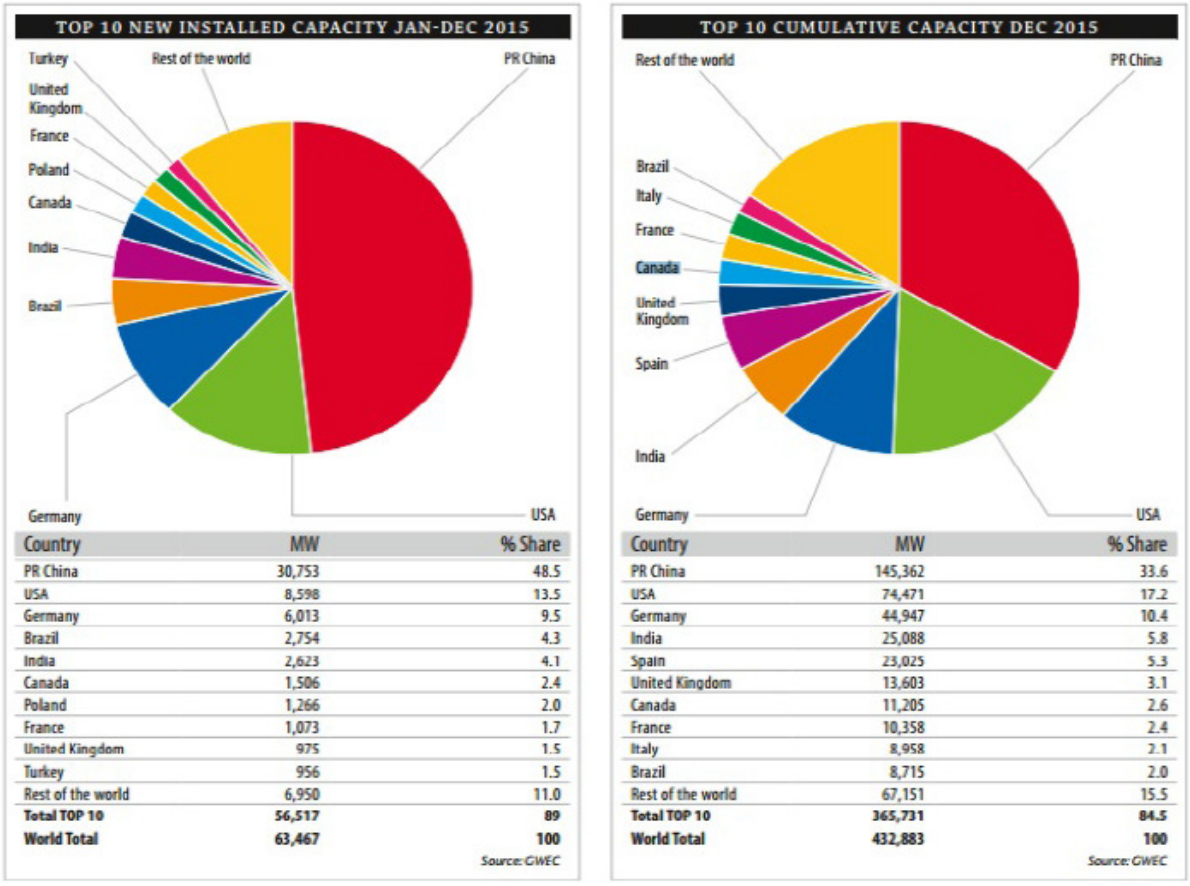
Generally, sites are pre-selected based on wind atlas and onsite are valid with airmeasurements. In addition, to reduce the impact of wind turbine on land use andlandscape, more wind turbines have been pushed to offshore locations for moreharvesting.There are two types of wind turbines; Fixed speed wind turbine and convertible speedwind turbine. In a fixed speed wind turbine, power converters are used to reduce curvedcurrent and torque oscillation during start-up, where, as a convertible speed wind turbine,power converters can be used to control the speed-torque of the generator is done for theflow along with. Reactive and active power for the gridApart from this, the WECS (Wind Energy Conversion System) affects the grid if it isaffected. It also affects the distribution network.The integration of WECS for distribution networks varies from being active to activenetworks. Through all these integration processes, generators can increase the embeddedgenerator to one degree through wind energy, which makes the compulsion compulsory,introduces sustainability problems.

## 2. PRESENT GLOBAL SCENARIO

2015 was an unprecedented year for the wind industry because the annual establishment had exceeded 60 GW marks for the first time in history. New wind power capacity was

brought to the line more than 63 GW. The last record was established in 2014 when global capacity of 51.7 GW was installed.

At the end of 2015, the new global total for wind energy was 432.9 GW, representing a cumulative market growth of more than 17%. This increase was driven by amazing new establishments of 30,753 MW in China; the global wind power industry installed 63,467 MW in 2015, representing annual market growth of 22%. By the end of last year eight countries had more than 10,000 MW of installed capacity including China (145,362 MW), the US (74,471 MW), Germany (44,947 MW), India (25,088 MW), Spain (23,025 MW), UK (13,603 MW), Canada (11,205 MW), and France (10,358 MW).




| Country | MW | % Share |
|---|---|---|
| PR China | 30,753 | 48.5 |
| USA | 8,598 | 13.5 |
| Germany | 6,013 | 9.5 |
| Brazil | 2,754 | 4.3 |
| India | 2,623 | 4.1 |
| Canada | 1,506 | 2.4 |
| Poland | 1,266 | 2.0 |
| France | 1,073 | 1.7 |
| United Kingdom | 975 | 1.5 |
| Turkey | 956 | 1.5 |
| Rest of the world | 6,950 | 11.0 |
| **Total TOP 10** | **56,517** | **89** |
| **World Total** | **63,467** | **100** |

Source: GWEC

| Country | MW | % Share |
|---|---|---|
| PR China | 145,362 | 33.6 |
| USA | 74,471 | 17.2 |
| Germany | 44,947 | 10.4 |
| India | 25,088 | 5.8 |
| Spain | 23,025 | 5.3 |
| United Kingdom | 13,603 | 3.1 |
| Canada | 11,205 | 2.6 |
| France | 10,358 | 2.4 |
| Italy | 8,958 | 2.1 |
| Brazil | 8,715 | 2.0 |
| Rest of the world | 67,151 | 15.5 |
| **Total TOP 10** | **365,731** | **84.5** |
| **World Total** | **432,883** | **100** |

Source: GWEC

**Fig.1: Installed capacity and Cumulative capacity worldwide**

**3. SCENARIO OF INDIA**

India is the second largest wind market in Asia, and in 2015 Spain has passed Spain to reach fourth place in the case of cumulative establishments. Indian Airfield is struggling for years to replicate the strong market performance of 2011 when more than 3 GW was established. Given the government's willingness to overcome certain structural constraints in the market in 2015, a recovery phase indicates the beginning of the phase.

Potential for wind energy generation for grid interaction has been estimated that sites ofabout 1,02,788 MW are taking sites with wind energy density over 200W/s. For the establishment of 9 m MW / square wind farms, with a availability of 2% in the potential areas, at 80 meters hb-height Km Wind power of 60,000 MW is an ambitious target of the government by the year 2022.


**Fig. 2: Current Installed capacity in Canada and India**

**4. CHALLENGES IN WIND ENERGY GENERATION**

Depending on how energetic a wind site is, the wind farm cannot be given competitive costs. Although the cost of wind energy has decreased dramatically over the last 10 years, the technology still requires higher initial investment than fossil-fuel generators.

1. The good wind site is often located in remote locations, from which electricity is required. Transmission lines should be constructed to bring electricity from the wind farm to the city.
2. Wind resource development cannot be the most profitable use of land. For wind-turbine installation, competing with alternative land use of suitable land, which can be more valuable than power generation.
3. Wind resource development cannot be the most profitable use of land. For wind-turbine installation, competing with alternative land use of suitable land, which can be more valuable than power generation.
4. Turbine blades can damage local wildlife. Birds have been killed in spinning turbine blades. Most of these problems have been solved by means of technical development or by sitting properly in the wind plants or have been greatly reduced.

**5. LITERATURE SURVEY**

Wind power contributes a significant proportion of the growing power of consumers to electricity demands. In the last few years, wind energy production has increased at a hazardous rate and will continue to do so as the electricity electronic technology isgrowing. Several power converter techniques have been developed to integrate with anelectric grid.

The use of electrical electronic converters allows for variable speed operation of windturbine. A wide range of control plans, variations in cost and complexity, are integrated with power electronic converter to maximize power generation at all possible windspeeds.

Based on possible combinations of converter and generator topologies for various drivesystems such as permanent magnet generator, caged rotorfade induction generator, a review is conducted and so far the potential control strategiesare affected.

To regain optimum energy capture, thiristor-based inverter is used in [21] to allow theconstant control of the turbine speed through the DC-link voltage, to allow continuouscontrol of the inverter firing angle. The benefits of this plan include higher availablepower ratings than hard-switch costs and hard-switched inverters. This inverter requires alarge reduction of reactive power and active compensation to create harmonic distortion.To allow continuous control of the hail of the speed of the turbine through the DC-linkvoltage, the inverter firing angle. [21]. A voltage source converter (VSC) is used

forcompensation and error signal between reference and actual compensation flows is usedto run pulse width modulated (PWM) control.

Different control strategies applied to the converter [23]. A proposed control involves the manipulation of the modulation index of the reference sinusoidal signal applied to thePWM generator. It is achieved by determining the DCtechnique that has maximum power versus DC voltfurther improved using the derived control on the stator frequency, as it changes with thechange in the DC-link voltage.

This control is compared to maximum power point tracking (MPPT), which includes ananemometer, a wind prediction control plan and a fixed voltage plan. Anemometermeasures the wind speed and accessories to provide the wind energy reference to theMPPT controller. The reference power is compared to the actual DC power in which theresult is used to determine the new operating voltage DC. The current control loop of theinverter receives the new operating DC voltage and outputs an instantaneous drivingsignal for PWM. Under fixed voltage control, the inverter voltage is fixed at a targetedoptimum wind speed. Compared to the four control methods, the fixed voltage schemewas used as reference because it was least efficient. MPPT proved to be better withanemometer setup, 56-63% energy is available. However, the proposed method usingThyristor based inverter [23]. A proposed control involves theDC-link voltage with a power mappingvoltage attribute.

An advanced method using backwork has been done using this type ofin those functions is almost identical;Differences lie in control strategy. through the current [7] and [8] changes. For the rotor side, decoupled control of electrictorque and rotor stimulation flow is presented [7]. The machinesynchronous rotating reference frame, in which the Dvector, which provides maximum energy transfer. In the case of [8] the rotor was decomposed into the current Dcontrol current electromagnetic torque and the QBoth types of rotor-side converter control PI controllers. Space vector modulation (SVM)is used to obtain better modulation index [8].place of Speed Encoder [9] and [10] With a capacitor in the DC link, the battery can be13s Hard switching Inverterback-to-back converter is shown in Figure 2.4, and a lot ofconverter [7], [8], [9] and [10]. The converter usedsupply-side converter is to implementDC-link voltage continuously. This Q-axis is also responsible for reactive power controlis controlled in theD-axis is oriented with the stator [8].The supply side controller is made up of three PI controllers - for external loop powercontrol, and the D-Q-axis remains

for internal control loop. Energy is storedduring high winds and is exported to the grid during low air conditions for compensation.The control algorithm is modified to control voltage for less air conditions.

Here, the rotor-side converter is gate to control the actual and reactive power of themachine. Another different option for rotor control is presented in [10], where thealgorithm detects the peak power by changing the speed of the rotor, and peak powerpoints are identified as zero slopes on the power-speed curve.

The use of induction generators (IG) is advantageousinexpensive, robust and require low maintenance. Induction generator need bi-directional power flow in the generatorside converter since it requires external reactive powersupport from the grid. The use of backthe implementation of one or more fuzzy logic controllers is a consistent convertercontrol combination [14], [15] and [16]. The advantages of fuzzy logic control areparameter insensitivity, fast convergence and acceptance of noisy and inaccurate signals. A PI type fuzzy logic controller takes in the DC voltage error and controls this error [15].The controller outputs the d-axis reference current used in real power flow control.

## 6. CONCLUSION

Currently, multi-day reality is moving forward to present protected and clean life forcecontrol plants, for example, turn (sea algae and coastal) and sun-powered structures.Unlike the size of the coastal air, due to the thickness of the oceanic population, theseawater frames are accepting much more attention in the Asian mainland.To provide the world's food life force request, there is abundant vital power potentialwith seaweed vitality. Under such high inspirational conditions, infiltration of windpower is increasing. Future network activity and control need to be capable of working asa conventional power plant in the wind energy conversion system (WECS) of the windand it will be able to defeat the voltage list and low voltage defect ride according tostandard counterfeit code.

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