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REVIEW ON DIFFERENT TYPE OF PROTECTION USED IN DOUBLE FED INDUCTION GENERATOR DURING FAULTS

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ABSTRACT

The installation of wind energy has increased rapidly around the world. The grid codes about the wind energy require wind turbine (WT) has the ability of fault (or low voltage) ride-through (FRT). To study the FRT operation of the wind farms, three methods were discussed. First, the rotor short current of doubly- fed induction generator (DFIG) was limited by introducing a rotor side protection circuit. Second, the voltage of DC bus was limited by a DC energy absorb circuit. Third, STATCOM was used to increase thelow level voltages of the wind farm. Simulation under MATLAB was stu-died and the corresponding results were given and discussed. The methods proposed in this paper can limit the rotor short current and the DC voltage of the DFIG WT to some degree, but the voltage support to the power system during the fault largely depend on the installation place of STATCOM.

Keywords: Wind Power Generation, Doubly Fed Induction Generator (DFIG)

I. INTRODUCTION

In electricity supply and generation, low voltage ride through (LVRT), or fault ride through (FRT), is a capability of electrical devices, especially wind generators, to be able to operate through periods of lower gridvoltage or faults. Many generator designs use electric current flowing through windings to produce the magnetic field on which the motor or generator operates. This is in contrast to designs that use permanent magnets to generate this field instead. Such devices may have a minimum working voltage, below which the device does not work correctly, or does so at greatly reduced efficiency. Some will cut themselves out of the circuit when these conditions apply. This effect is more severe in doubly-fed Induction generators (DFIG), which have two sets of powered magnetic windings, than in squirrel-cage Induction generators which have only one. A static synchronous compensator (STATCOM), also known as a static synchronous condenser (STATCON), is a regulating device used on alternating current electricity transmission networks. It is based on a power electronicssource voltage-source converter and can act as either a orsink of reactive AC power to an electricity network.

If connected to a source of power it can also provide active AC power. Usually a STATCOM is installed to support electricity networks that have a poor power factor and often poor voltage regulation. There are however, other uses, the most common use is for voltage stability. The voltage source is created from a DC capacitor and therefore a STATCOM has very little active power capability. However, its active power capability can be increased if a suitable energy storage device is connected across the DC capacitor. A crowbar circuit is an electrical circuit used to prevent an overvoltage condition of a power supply unit from damaging the circuits attached to the power supply.. Crowbar circuits are frequently implemented using a thyristor, TRIAC, trisil or thyratron as the shorting device. Once triggered, they depend on the current-limiting circuitry of the power supply or, if that fails, the blowing of the line fuse or tripping the circuit breaker.

II. WIND POWERGENERATION

Wind turbines produce electricity by using the power of the wind to drive an electrical generator. Wind passes over the blades, generating lift and exerting turning force. The rotating blades turn as haft inside the nacelle, which goes into a gearbox. The gearbox increases the rotational speed to that which is appropriate for the generator, which uses magnetic fields to convert the rotational energy into electrical energy. The power output goes to a transformer, which converts the electricity from the generator at around 700V to the appropriate voltage for the power collection system, typically 33 kV. A wind turbine extracts kinetic energy from the swept area of theblades.

Wind turbines convert the kinetic energy present in the wind into mechanical energy. Since the energy contained by the wind is in the form of kinetic energy, its magnitude depends on the air density and the wind velocity. The wind power developed by the turbine is given by theequation.

$P = 0.5Cp.A.\rho.V^3$

Where *Cp* is the Power Co-efficient, ρ is the air density in kg/m^3, *A* is the area of the turbine blades In m^2 and *V* is the wind velocity inm/sec.

In 1920, Albert Betz, a German pioneer of wind power technology, studied the best utilization of wind energy in wind mills establishing at heoretical limit for the powe rextraction. Basically, its aid that independently of the turbine design, a turbine design, at most 59% of the wind kinetic energy can be converted into mechanical energy. This is known as Betz’s limit. Also at every winds peed there is an optimum turbines peed at which the power extraction from the wind is maximized shown in Fig.1.

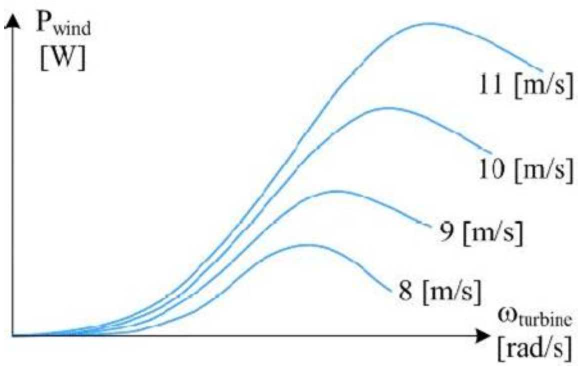

Fig.1. Extracted Power from the Wind

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III. DOUBLY-FED INDUCTION GENERATOR

During the last years, the most used configuration in wind power projects has been the doubly-fed induction generator shown in figure 2. The main advantage of this configuration is that it allows variable-speed operation. Therefore, the power extraction from the wind can be optimized.

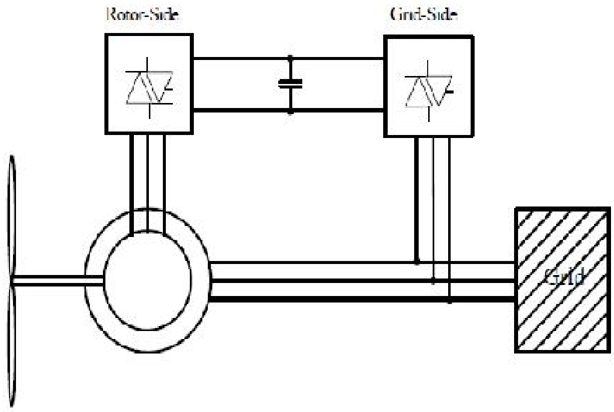

Fig. 2. Doubly Fed Induction Generator System

The mechanical power generated by the wind turbine is transformed into electrical power by an induction generator and is fed into the main grid through the stator and the rotor windings. Back to back converters consist of two voltage source converters (ac-dc-ac) having a dc link capacitor connecting them. The rotor side converter takes the variable frequency voltage and converts it into dc voltage. The grid side converter has the ac voltage from the dc link as input and voltage at grid parameters as output.

With the rotor-side converter it is possible to control the torque or the speed of the DFIG and also the power factor at the stator terminals, while the main objective for the grid-side converter is to keep the dc-link voltage constant regardless of the magnitude and direction of the rotor power. Between the two converters a dc-link capacitor is placed, as energy storage, in order to keep the voltage variations (or ripple) in the dc-link voltage small.

The stator is connected directly to the grid. The rotor on the other hand needs a step down transformer in order to connect to the grid. For a normal generation speed as an input is fed into the network by both the stator and the rotorregime, the energy obtained by processing the wind.

IV. THE ROTOR SIDE PROTECTION MEASURE

During the fault of the power system, the stator of DFIG will endure a large fault current because it is directly connected to the grid. The disturbance will be further transmitted to the rotor of DFIG for the reason that the rotor and stator is magnetically coupled and the flux must be conservative. So the rotor current will be very high and this may lead to over current to the rotor side con-verter. We use IGBT and resister to make an over current limiter (shown in **Figure 3**) to protect the rotor side con-verter.. We can find that use the limiter, the rotor current can be limited within the rated range.

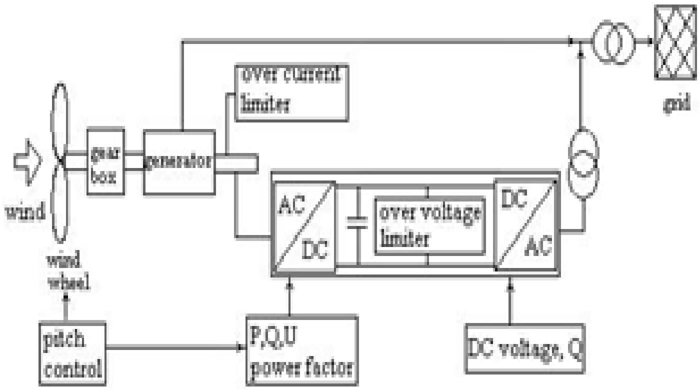

Fig. 3.The Block Diagram of Protection Measure for FRT of DFIG WT.

V. CONCLUSION

In this paper,it has been seen that during fault a large amount of current is being drawn from the grid which is approximately 8 times the normal value,in this we have discussed about LVRT,STATCOM and CROWBAR circuits are used. In this work of STATCOM is to provide reactive power to the DFIG during the fault (which draws large amount of reactive power from the grid).

The work of CROWBAR is to low down the active power i.e. current and voltage during LVTR.

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