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### Fault Analysis Studies on Wind Form

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#### Abstract

Wind form many type of turbine are used they have different type of fault occurred on system. Fault occurred on the system LG, LLG, LLLG or other, system start to reduce the capacity & stability. Wind turbine generator connected different type of convertor directly connected to the rotor side to minimize short circuit current decay time & to make system healthy.

**Keywords:** LG, LLG, LLLG.

#### Introduction

Importance of conventional energy wind form is best of energy for future. Power system are designed to be as free of short circuit as possible through careful system & equipment designed as well as proper installation & maintenance . prompt and accurate location of fault in electric power system can help the engineer to maintain system healthy. When a short circuit occurred on the power system, several thing happen 1. At the short circuit location , arcing & burning can occurred. 2. Short circuit current flows from the various sources to short circuit location. 3. All component carrying the short circuit current are subject to thermal & mechanical stress. This stress varies as a function of the current squared (I)<sup>2</sup> & duration of current flow . 4.system voltage drop in proportion to the magnitude of the short circuit current . maximum voltage drop occurred at fault location ( to zero for maximum fault ) but all part of the power system will be subject to some degree of voltage drop.

The maximum value of short circuit current is directly related to the size & capacity of the power source & is independent of the load current of the circuit protected by protection device. Ref1. Present short circuit behavior of a different type of wind turbine as well as their contribution. Ref2. Present the connection of dispersed generation unit with different structure to power network at short circuit fault was studied & the result of connected or disconnected DG unit at faulty time were investigated. Ref3 present fault location method for overhead distribution system for short circuit analysis by solving a simple quadratic equation for LG , LL fault & solving a set of non linear equation for LLG & LLL/LLLG fault

In the rest of the paper, section-II Short circuit current, section- III Factor that minimize short circuit , section-IV Followed by the conclusion.

#### Short Circuit Current

##### Definition

An electric circuit in which a path of very low resistance has been opened usually accidentally. When the resistance drops the electric current in the circuit becomes very high & can cause damage to circuit.

Or

Abnormal condition caused by direct connection between point of low resistance on circuit resulting in bypass or break due to excess flow of current.

##### Symmetrical & Asymmetrical current

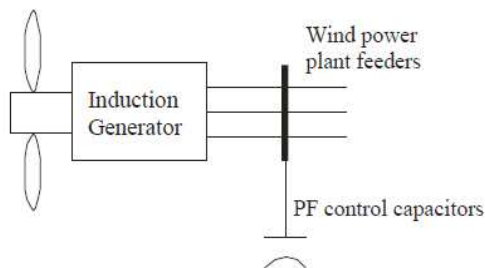
The enveloper of the peaks of the current wave are symmetrical around the zero axis , they are symmetrical current. If they are not symmetrical around the zero axis are called asymmetrical current. Short circuit current are asymmetrical.

##### Wind turbine generator

Generator are driven by turbine when a short circuit occurred on the circuit fed by generator. Generator continues to produce voltage because the field excitation is maintained & the prime mover drives the generator at normal speed. Short circuit occurred on generator flow of short circuit current is limited only by the impedance of generator & current is limited only be own impedance.

**Factor that Minimize Short Circuit Squirrel cage induction generator**

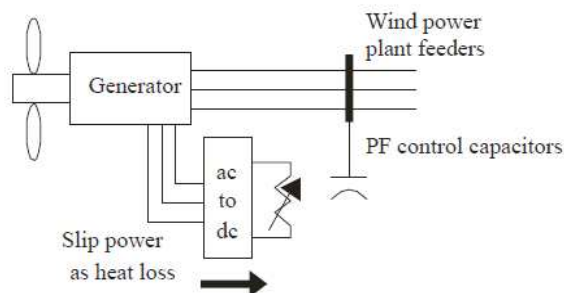
Wind turbine generator was a fixed speed turbine with a squirrel cage induction generator (SCIG). The induction generator generate electricity when it is driven above synchronous speed. The difference between the synchronous speed and operating speed of the induction generator is measured by its slip.



The connection diagram shown WTG connected with switched capacitor bank to compensate the induction generator at unity power factor. When three phase to ground fault occurred at system. WTG are able to contributed significant fault current. Depending on the time of the SC. Voltage at the WTG terminals to be small but not zero, due to voltage drop along the impedance between the fault and the WTG terminal. The SC at the WTG is slightly different from the SC contribution of the WPP by Ref1. There for by using switched capacitor bank to control the power factor of system & also control SC.

**Wound-rotor induction generator with variable , external rotor resistance**

WTG is the variable –slip wind turbine with a wound rotor induction generator (WRIG). The three phase rotor winding is connected to a power electronics component and three phase external resistance. The external rotor resistance controller is very fast controller that allow the effective rotor resistance.

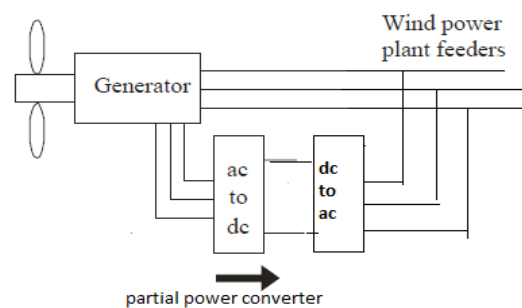


In low to medium wind speed the external rotor – resistance controller (ERRC) is controlled to keep the external resistance to be minimum. When the output power of wind turbine reaches its rated value, the fast EERC is adjusted to keep the output power constant. If the pitch angle of the blades is kept constant at zero degree, the rotor speed, and thus slip, will vary with the wind speed. However operation at higher slip generates a lot of loss because of a additional rotor resistance, thus the heat loss can be excess.

When fault occurred the external rotor resistance is shorted( operation on below rated slip). Operation at higher slip than the rated slip requires that the external rotor resistance is adjusted higher than zero. Thus it produce a lower SC current than the SC current of squirrel cage induction generator. The presence of external rotor resistance it is decreased short circuit decay time by refl.

**Doubly –fed induction generator Partial power converter**

WTG is a variable speed, rotor speed is allowed to vary between 0.3 slip to -0.3 slip. It is operated at optimum  $c_p$  below rated wind speed. With the use of power converters, the real and reactive power can be controlled independently and instantaneously. The real power control capability is used to maximize  $c_p$  below rated speed and to limit output power above rated wind speed. The reactive control capability is used to control the reactive power, power factor, or voltage.

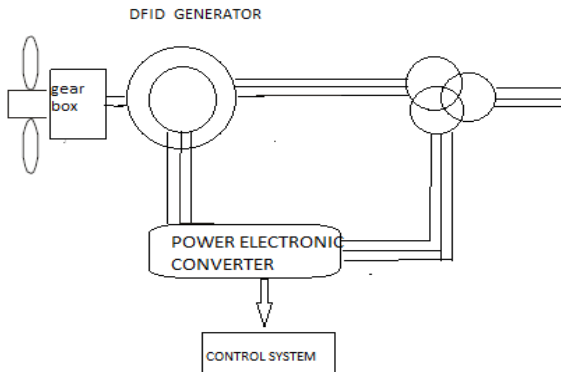


When fault occurred to give shortest decay time , the voltage collapse depleted the air gap flux and the SC current decreased to zero in a short time by refl.

**Power electronic converter**

Minimum threshold crowbar for a fault ride through grid code compliant double fed induction generator wind turbine, minimize the length of DFIG crowbar application periods during fault & optimize the resumption of power control. This involved partial suspension of the rotor current

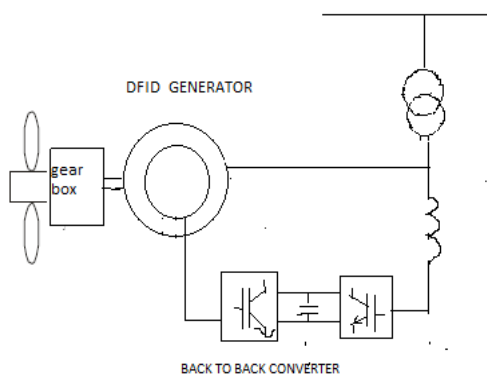
PI controllers and soft restart function for the PQ outer-loop PI controllers. The crowbar was engaged and disengaged strictly according to the rotor current magnitude, thus taking advantage of a single peak characteristic of the hastened crowbar-induced rotor flux decay.



In a range of fault tested, the new minimum-threshold crowbar method successfully diverted the overrated transient current and presented good power output within 45ms of each voltage step.

**Back to back converter**

Direct rotor current mode control improves the fault by using convertor. These advantage include high power production, low mechanical stress, high power quality and low cost of back to back convertor. The extra cross coupling term are implemented with available sensed variable, attributed to accurately control of the positive and negative sequence component of the rotor current.



Direct rotor current control significantly reduces the maximum over shoot and settling time in comparison with indirect rotor current control for both balanced and unbalanced fault.

**Conclusion**

Short circuit occurred on generator flow of short circuit current is limited only by the impedance of generator. Wind turbine generator contain different type of convertor connected to the rotor of generator to reduced or to minimize the fault and to make system stable and healthy.

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