IJRRECS/June 2016/Volume-4/Issue-6/5516-5520 **ISSN 2321-5461**

**INTERNATIONAL JOURNAL OF REVIEWS ON RECENT ELECTRONICS AND COMPUTER SCIENCE**

# AN EXPOSURE TOWARDS ANALYSIS OF FAULT CURRENT FEATURES OF DOUBLY FED INDUCTION GENERATOR

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**ABSTRACT:**

With the increased grid-connected wind power ability, to make the wind turbines present grid support throughout grid voltage dips, the novel grid codes were developed to require the wind turbines to contain the ability of low voltage ride through. In this circumstance, the operation features of doubly fed induction generator under low voltage ride through condition have a great influence on fault features of voltage and current. We study only dynamic response features as well as stator fault current in our work and introduce an analysis technique for fault current features of doubly fed induction generator in non-severe fault conditions. The proposed system is appropriate for study of fault current features of doubly fed induction generator with several control strategies in support of low-voltage ride through.

***Keywords: Wind turbines, Doubly fed induction generator, Non-severe fault, Low-voltage ride through, Fault current.***

## 1. INTRODUCTION:

The most general type of wind turbine which was extensively applied in traditional wind farms is doubly fed induction generator, because of its simple arrangement, minute capacity of converter, as well as flexible power control [1]. The increased penetration of doubly fed induction generator brings numerous new challenges towards traditional relaying protection of power grid, as protection of

relaying identifies fault element which is based on change features of electrical quantities. For managing of the issues of relaying protection of power grid by penetrations of doubly fed induction generators, fault current features of doubly fed induction generator must be studied. In severe faults which take place close to doubly fed induction generator and make the voltage drop of doubly fed induction generator seriously, to ensure protection of doubly fed induction generator, crowbar protection is activated to short circuit rotor windings and diverts surge current from rotor-side converter. In non-severe faults which take place far away from the doubly fed induction generator, crowbar security is not activated and rotor windings are still excited by means of the ac/dc/ac converter. The fault current features of doubly fed induction generator, such as transient components and damping time constant, are different in these two conditions. In our work, an analysis technique for fault current features of doubly fed induction generator in non-severe fault conditions is introduced [2]. The active response of the rotor-side converter is analyzed on condition that external power control loop is minimized and reference signals of inner rotor current control loop are maintained stable. Later basic calculation models of rotor fault current are recognized in relation to various design principles of inner rotor current controller. The fault features of stator current are studied and analytical expressions of stator fault current are gained. At last, digital simulation results authenticate analytical results. The proposed analysis method is appropriate for study of fault current features of doubly fed induction generator with several control strategies in support of low-voltage ride through. The results are supportive to construction of sufficient relaying protection for power grid by penetration of doubly fed induction generators.

## 2. METHODOLOGY:

For fault current features of doubly fed induction generator on condition that a severe fault take place and crowbar protection is activated, several research works were carried out. In non-severe fault conditions, dynamic response of ac/dc/ac converter consequences in additional difficult fault current features of doubly fed induction generator which are tricky to analyze. To ensure protection of doubly fed induction generator, crowbar protection is

activated to short circuit rotor windings and diverts surge current from rotor-side converter in severe faults which take place close to doubly fed induction generator and make the voltage drop of doubly fed induction generator. In non-severe faults which take place far away from the doubly fed induction generator, crowbar security is not activated and rotor windings are still excited by means of the ac/dc/ac converter. The fault current features of doubly fed induction generator are different in these two conditions. For simplicity, the fault current of doubly fed induction generator is studied on the assumption that excitation current will keep stable before and after fault occurrence or rise speedily to highest value and then keep stable during grid faults [3]. Therefore, the research results cannot totally meet needs of study of relaying protection hence later research has to be implemented to learn fault current features of doubly fed induction generator in non-severe fault conditions. To fill the gap, a theoretical analysis technique for fault current features of doubly fed induction generator in non-severe fault conditions is projected. The active response of the rotor-side converter is analyzed on condition that external power control loop is minimized and reference signals of inner rotor current control loop are maintained stable [4]. The fault features of stator current are studied and analytical expressions of stator fault current are gained. While rotor windings are still excited by ac/dc/ac converter, dynamic response of ac/dc/ac converter throughout non-severe fault conditions has a huge influence on features of stator fault current.

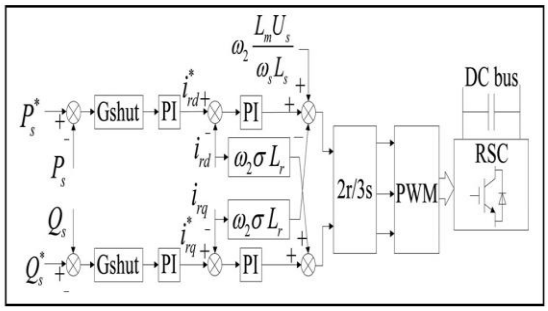


Fig1: overview of rotor-side converter.

## 3. AN OVERVIEW OF PROPOSED SYSTEM:

In non-severe faults, fault current provided by doubly fed induction generator that consists of stator fault current as well as grid side fault current of grid side converter. As the ability of grid side converter is just to some of rated capacity of wind turbine, grid side fault current that is provided by grid side converter is so minute that it has restricted influence on fault current that is offered by doubly fed induction generator. For supporting the issues of relaying

protection of power grid by penetrations of doubly fed induction generators, fault current features of doubly fed induction generator has to be considered. In our work only dynamic response features as well as stator fault current are considered. It is appropriate for study of fault current features of doubly fed induction generator with several control strategies in support of low-voltage ride through. During fault transient period, it is difficult to make doubly fed induction generator work with unity power factor and confine maximum wind power; besides, measurements of active as well as reactive power are imprecise. A distinctive handling method is to minimize external power control loop when fault is detectable. The operation features of the inner rotor current control loop are based on proportional gain as well as integral gain of controller [5]. Initially active response of the rotor-side converter is analyzed on condition that external power control loop is minimized and reference signals of inner rotor current control loop are maintained stable and after that calculation models of rotor fault current are recognized in relation to various design principles of inner rotor current controller. The fault features of stator current are studied and analytical expressions of stator fault current are gained. There are two principles of classical design of proportional gain as well as integral gain. Principle I chooses enough controller parameters to make inner rotor current controller a distinctive first-order system. Principle II: selects enough controller parameters to build inner rotor current controller a distinctive second-order system. Based on these two design principles, various calculation models of rotor fault current are built and it is worth mentioning that rotate inertia time constant of doubly fed induction generator is extremely huge, and changes of electrical quantities are much quicker to that of rotate speed during fault transient period hence rotate speed is considered stable for analysis [6].

## 4. CONCLUSION:

While wind energy plays an essential role in energy industry, this technology of wind power generation has gained much attention global wise. The results cannot meet needs of study of relaying protection hence later research has to be implemented to learn fault current features of doubly fed induction generator in non-severe fault conditions. We introduce an analysis technique for fault

current features of doubly fed induction generator in non-severe fault conditions. It is appropriate for study of fault current features of doubly fed induction generator with several control strategies in support of low-voltage ride through. Initially active response of the rotor-side converter is analyzed on condition that external power control loop is minimized and reference signals of inner rotor current control loop are maintained stable and later basic calculation models of rotor fault current are recognized in relation to various design principles of inner rotor current controller. The fault features of stator current are studied and analytical expressions of stator fault current are gained. The results are helpful to construction of sufficient relaying protection for power grid by penetration of doubly fed induction generators.

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