CONFIGURATION OF DFIG AND SST BASED NEURAL NETWORKS

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ABSTRACT

The main intention of this project is a constellation of Dual feed induction generator founded solid state transformer by employing neural networks. The main grant about work strike the proposed constellation is to interface the turbine with grid while providing enhanced operation and performance. In this project SST regulates the active power to/from the rotor side converter, thus, eliminating the grid side converter, and regulated by ANN controller. The rotor side transformer is acclimated widen the pedigree of strength and to cater the recommended strength prescribed to Dual feed induction generator. The proposed arrangement meets the grid code necessity of wind turbine functioning under rare fault disciplines. Additionally, it has the might to supply reactive power to grid when the wind generation is not up to its rated value.

Key terms: *Dual feed induction generator, neural networks, and Solid state transformer.*

I.INTRODUCTION

With population density and mechanization, potential stipulate has enlarged far. However, historic potential origins equally coal, oil, and gas are poor in variety. Now, continuous electricity causes come to for outlook electricity require. The separate preeminent advantages on this subject inexhaustible expert are environmentally peaceful and unrestricted in description. Due to vocational advances, the cost of geothermal power staged reaches the cost of ordinary management plants. Therefore, geothermal power is gorgeous culled of all viable potential authorities. In the beforehand days, wind generator was used as eternal fly wind cylinder with nine-to-five induction dynamo and condenser banks. Most wind types of diesel prevail fly by means of their directness and reasonable. By watching the characteristics of wind cylinder, one can cal promptly control that to squeeze the height potential, the design must be negotiated at volatile rotor hurry at original wind flees.

Using modern strength thermionic generator, the machinery may set upon a pliable further [5]. Therefore, the above-mentioned wind-boost wind cylinder allows enhancing wind electricity manufacturing. Of all fickle-hurry wind diesel, dual-impulse dynamos (DFGs) are approved by reason they're economical. Other advantages in this regard DVG are high law harvest, low alteration rate, and excel use of dynamos.

These devices also arrange good dampen opera for weak structure. Independent rule of alive and interacting violence is achieved with a recurring aim method granted. This bearing administer organization is regularly

achieved in synchronized rotation of the coordinate system oriented at the electricity axis or veil axis. In this work, the rotor side transformation governs (RSK) transport out in an intensity-oriented standpoint. The organization edge requirements for structure connectedness and wind farm exercise are discussed.

In this project, a new constellation is proposed that combines the operation of Dual feed induction generator based WECS and SST. This constellation acts as an interface between the wind turbine and grid while extinguishing the GSC of DFIG. Moreover, it is necessity to have fault ride through comprised in DFIG scheme to meet grid code demands. In the projected work, the developed constellation allows DFIG to ride through faults seamlessly, which is aspect that has not been addressed in the earlier work on SST interfaced WECS. Fig1. Shows the outline of SST integrated with grid.

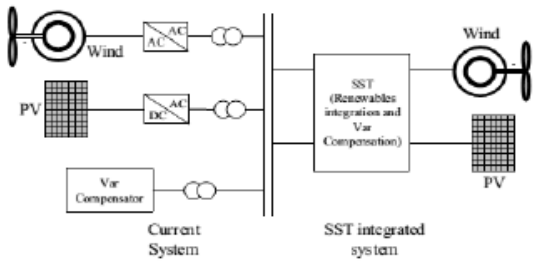


Fig.1 SST structured with grid

II. PROPOSED SYSTEM CONFIGURTION

DVG is an abridgment for the Induction Generator, a period precepts conventional intended cylinder. It rests on an introduction alternator with multi-stage traumatize rotor and a multi-stage sliding loop set with scrapes to strike rotor curving. It is potential to dodge the multi-phase sliding loop assembly (see Electric Brushless Double Feeding Machines), but licensed are problems with skill, cost, and size. A beat substitute is the dual damage rotor smooth feeding machine.

III.PRINCIPLE OF A DUAL FEED INDUCTION GENERATOR ASSOCIATE TO A WIND TURBINE

The regulation of DVG is that the rotor coil characterizes to the grid with slip rings and a potential origin generator from closest that governs both the rotor and the grid tides. Thus the rotor recurrence can vary liberally from the chain repetition (50 or 60 Hz). Using the generator to govern the rotor tides, it is potential to correct the dynamic and operating strength feeding grid of the pro freely of the alternator turn quicken. The manage precept used is one to manage the river dual-axle communication or guide collar command. The DTK has been transformed into a correct cohesion than modern bearing administer principally when high tides of the dynamo are needed.

Mixed rotors are regularly entangled 2 to 3 time's transaction of turns of the definitive part. This measure that the rotor heats will be surpassing and the streams individually cut. Thus in an emblematic ± 30% operational fly drift nearby the synchronized quicken, the weighted side of the generator is subsequently decreased gravitate pare cost of the turbine. The shortcoming is that the

trip unforeseen the foreign performing quicken differ is inconceivable by the agency of bigger appraisal of rotor potential. Moreover, the fleeting intensity by virtue of web disruptions (three-phase and two-phase potential dips, principally) will also be amplified. I tell in order to avoid the high rotor electricity - and the high streams generated by the particular heats - from spoiling the Magpies and the diodes of the generator, a safety lap (christened the juicer) is used.

The thick tour member will spin the rotor coil over small-scale intransigence when extra streams or heats are detected. In request ultimate able as well the treat as soon as achievable you must use an a live grouch. Active Mixer The abbreviated rotor perhaps disconnected in an orderly process so the rotor side modification perhaps in only afterward 20-60 ms from the outbreak of the grid eruption. It is so available to spawn a keen cascade to the grid at the time the rest of the potential drop and so on helps the structure increase from the error.

Double feeding inauguration machinery is an angel rotor feed feeding machinery and has many advantages over historic greetings engine upcoming strength applications. First, the rotor tour is also subservient the sovereignty radios cylinder, and the inductor manages both construction and transports the relative law. This has intended ant sequel for the strength of the strong organization and allows the structure to pay the organization in the course of unreasonable intensity eruptions (low electricity ride about, leveret).

Second, predominant the rotor heats and floods enable the inauguration strategy to hover synchronized with the grid time the boost of wind cylinder varies. Wind-further wind cylinder uses a free wind source more wholly than immobile wind diesel, exclusively at the same time as small wind surrounding. Thirdly, the cost of the generator is low when as to alternative yo-yo fly solutions for the reason that only a small-scale chunk of the stereotyped strength, commonly 25-30%, is fed to the organization about the preacher, et al. is fed to the organization honestly from the incumbent. The efficiency of DVG is gorgeous for the same reason.

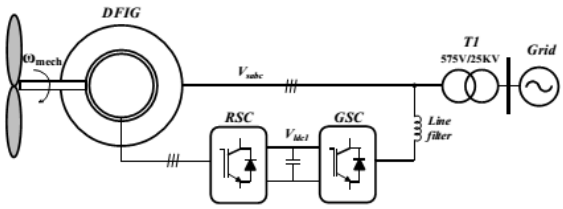


Fig.2 Regular DFIG outline

III.SYSTEM MODEL:

Three stage SST constellations is shown in Fig.3, where it link up grid to a distribution load. Conv-1 is a fully regulated three-phase converter attached to high voltage grid (11-33 kV). It draws real power from grid and maintains high voltage DC bus (*vhdc*).

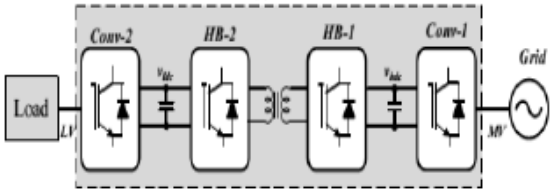


Fig.3 SST structure

A) PROPOSED SYSTEM CONFIGURATION

The projected system constellation is shown in Fig. In projected system, the fundamental frequency transformer is replaced by SST. The proper manipulate of SST converter that is close to the stator of Dual feed induction generator, addressed as machine interfacing converter, can aid machine in its function. Thus, it is projected that exclude the GSC in DFIG system constellation by incorporating its role in SST. Note that this new disposition modifies the overall function and regulate of standard GSC-RSC founded in DFIG system. In the principle, the machine terminal voltages can be defended constant in spite of the voltage variations in grid employing the MIC. The direction of power flow in projected outline occurs from the low voltage machine terminals to the particular grid. The MIC is responsible for: (i) keeping the required voltages at the stator poles and (ii) transmitting the active power from the stator poles (*Ps*) to the low voltage DC bus (*vldc*). This allows the RSC in the proposed configuration to be connected directly to *vldc* of SST. The *vldc* has two functions, namely, (i) to transfer active power from the stator terminals to the grid and (ii) to transfer active power (*Pr*) to/from the RSC during sub-synchronous or super-synchronous operation.

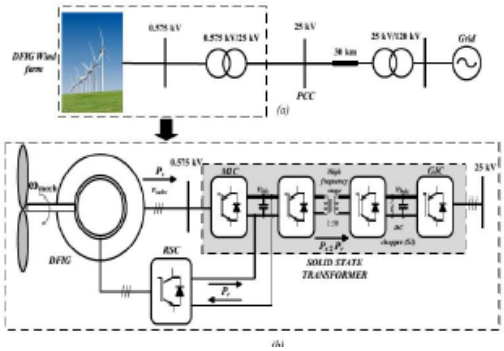


Fig.4. Projected SST based DFIG outline

B) DFIG Model

The Dual feed induction generator is modeled employing the *d-q* synchronous reference frame rotating at synchronous speed. The machine flux equations can be written as in the *d-q* reference frame as,

$$\left.\begin{aligned}\lambda_{sd} &= L_{ls}i_{sd} + L_m(i_{sd} + i_{rd})\\ \lambda_{sq} &= L_{ls}i_{sq} + L_m(i_{sq} + i_{rq})\\ \lambda_{rd} &= L_{lr}i_{rd} + L_m(i_{sd} + i_{rd})\\ \lambda_{rq} &= L_{lr}i_{rq} + L_m(i_{sq} + i_{rq})\end{aligned}\right\} \quad (1)$$

The voltage equations for the stator and rotor are given as,

$$\left.\begin{aligned}v_{sd} &= r_s i_{sd} - \omega\lambda_{sq} + \frac{d\lambda_{sd}}{dt}\\ v_{sq} &= r_s i_{sq} - \omega\lambda_{sd} + \frac{d\lambda_{sq}}{dt}\\ v_{rd} &= r_s i_{rd} - (\omega-\omega_r)\lambda_{rq} + \frac{d\lambda_{rd}}{dt}\\ v_{rq} &= r_r i_{rdq}(\omega-\omega_r)\lambda_{rd} + \frac{d\lambda_{rq}}{dt}\end{aligned}\right\} \quad (2)$$

The *d* and *q* axes quantities are the delineated by respective subscripts *d* and *q*. *rs* and *rr* represent the stator and rotor resistances. *Lls*, *Llr* and *Llm* delineate stator, rotor and mutual inductances referred to stator. *ω* delineates electrical supply frequency and *ωr* delineates the rotor frequency. Using (1)-(2), the torque equation for the machine can be obtained as,

$$T = -\frac{\lambda_{sd}L_m}{L_s}i_{qr} \quad (3)$$

It can be understood from the above equation that on aligning the stator flux with the *d*-axis, the torque in the machine can be regulated by varying *iqr*. This is the basis on which the rotor side converter is controlled. It can also be shown that by varying *idr*, reactive power output from the stator can be

controlled. Further details on the DFIG modeling can be obtained from.

IV.CONTROL OF THE PROPOSED SYSTEM

The control objective and algorithms for the projected system is shown in Fig.5.

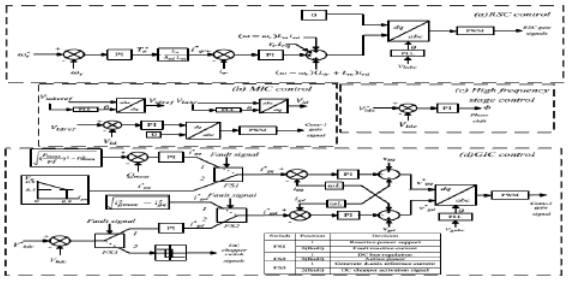


Fig.5. Control diagram of projected system

V.SIMULATION RESULTS

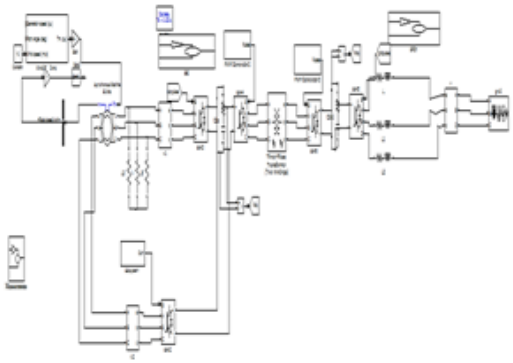
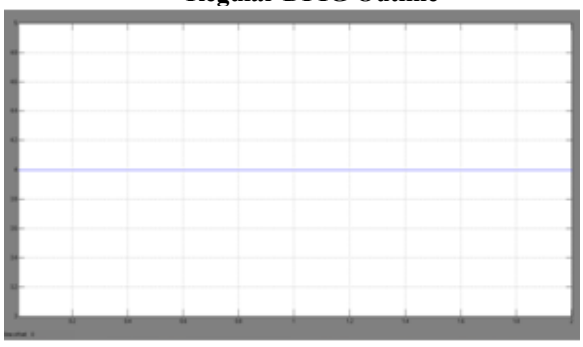
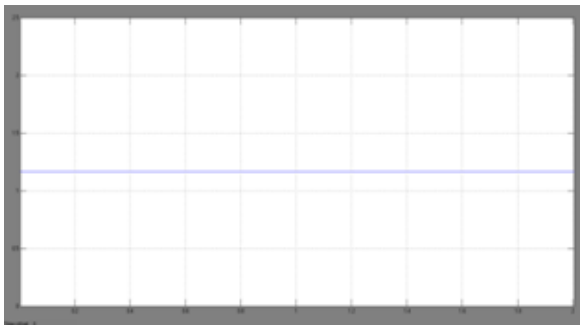


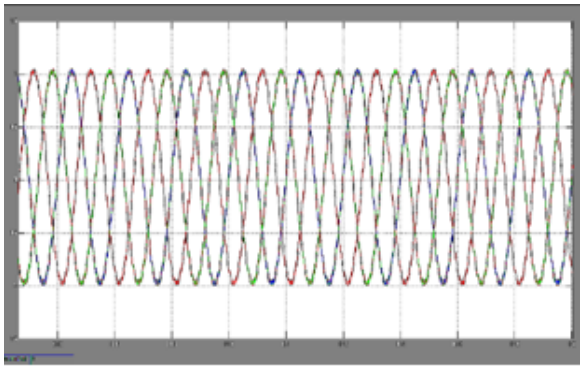
Fig 6 MATLAM/Simulink circuit diagram for Regular DFIG Outline



a) Pgen active power injected by the system



b) Speed of the Rotor



c)Vgabc Grid voltages

d)Inner loop regulated d-q axis grid currents

Fig 7.Simulation waveforms for Normal operation of proposed configuration showing dynamics of the P and Q injection

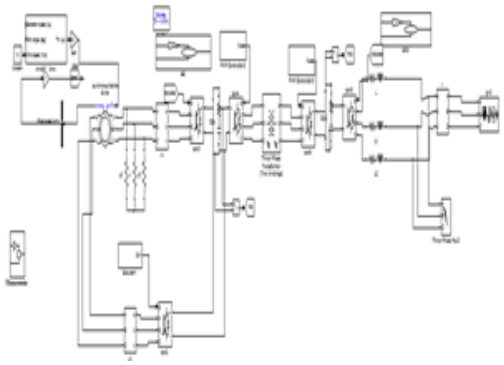


Fig.8 Matlab/Simulink circuit for Projected SST based DFIG with neural network configuration

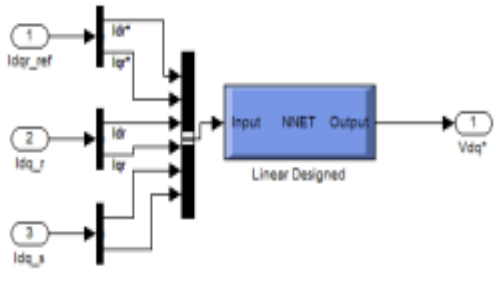


Fig 9. Rotor Side ANN controller

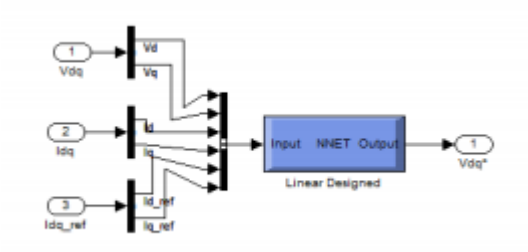
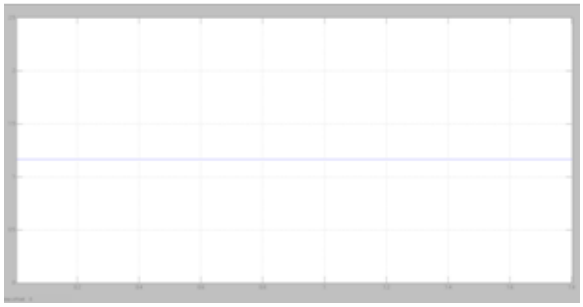
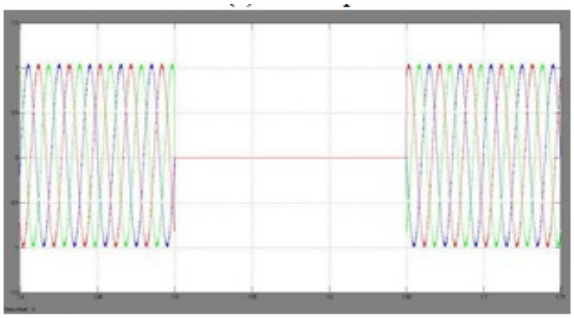


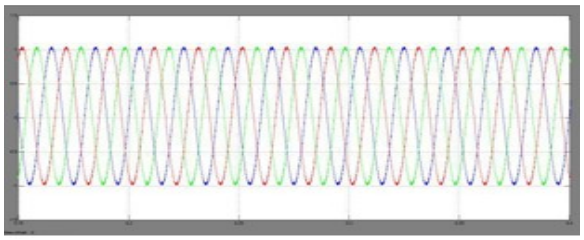
Fig 10.Grid side ANN controller



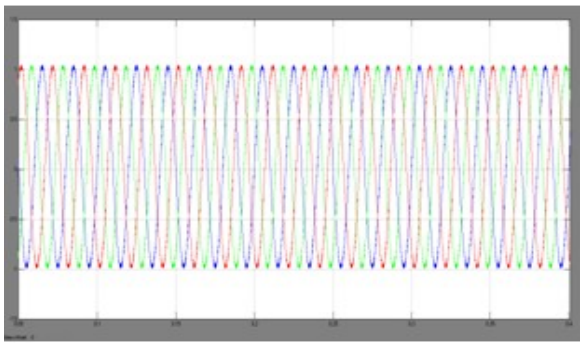
a)Rotor Speed



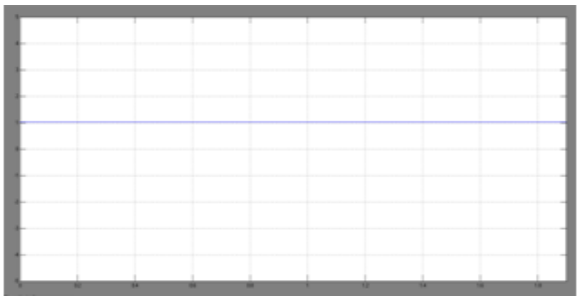
b)Vgabc Grid Voltages



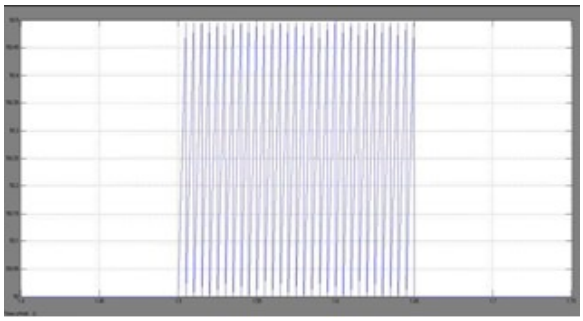
c)Vsabc Stator terminal voltages



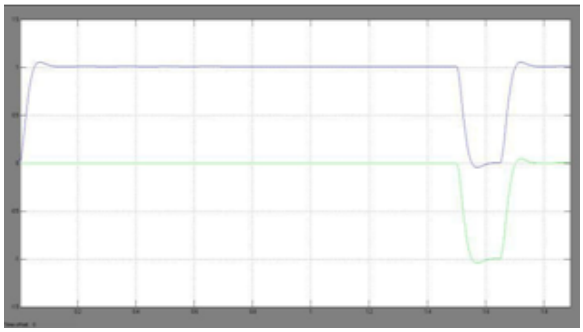
d)Grid Currents



e) Low voltage of DC bus



f) High voltage of DC bus



g)Inner loop regulated d-q axis grid

Fig.11 Simulation waveforms for Performance of the projected constellation under three-phase symmetrical LLL-G fault

CONCLUSION

In this project, a new system constellation that combines DFIG and SST operation has been projected founded neural networks. This constellation replaces the veritable fundamental frequency transformer with modern power electronics founded SST. The projected system is extended with neural network based system for effective operation which observes that SST regulates the active power to/from the rotor face converter, thus, rejecting the grid face converter and gather recent grid code demands of wind turbine operation under the fault conditions. Additionally, it has the ability to supply the reactive power to grid when wind generation is not up to its rated value. The major advantage of ANN controller is that there is no mathematical framework so the theoretical calculation time is reduced.

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