

Voltage Control of the Grid Connected Wind Plant using Energy Storage & FACTS Controller

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Abstract— Developments in rotary engine technology square measure facilitating the increase of power generation capability from renewable energy resources. The utilization of the squirrel-cage induction generator for wind power generation has some blessings over that of typical synchronous generators. Throughout this work, Associate in nursing induction generator model driven by rotary engine and connected to the grid is simulated in SIMULINK / MATLAB. The simulation results make sure that the performance of the grid connected wind plant improves with the use of energy device i.e. (capacitor bank) & FACTS device i.e. (Static electromagnetic unit Compensator). However, higher results square measure obtained by use of SVC. Together we've a bent to check all series truth controller with SVC truth controller. That represents the only FACTS controller for wind energy coupling. The FACTS Device (STATCOM) management theme for the grid connected wind energy generation system to spice up the power quality is simulated pattern MATLAB/SIMULINK in power system block set. The supposed results of the planned theme relieves the foremost supply offer from the reactive power demand of the load and so the induction generator. From the obtained results, we have got consolidated the usefulness and utility of the approach for the applications thought of.

Key words: Voltage Control, Grid Connected Wind Plant

I. INTRODUCTION

Today, fashionable energy business faces a growing awareness regarding the impact of typical power generation on the setting. Issues like restricted fuel reserves, international global climate change thanks to greenhouse gas emissions, arouse attention numerous technologies to induce electricity in very lots of property manner [2].

As international energy demand is systematically rising, there is a superb responsibility for society to develop the inexperienced technologies for reducing its impact on the setting. At intervals the trend of diversifying the energy market, wind power is that the foremost speedily growing sector. Once the oil crisis from three decades a gone, wind power business began to flourish. Since then rotary engine technology improved speedily and it presently took the title of champion from all renewable sources of energy.

In keeping with world Wind Energy Council quite hundred and sixty GW of place in capability has been achieved by the tip of 2009 around the world. jointly an entire power increase of thirty fifth is accomplished at intervals the year 2009 at intervals the globe. Thus a replacement record every year of place in energy capability has been reached, summation in thirty eight GW around the world. Europe accounts for 5 hundredth of the whole amount of place in energy around the world [3]. Figure 1.1 shows the endlessly growing trend of different energy

installations at intervals EU. This reference scenario shows that with installations of up to 3 hundred GW by the year 2030, EU will have a twenty initial to twenty-eight wind penetration [4].

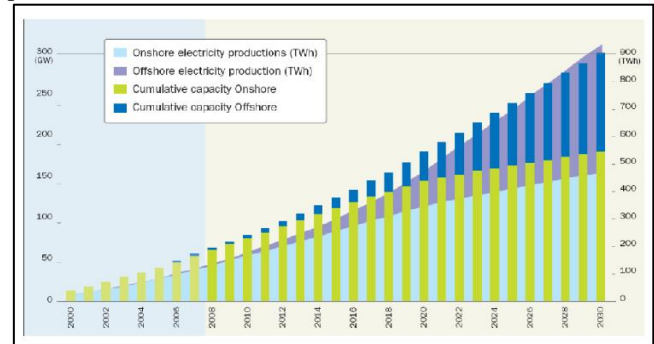


Fig. 1: EU Wind Power Forecast for 2030 [1]

Along with the increasing demands for energy, the rotary engine technologies area unit up and thus instrumentality costs area unit reducing. As a results of the wind business can be a well-established powerhouse on the renewable market, its prices per kWh area unit comparable prices of the quality energy generations. Unlike gas, coal and oil resources that in future will become scarce, which the technologies became mature decades ago, the wind energy is swarming and new enhancements on mechanics and power electronic devices area unit still to come back. Therefore by 2030 electricity production from wind will inevitably become cheaper than the opposite offer of energy, presently having a high market share [4].

II. PROPOSED METHODOLOGY

A. MATLAB simulation model

A power plant consisting of 2 one.5-MW wind turbines is connected to a 25-kV distribution system exports power to a 120-kV grid through a 25-km 25-kV feeder. The 9-MW station is simulated by 3 pairs of one.5 MW wind-turbines. Wind turbines use squirrel-cage induction generators (IG). The computer winding is connected on to the sixty Hertz grid and jointly the rotor is driven by a variable-pitch rotary engine. The pitch angle is controlled therefore on limit the generator output power at its value for winds exceptional the nominal speed (9 m/s). therefore on come back up with power the immune human gamma globulin speed have to be compelled to be slightly on prime of the synchronous speed. Speed varies extra or less between one variety ninety four at no load and one.005 variety ninety four at full load.

Reactive power absorbed by the IGs could be a element paid by capacitance banks connected at every rotary engine low voltage bus (400 kvar for every mixture of one.5 MW turbine). the remainder of reactive power needed to need care of the 25-kV voltage at bus B25 near one variety

ninety four is provided by a 3-Mvar STATCOM with a third droop setting.

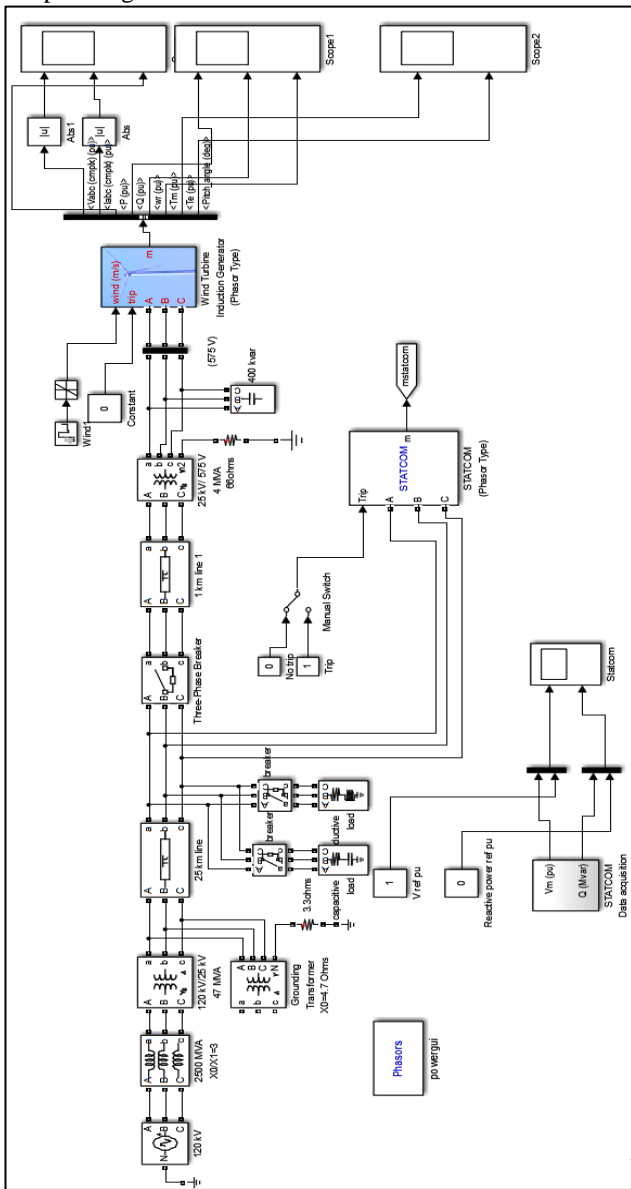


Fig. 2: MATLAB simulation model of proposed approach

Variable load unit connected with main grid through 3 section breaker within that inductive load of 3000Mvar connected with system between four to five second of total simulation time whereas natural phenomenon load of 3000Mvar connected in system between six to seven second of total simulation time of model. This behavior of load act as non linear or variable load of system. Total simulation time is ten second.

The wind speed applied to rotary engine is controlled by the "Wind 1" block. Initially, wind speed is ready at eleven m/s, then beginning at t=2s for "Wind rotary engine", wind speed is rammmed to five m/s in four seconds. Once more wind speed is 6m/s at five seconds so finally wind speed modification to nine m/s at 8second and continue up to total simulation time. This shows the nonlinear behavior of different energy in rotary engine system. During this simulation model rotary engine generator connected to grid at a pair of second time with the assistance of 3 section breaker.

B. Simulation model parameters

Sr No.	Parameter	Symbol
1.	Three phase programmable voltage source	Positive sequence Amplitude (Vrms ph-ph) = 120 KV Frequency = 60Hz Phase difference = 0 Degree Generator type = Swing
2.	Three phase mutual inductance ($Z_0 - Z_1$)	$R_1 = 0.1$ Ohm; $L_1 = 1.0H$; $R_0 = 0.3$; $L_0 = 3.0H$

Table 1: Parameters Used For Simulation

III. MATLAB SIMULATION RESULTS

A. STATCOM as voltage regulator

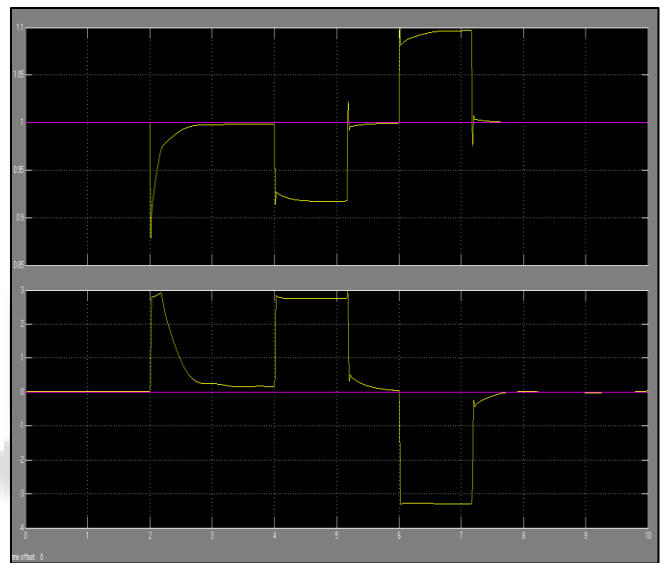


Fig. 3: STATCOM act as voltage regulator corrected grid voltage and generated and absorbing reactive power

Figure 3 and 4 shows that, once the simulation model run, at a try of second time rotary engine connected with main grid through three section breaker. The wind speed applied to rotary engine is controlled by the "Wind 1" block. Initially, wind speed is prepared at eleven m/s, then starting at t=2s for "Wind rotary engine", wind speed is rammmed to 5 m/s in four seconds. Another time wind speed is 6m/s at 5 seconds so finally wind speed modification to 9 m/s at 8second and continue up to total simulation time. This shows the nonlinear behavior of alternative energy in rotary engine system.

At a try of second once rotary engine connected with grid system voltage get reduced but at that time STATCOM generate 3 substance reactive power and supply reactive power to grid for voltage improvement up to reference voltage that is one substance.

At four second simulation time inductive load of 3000mVar connected in grid through breaker and closed at 5 second. Throughout this era, due to inductive load grid voltage get drop up to -0.93 substance but STATCOM generate the +2.97 substance reactive power for improve the grid voltage of 1 substance.

At six second another time physical phenomenon load of 3000Mvar unit of measurement connected with grid and disconnect at seven second. Throughout this era, due physical phenomenon load grid voltage becomes rises up to +1.1 substances but STATCOM fascinating the reactive power of -3.2 substances for maintaining grid voltage as reference voltage that is one substance.

B. STATCOM as Var Controller

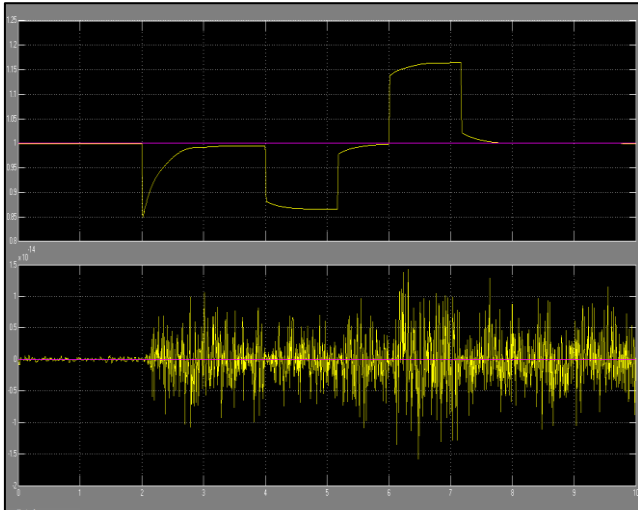


Fig. 4: STATCOM act as reactive power compensator for voltage profile improvement corrected grid voltage and generated and absorbing reactive power

IV. CONCLUSION

This writing has been an attempt to alter the importance of the reactive power compensation for facility with rotary engine. The role and additionally the impact of obtaining external devices for reactive power compensation is analyzed with regards to chosen grid codes. The VSC based totally STATCOM is chosen as fashionable, fancy and reliable account energy application.

This writing gift the FACTS device (STATCOM) based management theme for power quality improvement in grid connected wind generating system and with nonlinear load. The power quality issues and its consequences on the patron and electrical utility ar given. The operation of the system developed for the STATCOM in

MATLAB/SIMULINK for maintaining the power quality is to be simulated. it is a capability to wipe out the harmonic parts of the load current. It maintains the provision voltage and current in-phase and support the reactive power demand for the windmill and consignment at PCC among the grid system; therefore it offers an opportunity to spice up the use issue of cable. The integrated energy and FACTS device with BESS have shown the outstanding performance. That the projected theme among the grid connected system fulfills the power quality norms as per the IEC customary 61400-21.

Most of the objectives declared among the initial a part of the project were fulfilled. The investigation of subsidiary service requested from energy plant in terms of reactive power generation/absorption was performed. For us, master students it had been a replacement analysis topic. to boot to the review of SOA of FACTS it's shown that grid

codes from utterly completely different mechanism operator (TSO) became plenty of and plenty of tight in term of grid voltage support. Modeling and simulation model implementation of the projected system was completed successfully.

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