International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 06| June 2021 www.irjet.net p-ISSN: 2395-0072

# DFIG BASED WECS FOR REGULATED POWER FLOW

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**Abstract –** *In this paper a Doubly Fed Induction Generator (DFIG) based wind energy conversion system for regulated power flow with the grid and Battery Energy Storage System (BESS) is designed. A doubly fed induction generator (DFIG) whose stator and therefore rotor is connected to the grid through a back-to-back AC-DC-AC PWM converter by mean of Battery Energy Storage System. To make sure a smooth DC voltage and sinusoidal current within the grid side is achieved by means of the grid side converter (GSC). The system is modeled to improved power quality problem by unbalanced nonlinear load using Sim Power Systems toolbox MATLAB/ Simulink .*

**Key Words:** Doubly fed induction generator (DFIG), Battery Energy System (BES), utility grid, wind energy conversion system (WECS).

## 1. INTRODUCTION

Wind industry is becoming one among the world's fastest growing energy sectors nowadays, offering the simplest opportunity to unlock a replacement era of environmental protection, helping to satisfy global energy demand and starting the transition of sustainable energy to a worldwide economy. Variable speed constant frequency operation, reduced flicker and independent control capabilities for active and reactive powers are often achieved by Wind turbines supported doubly fed induction generators have attracted particular attention due to their advantages. Active power from the generator is decided by the turbine control and must in fact be within the potential of the turbine generator system. The development caused by doubly fed induction generator features a good performance without losing any equilibrium when the voltage reduction occurs in these conditions; it will remain connected to the power system. DFIGs are variable speed generators with controlled power electronic converters are used for improving the efficiency and power quality. The main components of a wind turbine system that including the turbine rotor, gearbox, generator, transformer and possible power electronics. Wind turbines capture the power from the wind and convert it to rotating mechanical power, which successively converted into electric power by alternator/ generator.

## 2. DOUBLY FED INDUCTION GENERATOR

Most doubly-fed electric machines in industry today are three-phase wound-rotor induction machines that contain the stator and the rotor windings. Doubly-fed electric machines are basically electric machines with a back-to-back converter are often seen in Figure 1. The back-to-back converter consists of two converters i.e machine-side converter and grid-side converter. DFIG are that they allow the amplitude and frequency of their output voltages to be maintained at a constant value. A dc-link capacitor is placed between the two converters as energy storage to say the voltage variations/ ripple in the dc-link. The most objective for the grid-side converter is to stay the dc-link voltage constant it's possible to regulate the torque or the speed of the DFIG and therefore the power factor at the stator terminals by the machine-side converter.

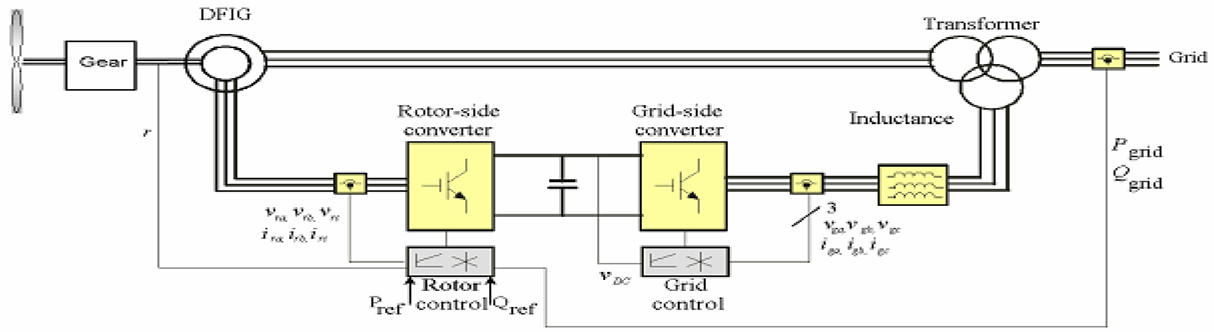


**Figure 1 Back-to-back converter in DFIG systems**

## 3. PROPOSED DFIG AND BESS SYSTEM

Typical wind energy conversion system shown in figure 2 composed of a DFIG which has the capacity to work in variable wind speed conditions, a gearbox responsible of connecting the DFIG with the blades, which captures the kinetic energy contained within the air, two power converters named rotor side converter (RSC) and a grid side converter (GSC) responsible of controlling the flow of power exchanged with the grid and a battery energy storage system (BESS) connected to the DC link of the back-to-back converter. The battery will begin to charge and therefore the battery will provide power when DC link voltage decreases. As shown in Figure 2, DFIG-BESS system can absorb/inject active power in grid connected operating mode and in additionally to feed the loads to participate in frequency control. The control strategy manages when the DFIG is connected within the grid, the power generated by the wind turbine to charge or discharge the battery and therefore the discharge of the battery through droop control.

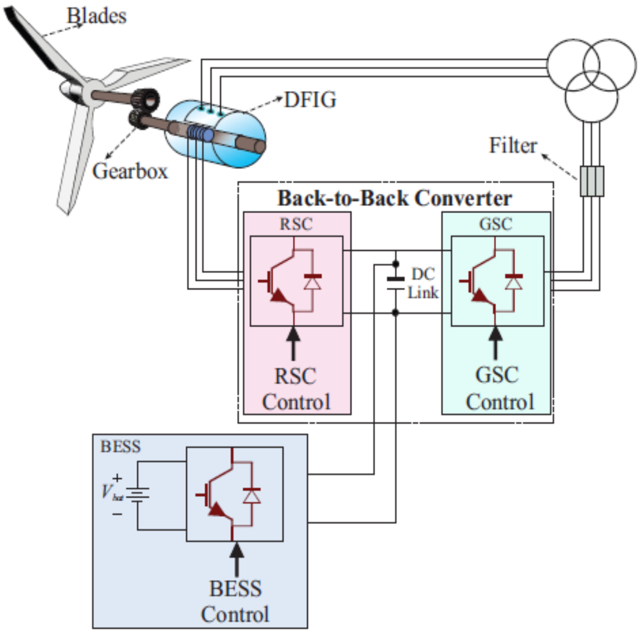


**Figure 2 DFIG wind system with BESS**

## 4. SIMULATION AND DISCUSSION

Figure 3 shows a wind power generation system (WECS) supported doubly fed induction generator (DFIG) with battery energy conversion system connected to grid system is simulated using MATLAB/SIMULINK software.

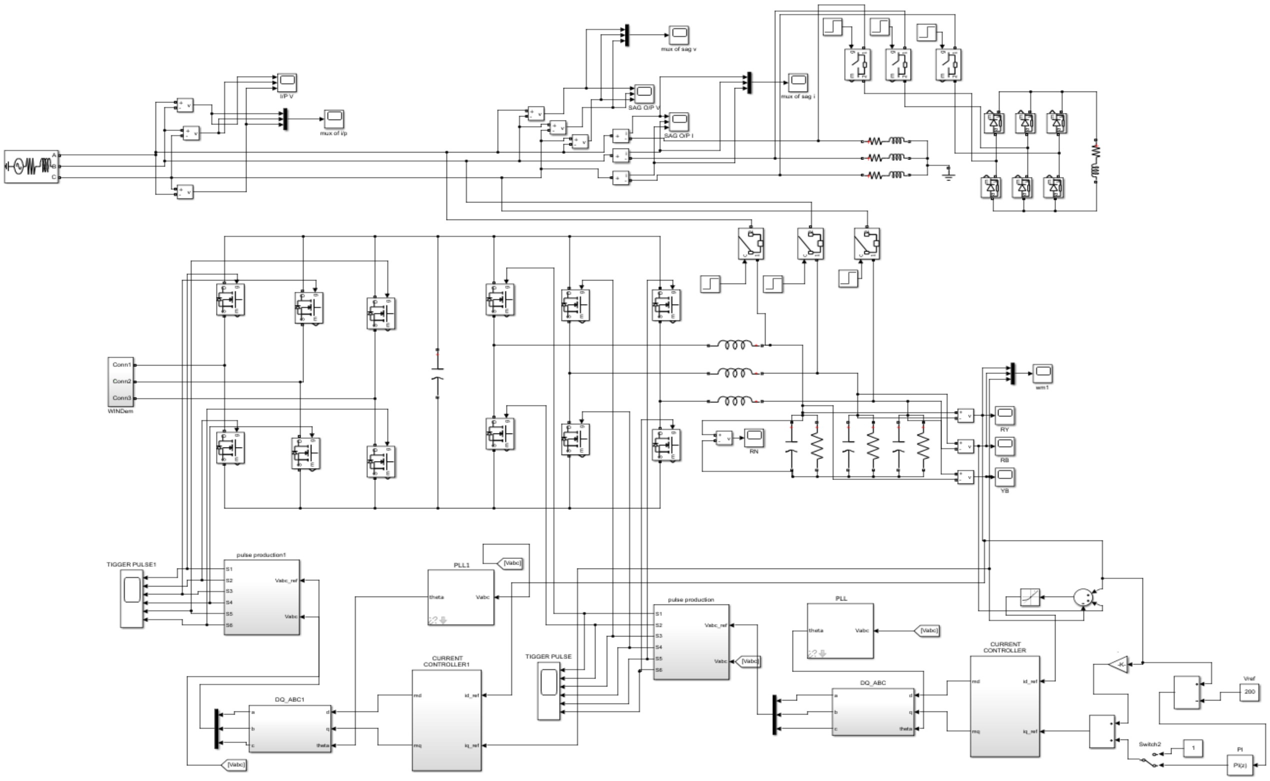

**Figure 3 Simulation Diagram of Doubly Fed Induction Generator with BEES**

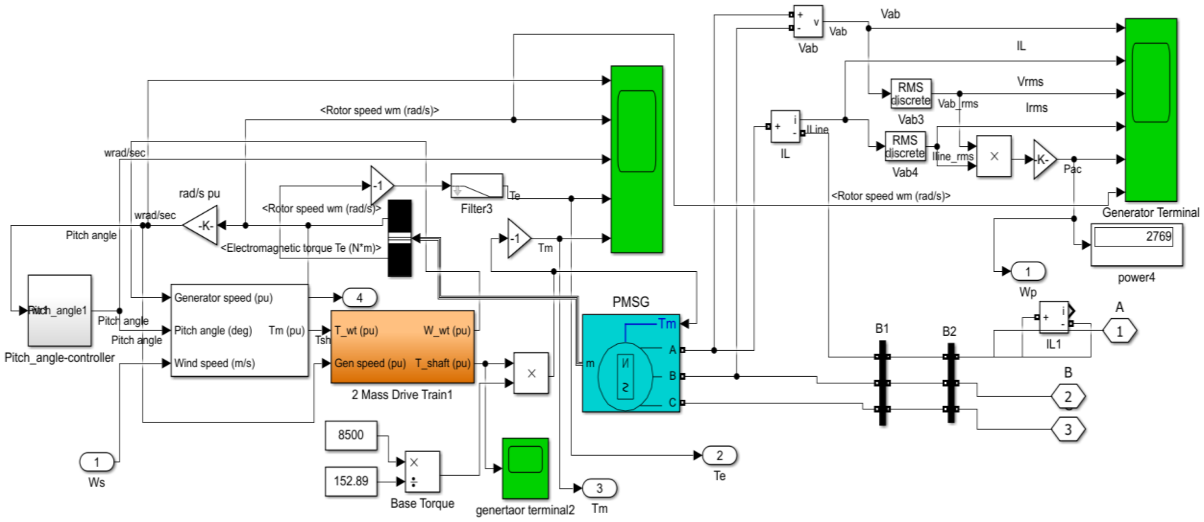


**Figure 4 Wind generation**

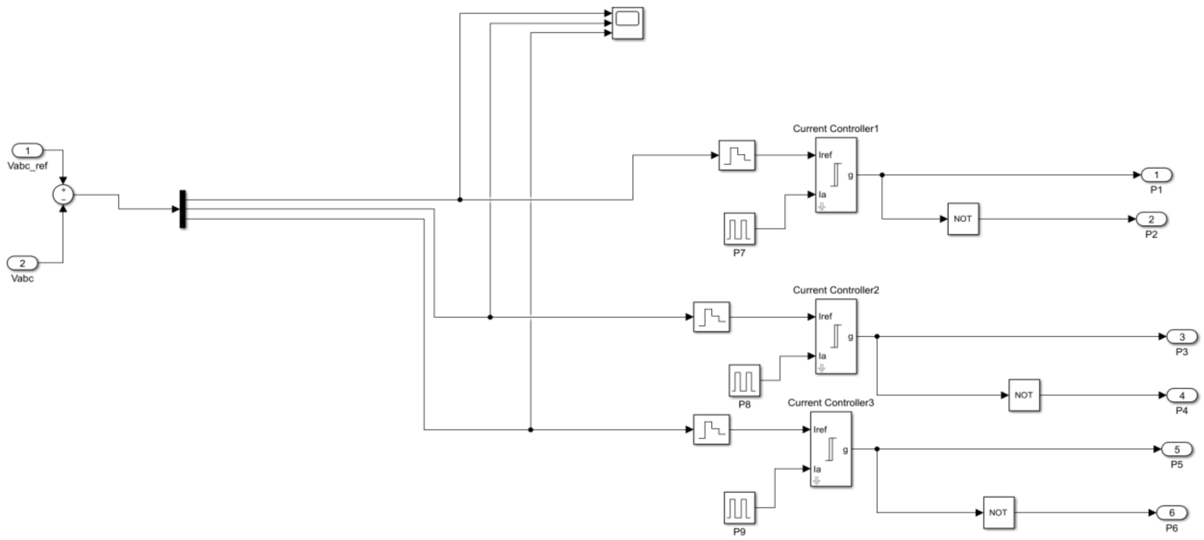


**Figure 5 Pulse generation circuit**

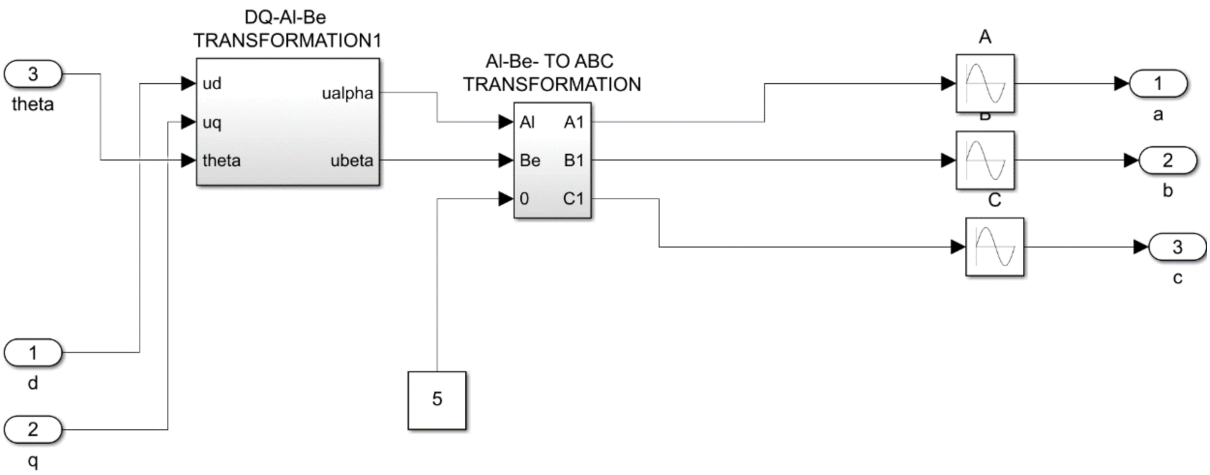


**Figure 6 DQ Transformation circuit**

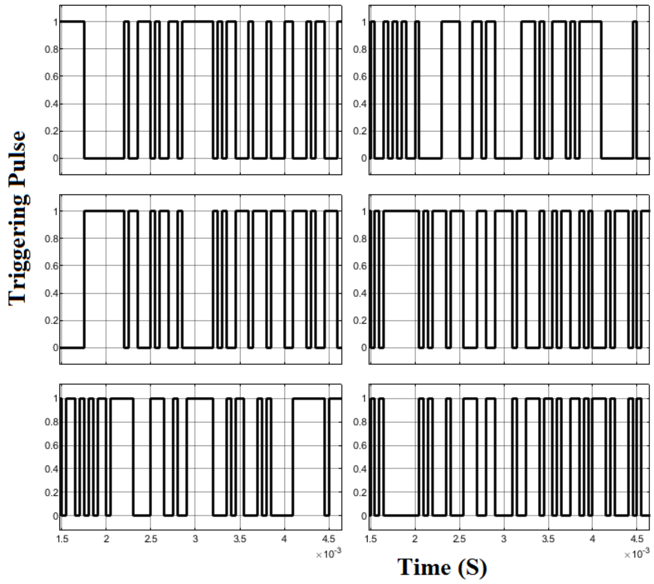


Figure 7 Gate Pulse

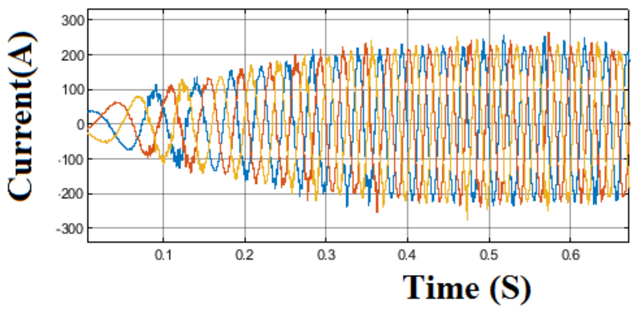


Figure 8 Wind Current

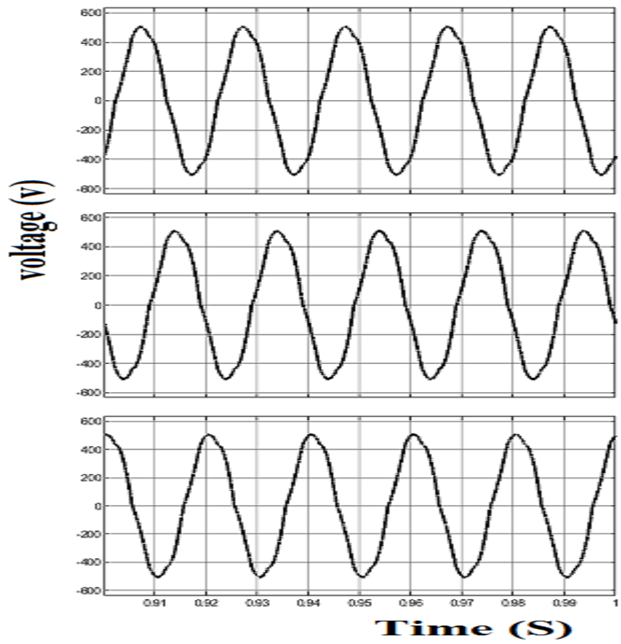


Figure 9 Input Voltage at each phase

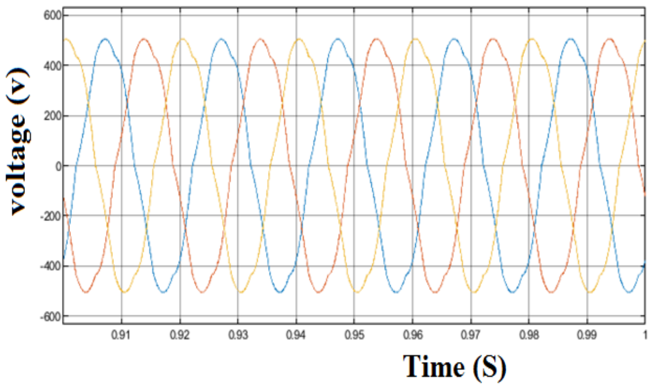


Figure 10 Input three phase voltage

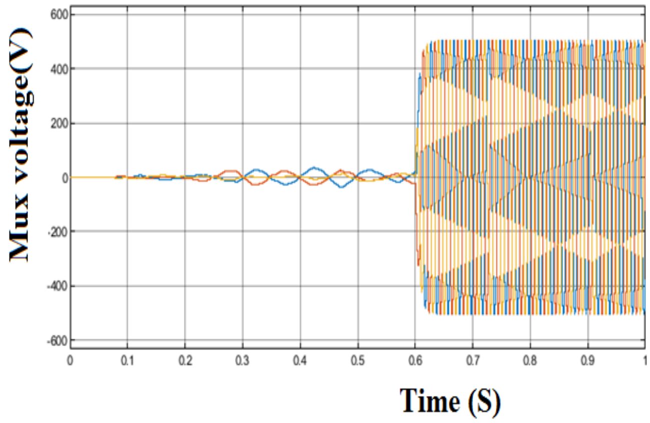


Figure 11 Three phase Mux voltage

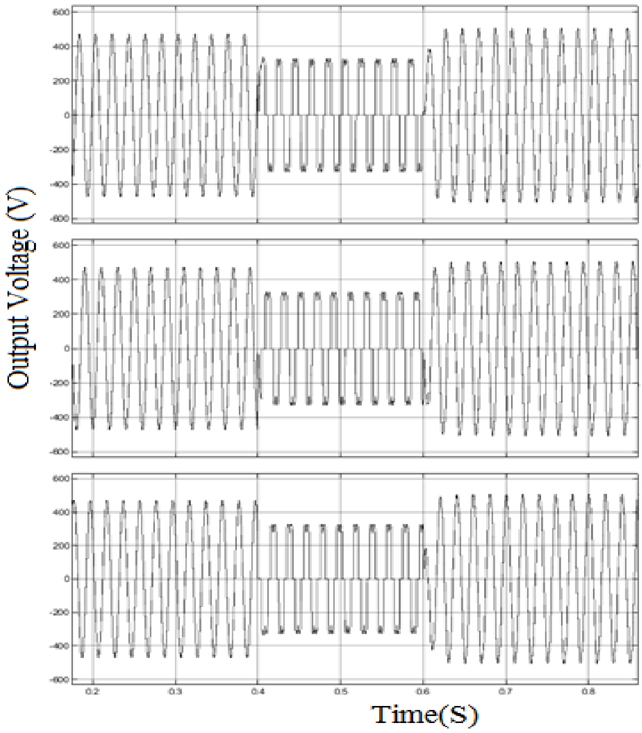


Figure 12 Sag output Voltage

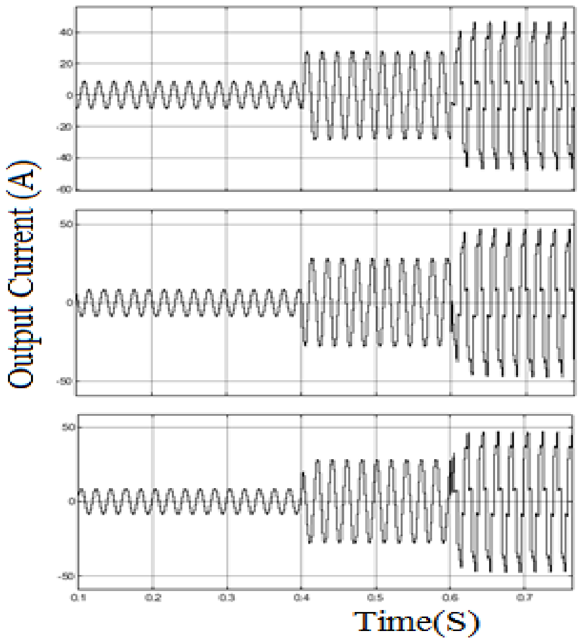


**Figure 13 Sag output current**

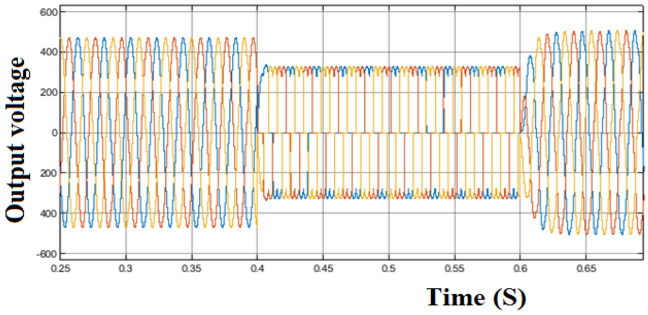


**Figure 14 Three phase Sag output Voltage**

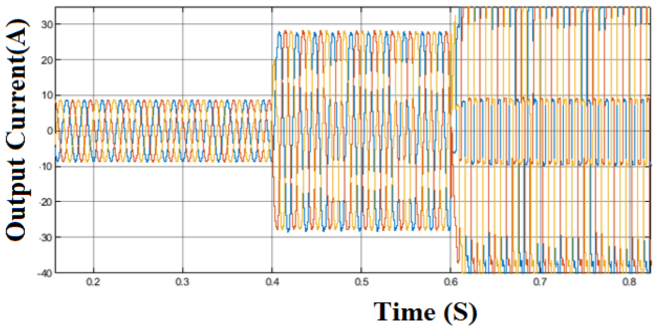


**Figure 15 Three phase Sag output Current**

## 5. CONCLUSION

In this paper a Doubly Fed Induction Generator (DFIG) based wind energy conversion system for regulating power flow with Battery Energy Storage System (BESS) was designed and simulated by MATLAB/Simulink. Simulated results shown that the system gives reasonably good performance under varying reactive power sharing and unbalanced nonlinear loads and regulate constant power flow with the assistance of Battery energy storage system.

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## BIOGRAPHIES

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