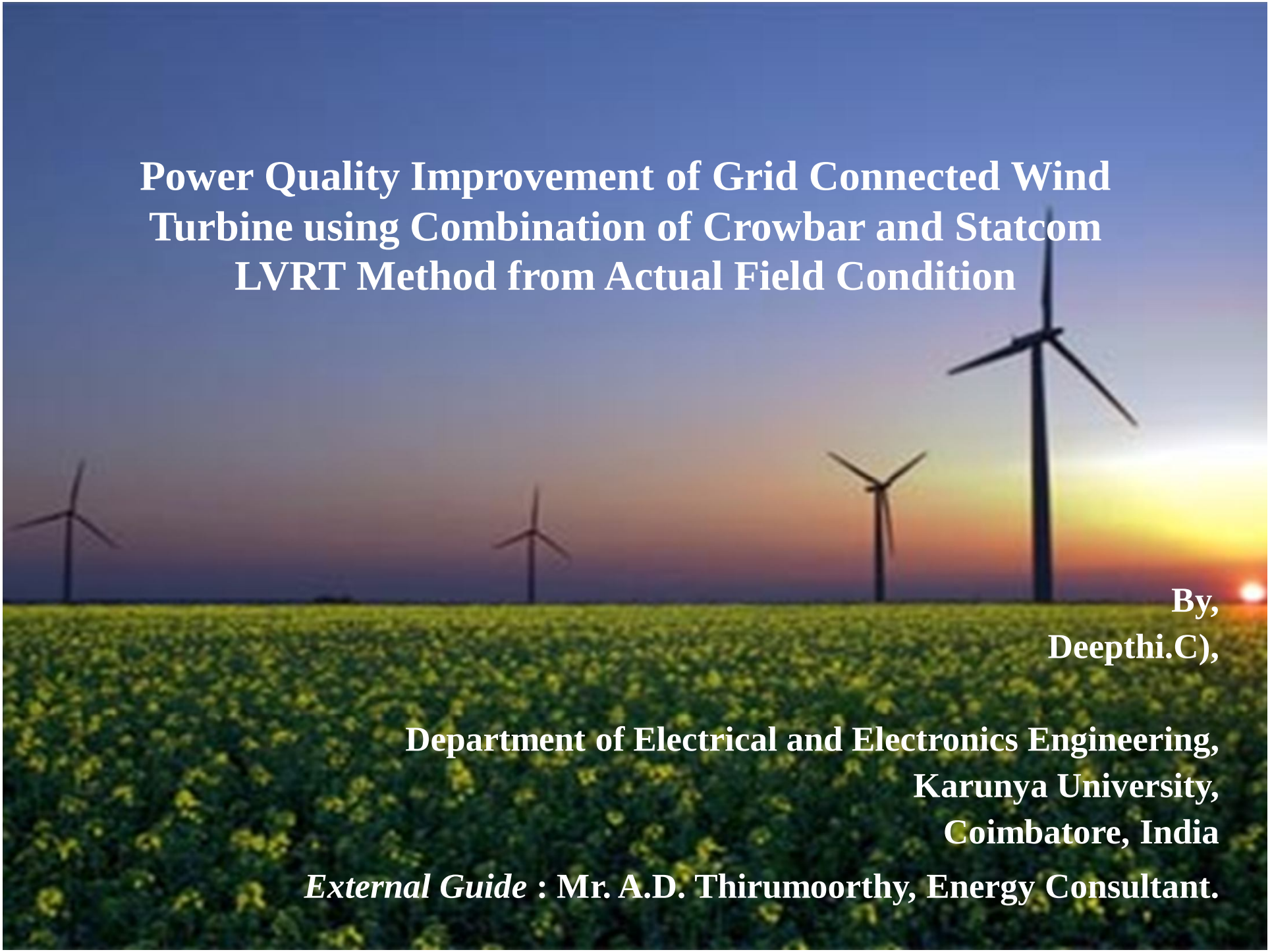

Power Quality Improvement of Grid Connected Wind Turbine using Combination of Crowbar and Statcom LVRT Method from Actual Field Condition

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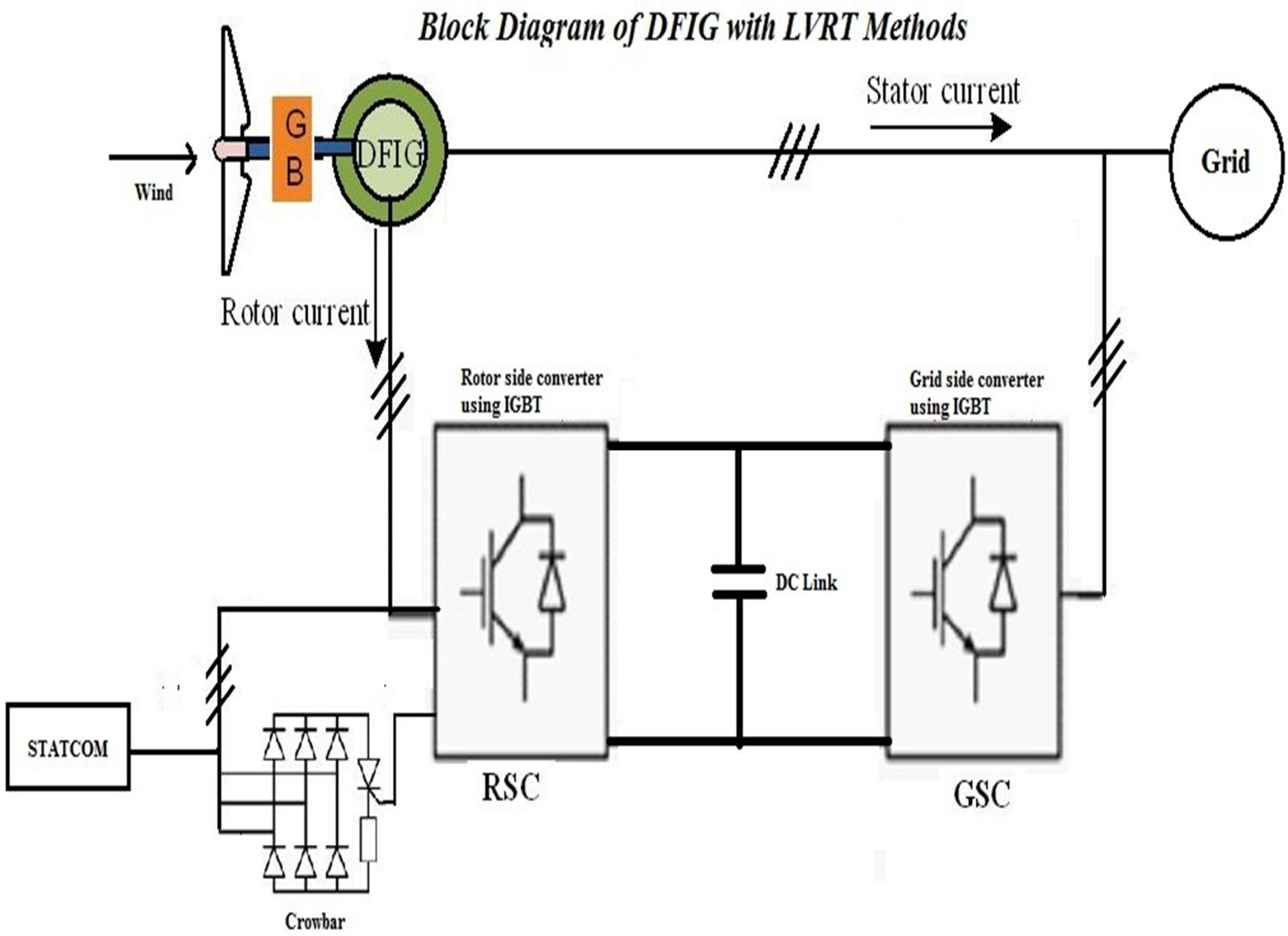
SPECIFIC PROBLEM

- During grid faults, sudden disconnection of DFIG from the grid causes huge outages.
- LVRT (Low Voltage Ride Through) methods are necessary to keep the DFIG connected to the grid as mentioned by the grid codes.
- Crowbar and STATCOM is used for voltage sag mitigation.

BASE PAPER

- ALMOATAZ Y. ABDELIZIZ, AMR M. IBRAHIM, AHMED M. ASIM, AHMED H. ABDEL RAZEK (2013). Dynamic behaviour of DFIG-based wind turbines during symmetrical voltage dips. International Journal of electrical and Electronics Engineering.


Block Diagram of DFIG with LVRT Methods
Wind
G
B
DFIG
Stator current
Grid
Rotor current
Rotor side converter
using IGBT
Grid side converter
using IGBT
DC Link
STATCOM
RSC
GSC
Crowbar

EXPLANATION

- *DFIG (Doubly Fed Induction Generator),*

  Stator : directly connected to the grid;

  Rotor : connected through the power electronic circuits to grid.

- *During grid faults,*

➢ DFIG experiences voltage sags (0.1-0.9 p.u), 90% the nominal value

➢ Large transient currents are induced in stator & rotor.

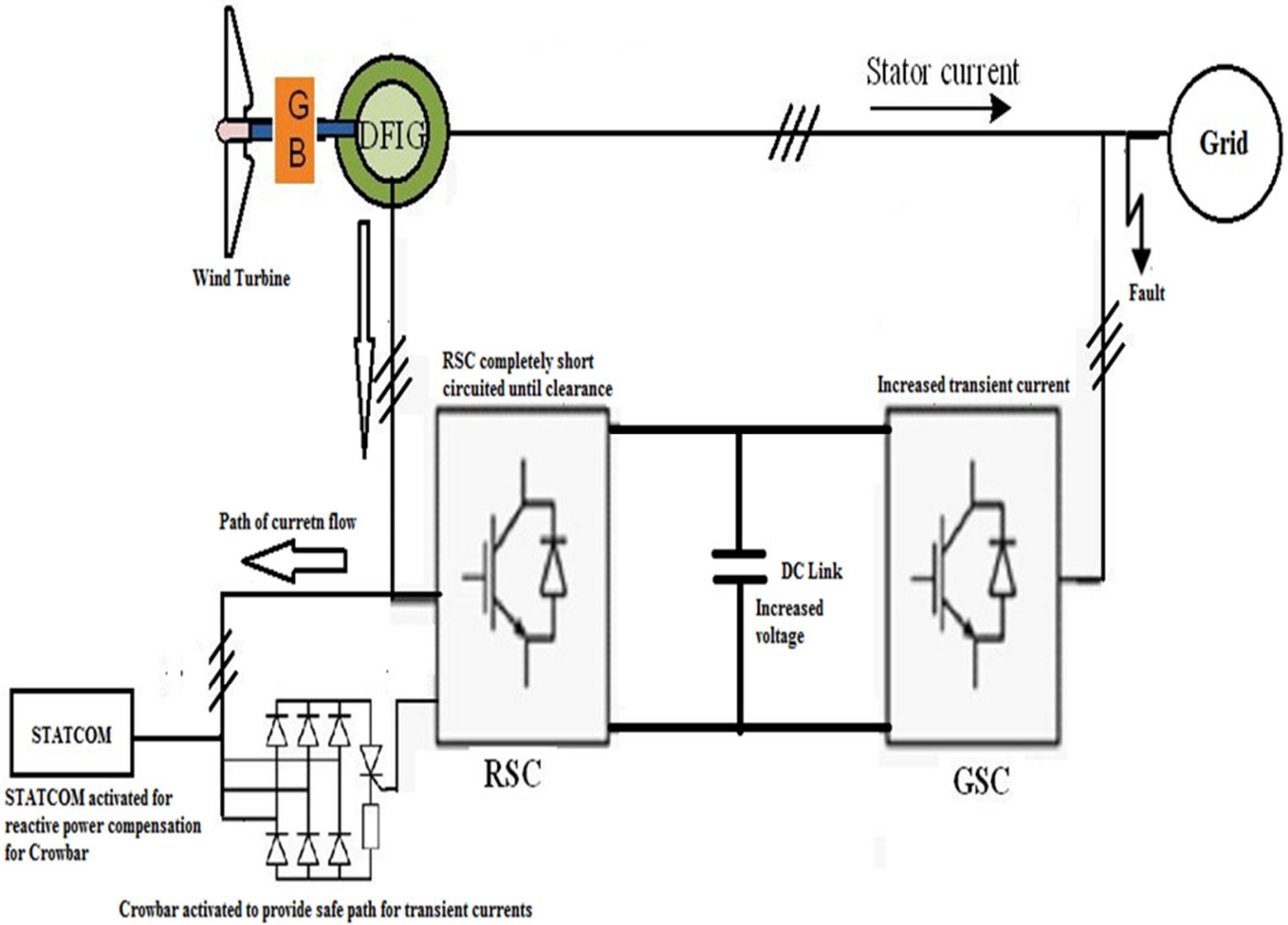
➢ High currents damage the converters and increase the dc link voltage.

- DFIG disconnects the rotor to protect the generator and operates as normal SCIG (Squirrel Cage Induction Generator).

- Sudden disconnection causes outages; hence, LVRT needed as mentioned in grid codes.

- LVRT methods used are the Crowbar and STATCOM.
- Crowbar is activated when it senses DC link voltage rises to 1.1 – 1.2 p.u and lasts for 100ms.
- Crowbar short circuits the RSC and provides a safe path for the transient currents.
- After fault clearance crowbar is still connected for 10 ms.
- Crowbar absorbs reactive power from the grid (violates grid code), to compensate reactive power absorption STATCOM is being used along with the crowbar.

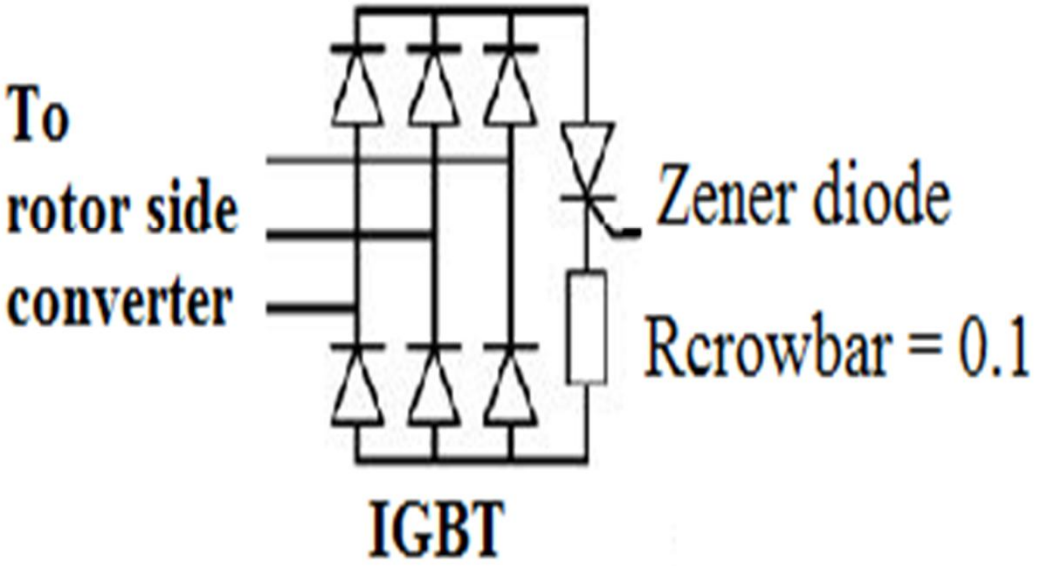
DFIG during fault condition



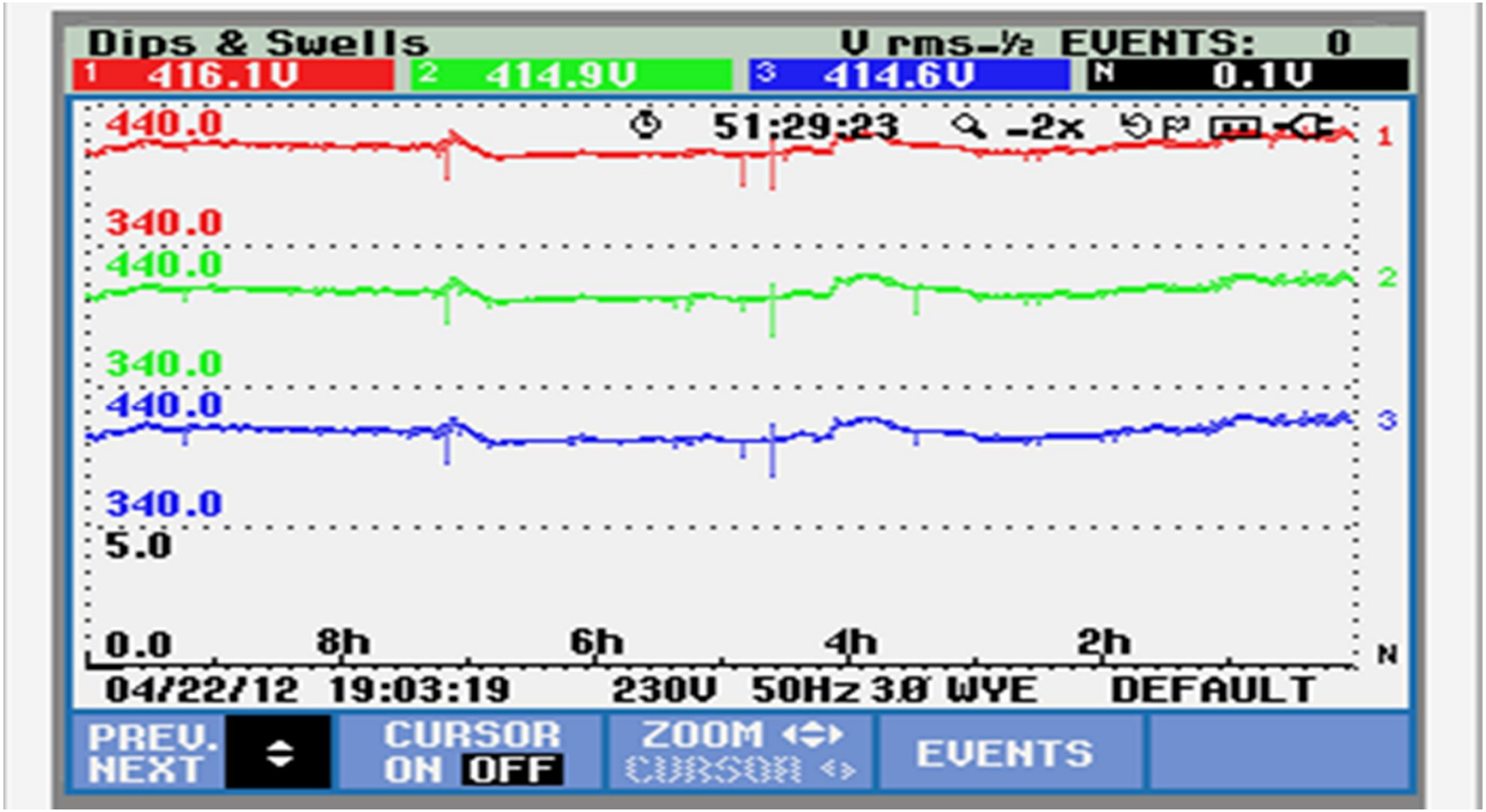
RATING FOR SINGLE PHASE MEASUREMENT

- *Wind speed* : 8 m/sec (at Udumalpet wind farm)
- *Output power* : 230 V (max)
- *RSC and GSC* : IGBT with PWM control (switching 800V or above, 12V D.C. Gate triggering).
- *Switching frequency of switches* : 17KHZ-38KHZ
- *DC link capacitance* : 10 mF – 50 mF
- *Crowbar* : Active crowbar, Resistance : 0.1 ohm
- *STATCOM* with IGBT
- *Oscilloscope* used for grid
- *Rated speed of generator* : 380-400 rpm
- IC : IR2110 used to control IGBT
- *PIC microcontroller :* ICF887

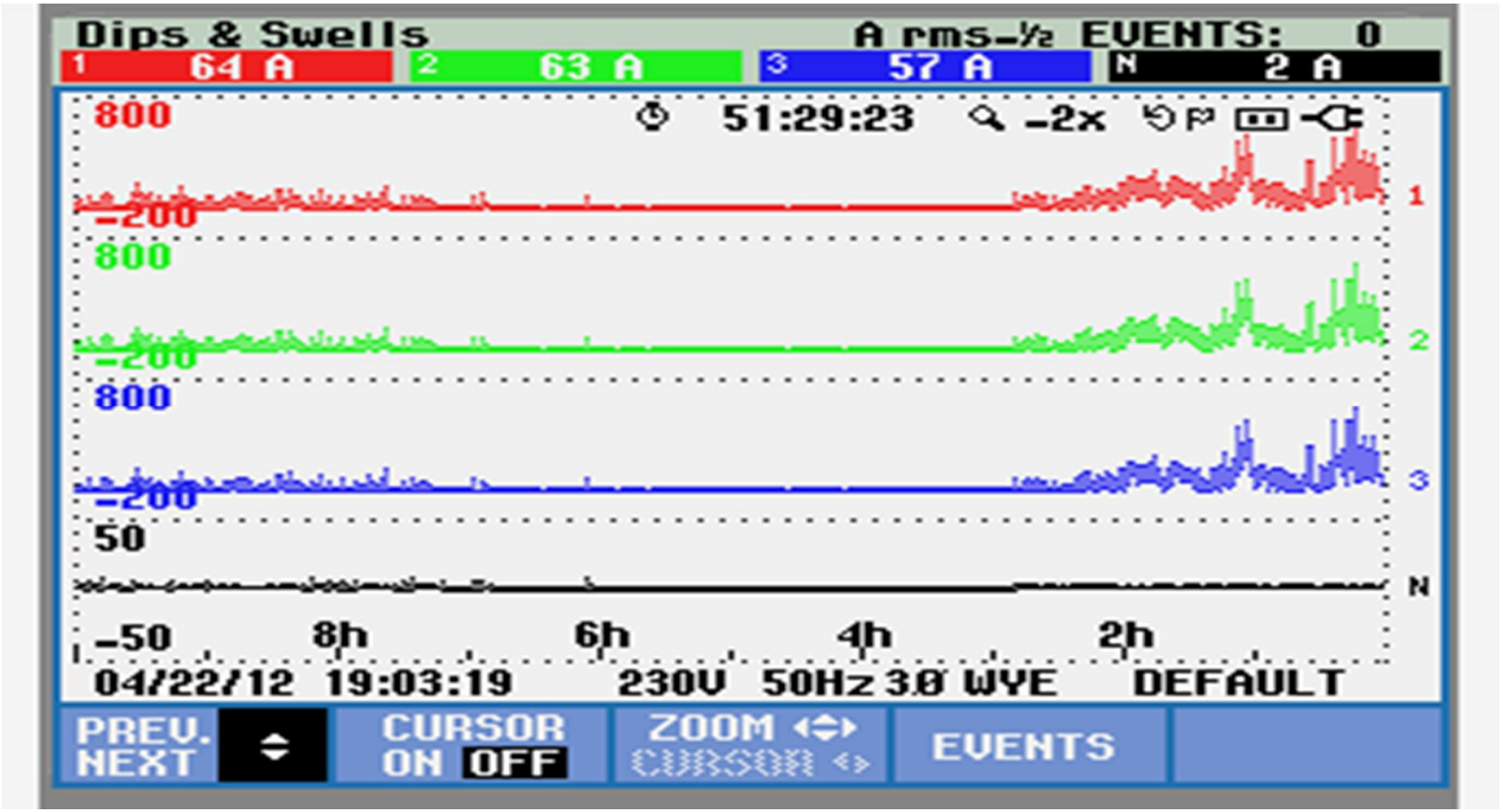
Design parameters for crowbar protection circuit



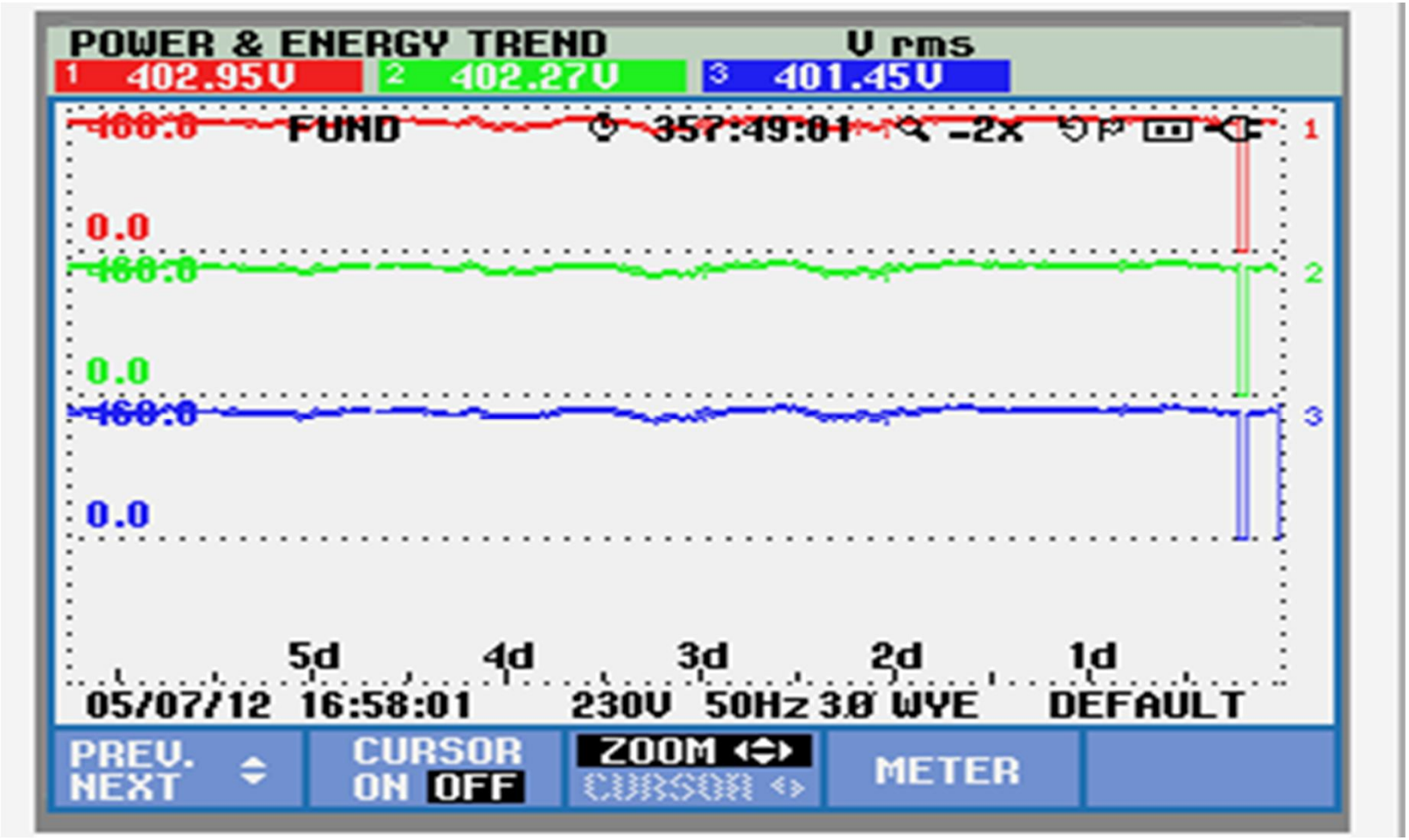
OCCURRENCES OF SAG IN THE FIELD RECORDED BY POWER ANALYSER –FLUKE 434.



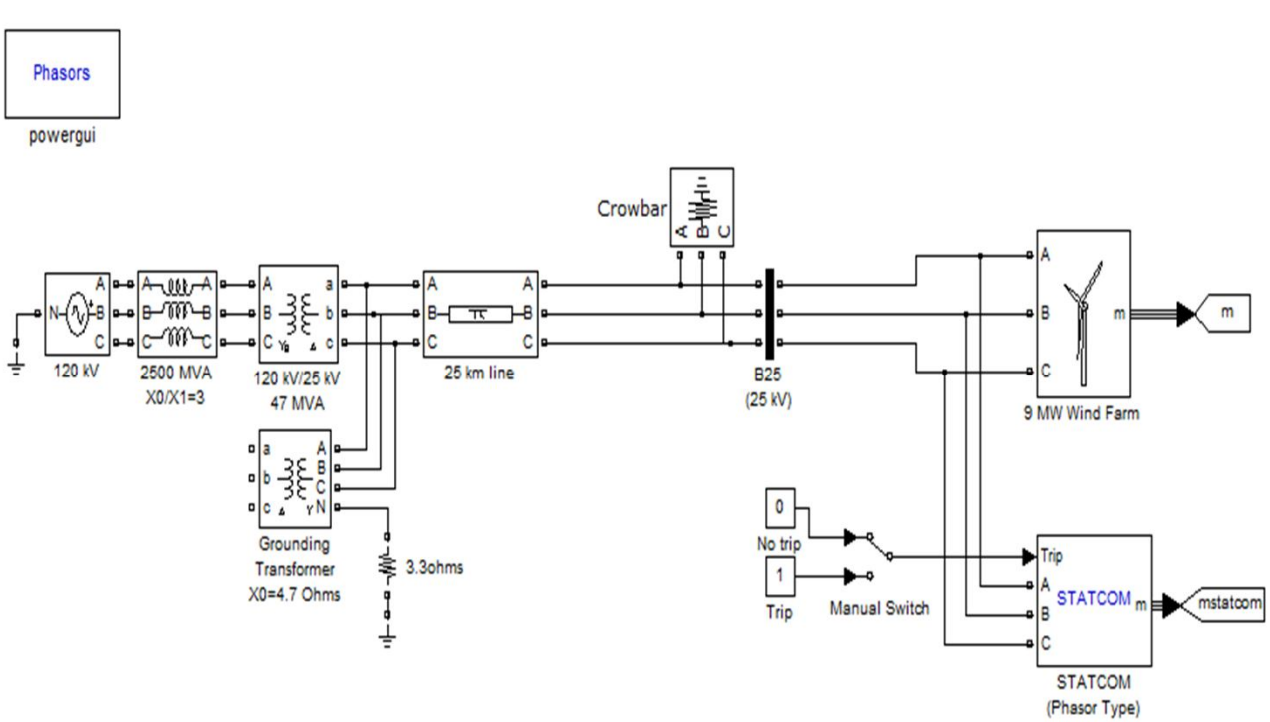
CURRENT INCREASE

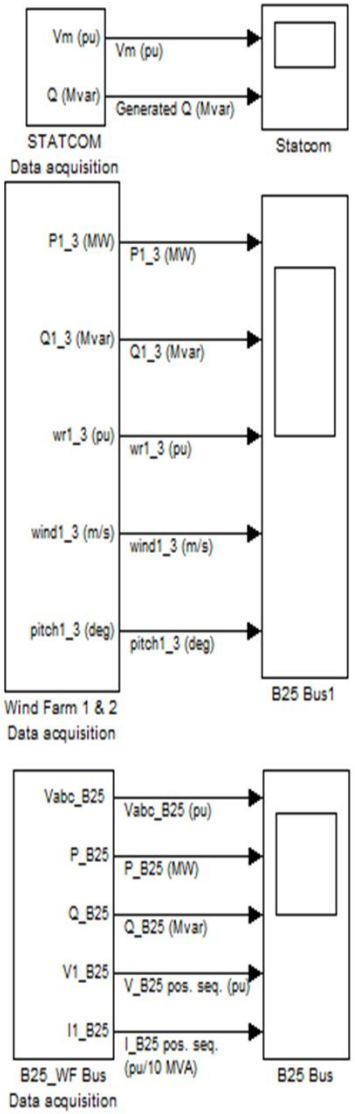


VOLTAGE DECREASE



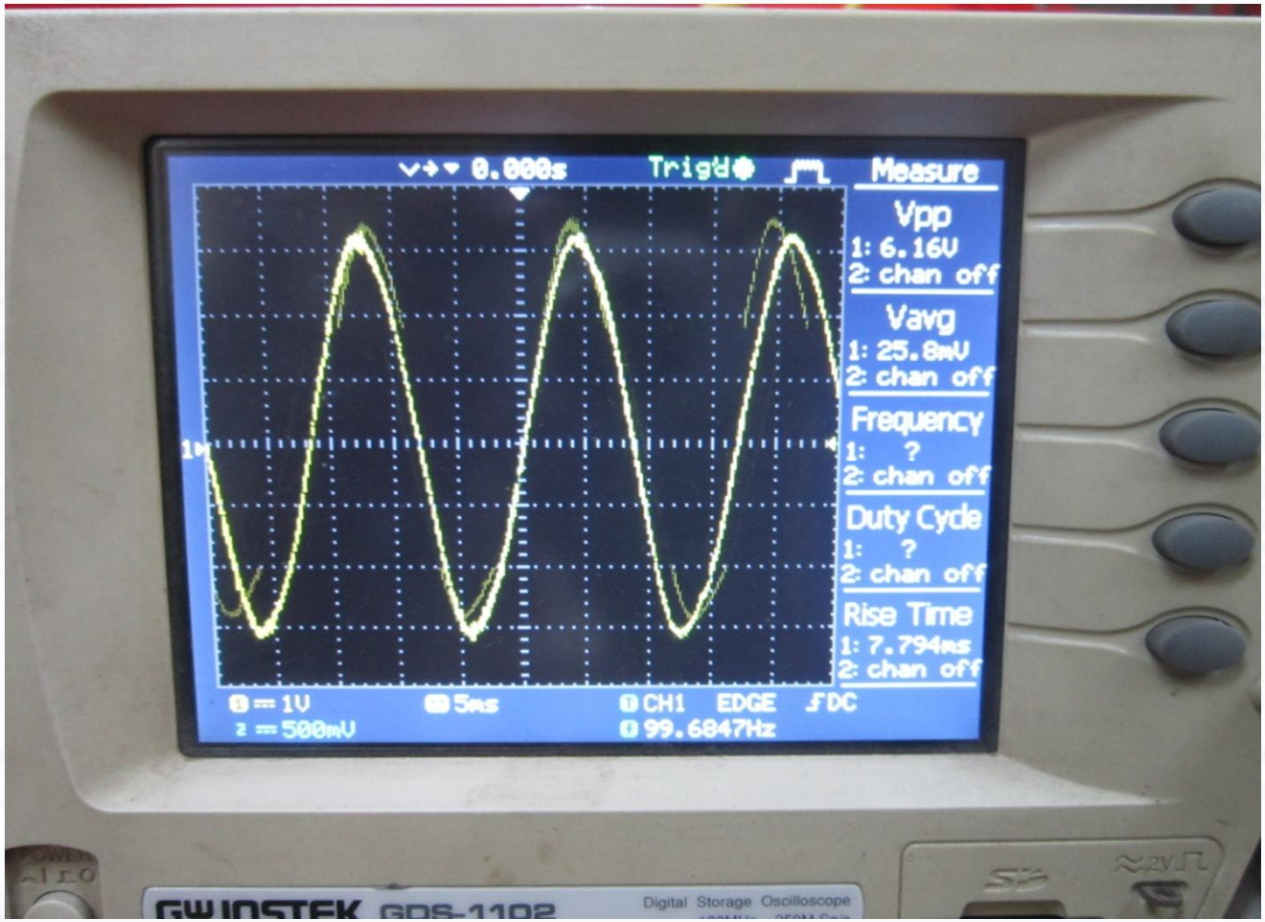
SIMULATION DIAGRAM FOR THREE PHASE CALCULATION



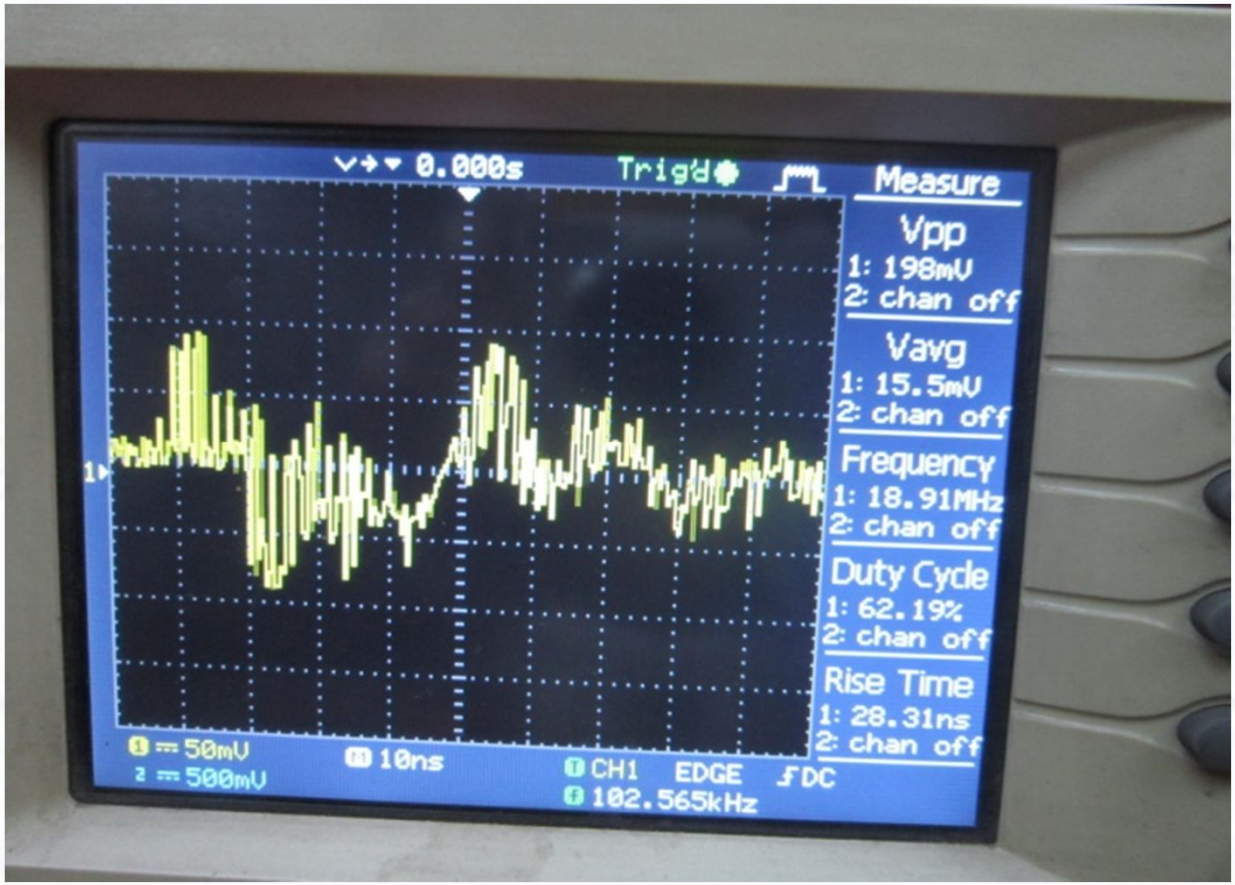


SINGLE PHASE HARDWARE : CROWBAR AND STATCOM

NORMAL OPERATION



DURING FAULTS



Thank you