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STABILITY ANALYSIS OF ISLANDED MICROGRID DURING FAULT

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Abstract: A Transient Stability Analysis of a Islanded microgrid system during fault is presented in this paper. The analysis is performed on MATLAB Simulink of islanded microgrid and data collected for different fault on system at various locations at grid. The Simulink Model consists of a reconfigurable 400kW PV, 6MW of Wind system with DG generator and three loads. Islanded situations are considered for a three phase fault analysis and comparison. In This paper we have stability analysis in Islanded Microgrid system, using MATLAB Simulink's simpower system software. In that we create of short circuit faults on a Microgrid system when it is Islanded mode. In this Microgrid model based on renewable energy and distributed generation based it included solar plant, wind farm and DG. After the creating model of Microgrid system firstly we create fault on load side and then DG side in system when it islanded mode at two locations.

***Index Terms*— Islanded Microgrid, Three phase fault, Transient Stability, MATLAB Simulink.**

I. INTRODUCTION

Now days, centralized generating facilities are giving away to microgrids. These microgrid involves various energy resources, such as internal combustion engine generator, photovoltaic, and wind that if operated as an islanded mode will give rise to numerous problems and challenges in terms of stability of the system because of the limitation in current and reactive power support of the resources. Islanded microgrids are very sensitive to disturbances in the system and can easily go unstable because of the lack of inertia as compare to main power grid.

Microgrids can operate in both mode connected to the main grid and separately in islanded mode. Although this combination of distributed resources makes the system suppler from an operation and manage point of view, it also makes the power grid more stable resulting from grid disturbances. Therefore, research into islanded microgrid stability is of great importance. For instance, authors of [1], [2], investigated the effect of fault and condition in micro grid stability. Some literatures propose issues and challenge in, and causes of instability in microgrid [4].

So the maximum work has done on unintentional islanding control, transient stability and small signal stability of microgrid when connected to main grid. In this work we present stability of islanded microgrid during fault condition at various locations

II.SLANDED MICROGRID

Fault scenarios have been implemented on a software Model. The system has been provided with capability of running 7-bus power system with two-way communication infrastructure.

SYSTEM DESCRIPTION

The Islanded microgrid system used in this study is a three-phase network as shown in Fig. 1. It consists of a wind farm, photovoltaic (PV) arrays and a diesel generation plant. There are three power loads connected at a medium voltage level (25 kV) .The wind farm and PV arrays are coupled with the microgrid using rated transformers. The total load capacity of the microgrid is 3 MW consisting of 1 MW and 1.5 MW and 500 kW power loads.

PV Arrays

The solar arrays used in this study are four 100 kW PV arrays supplying a total power of 400 kW to the microgrid as shown in Fig. 1. Each array consists of modules connected in series and strings in parallel, which results in a peak power output of 100 kW. PV modules are modeled using a photo-diode with series and shunt resistors. This model is shown in Fig. 1.

Wind Farm

A 6 MW wind-farm integrated with the microgrid comprises of Four 1.5 MW wind turbines. The synchronous generator is used to convert wind energy to electrical power which is fed to the microgrid through a 10.5 MVA transformer as shown in Fig. 1. The power conversion goes through the ac-dc-ac power converter. The transformer steps up the voltage from 525 V to 25 kV. The wind farm is coupled to the system at Bus through a 25 kV transmission line. The wind speed is considered to be 15m/s and the wind-farm is supplying 6 MW to the microgrid.

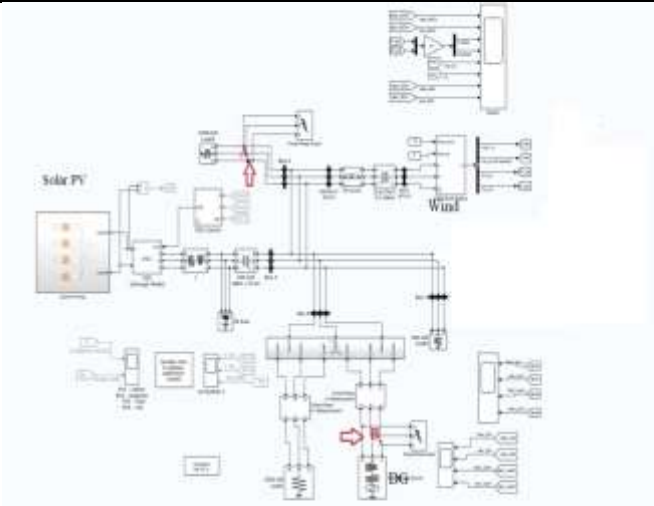

Fig 4. Single line diagram of the microgrid

III.TRANSIENT ANALYSIS

Stability analysis of different fault is presented in this section.

A. Three phase to ground fault on Load 3 Terminal.

In this case, a three phase to ground fault was applied on Load 3 terminal at point ‘A’ of the system at t = 0.05 sec. The microgrid was connected Islanded mode. The simulation results obtained are shown in Fig. 2-5. The results show in Fig. 2 that there was increase in current at DG terminal and drop in voltage to zero and also voltage, current at load 1 decreases to zero. Transient difference before and after the fault and there was disturbance at the time when the fault was applied and after that the system returned to its pre-fault state in about 0.035 sec. Fig. 3 shows nature of the current and voltage at Wind terminal. The current increases and dip in voltage at wind terminal. In Fig. 4 behavior of voltage and current at load 2 and load 3 are shown. There was a sag in the voltages, but the increase in Load 3 current was considerable because it is closer to the fault (see Fig. 1). The change in bus voltages and current was seen in at PV Solar Array side.

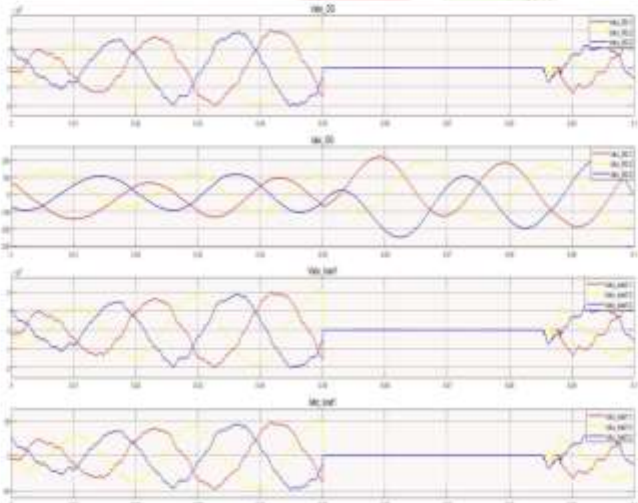

Fig. 2 DG, Load 1 Voltage and current for LLLG fault on Load 3 at ‘A’

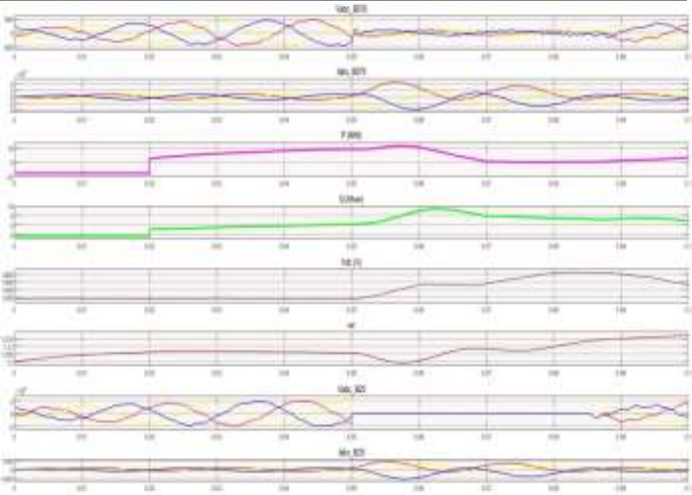

Fig. 3 Wind terminal Voltage and current for LLLG fault on Load 3 at ‘A’

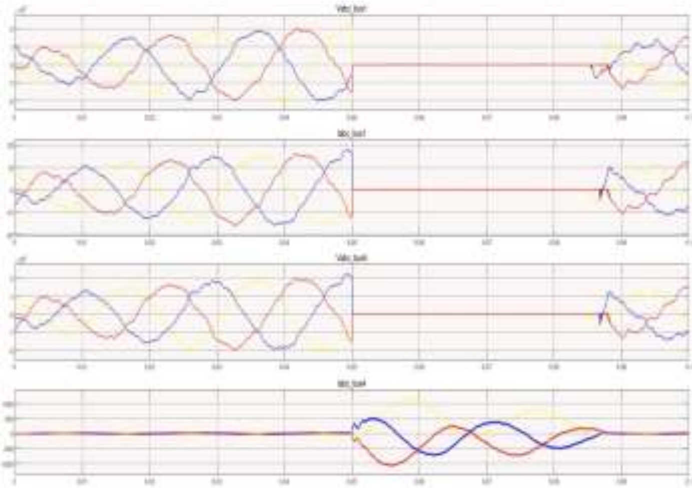

Fig.4 Bus 1, 4 Voltage and current for LLLG fault on Load 3 at ‘A’

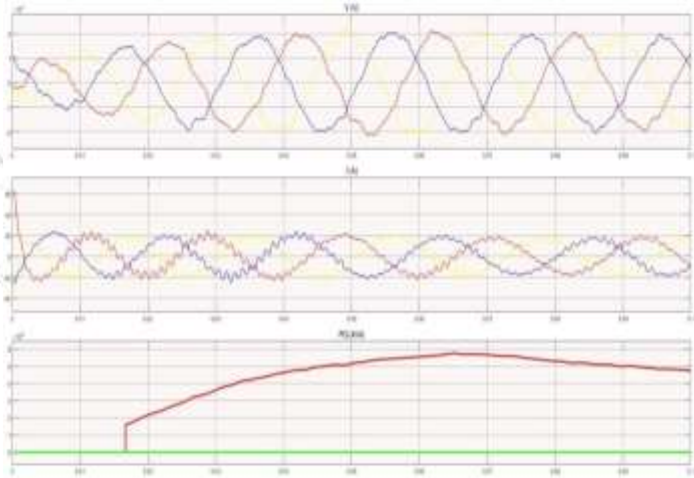

Fig. 5 Solar PV Array Voltage and current for LLLG fault on Load 3 at ‘A’

B. Three phase fault on Load 3 Terminal at Point ‘A’

From Fig. 2-5 and Fig.6-9 results there is difference observed in current and voltage at Wind, Solar PV Array side, DG terminal and also at Loads terminal when LLLG and LLL Faults occurs at Load 3 terminal at ‘A’

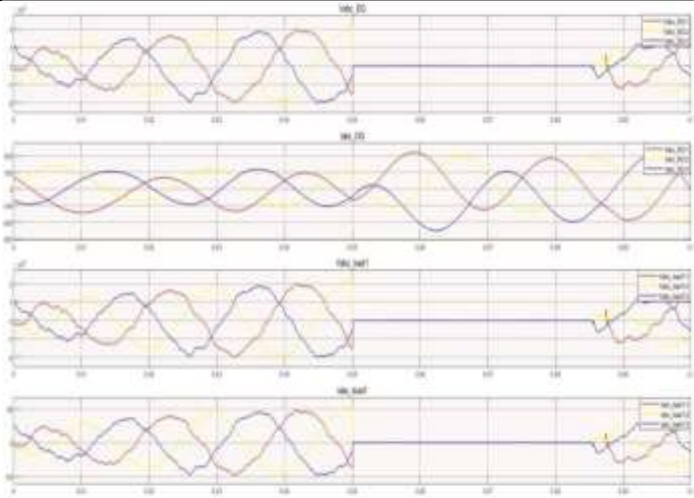

Fig. 6 DG, Load 1 Voltage and current for LLL fault on Load 3 at ‘A’

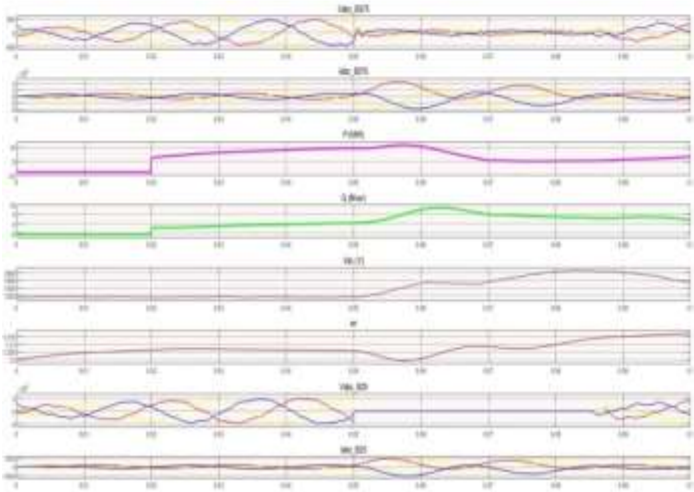

Fig. 7 Wind Terminal Voltage and current for LLL fault on Load 3 at ‘A’

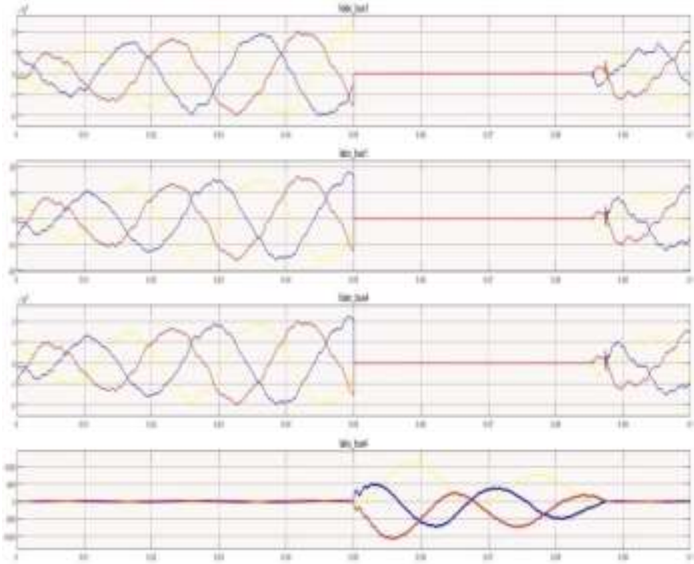

Fig. 8 Bus 1, 4 Voltage and current for LLL fault on Load 3 at ‘A’

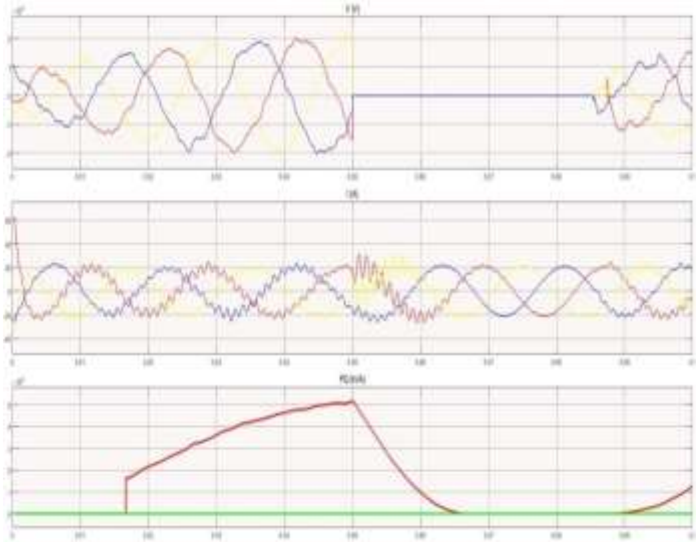

Fig. 9 Solar PV Array Terminal Voltage and current for LLL fault on Load 3 at ‘A’

C. Three phase to ground fault on DG Terminal.

In this case, a three phase to ground fault was applied on DG terminal at point ‘B’ of the system at t = 0.033 sec. The microgrid was connected Islanded mode. The simulation results obtained are shown in Fig. 10-13. The results show in Fig. 10 that there was increase in current at DG terminal and drop in voltage to zero and also voltage, current at load 1 decreases to zero. Transient difference before and after the fault and there was disturbance at the time when the fault was applied and after that the system returned to its pre-fault state in about 0.053 sec. Fig. shows nature of the current and voltage at Wind terminal. The current increases and dip in voltage at wind terminal. In Fig. 12 behavior of voltage and current at load 2 and load 3 are shown. The change in bus voltages and current was seen in at PV Solar Array side.

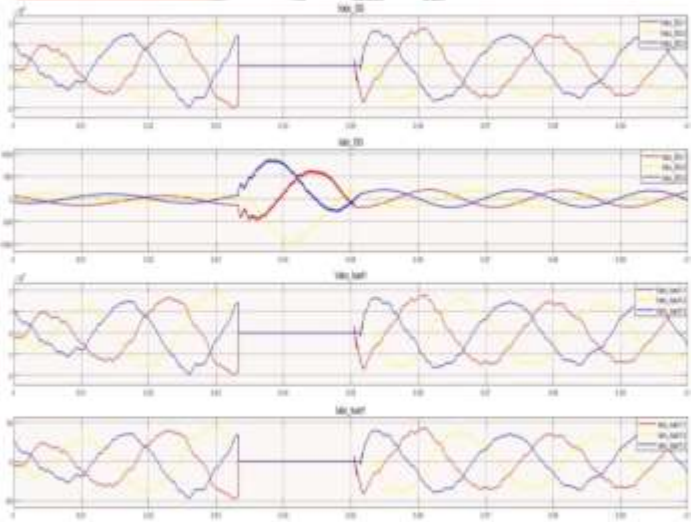

Fig. 10 DG Voltage and current for LLL fault on DG terminal at ‘B’

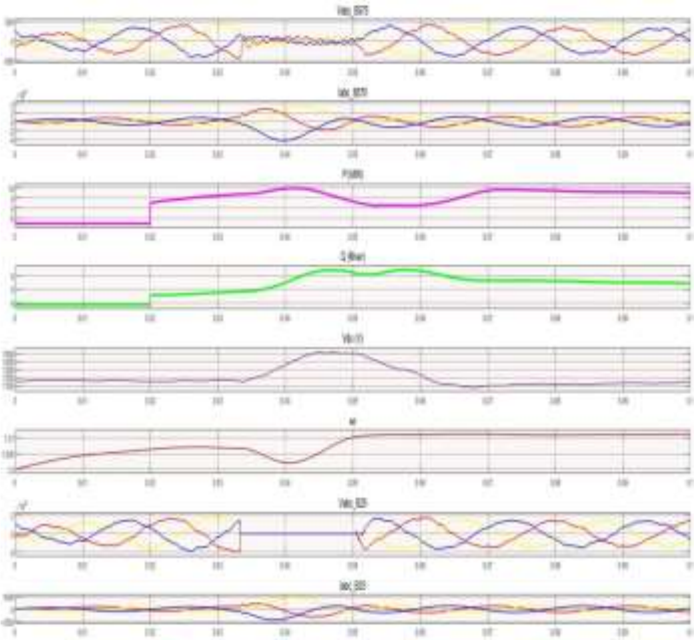

Fig. 11 Wind Terminal Voltage and current for LLL fault on DG terminal at 'B'

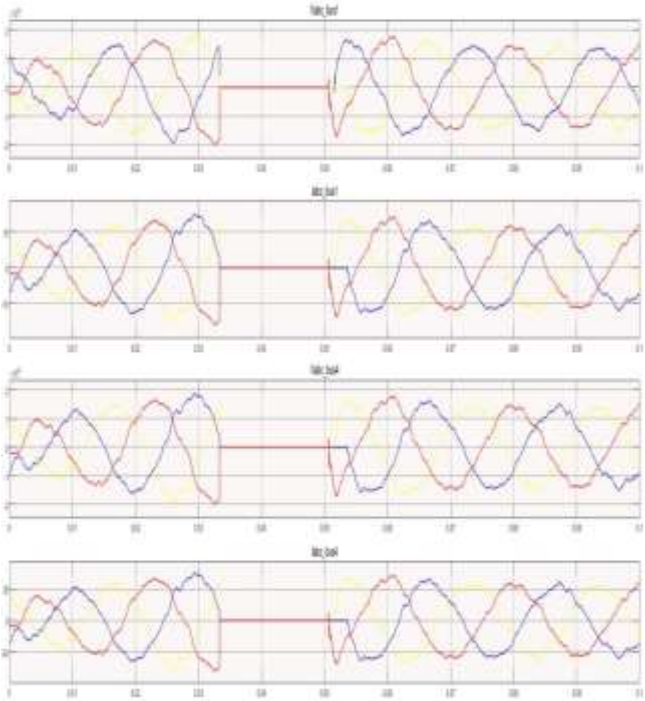

Fig.12 Bus 1, 4 Voltage and current for LLL fault on DG terminal at 'B'

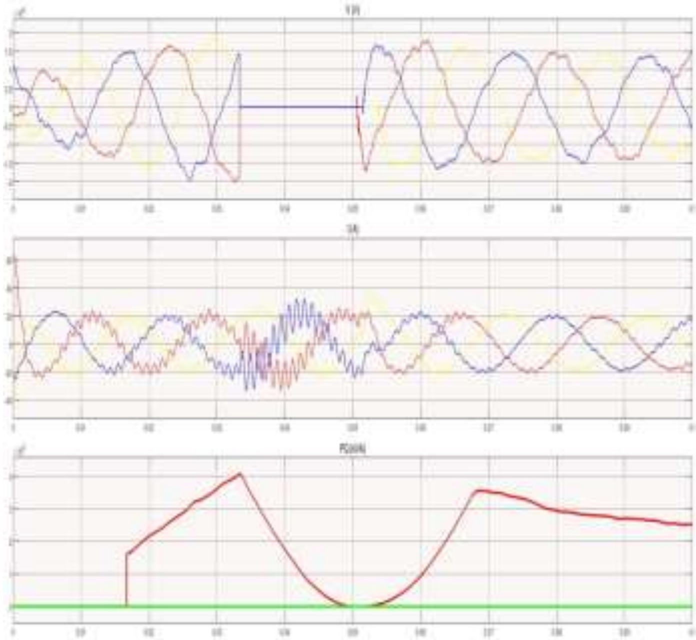

Fig. 13 Solar PV Array Voltage and current for LLL fault on DG terminal at 'B'

D. Three phase fault on DG Terminal.

From Fig. 15-18 results there is difference is observed in current and voltage at Wind, Solar PV Array side, DG terminal and also at Loads terminal when LLLG Faults occurs at DG terminal at 'B'.

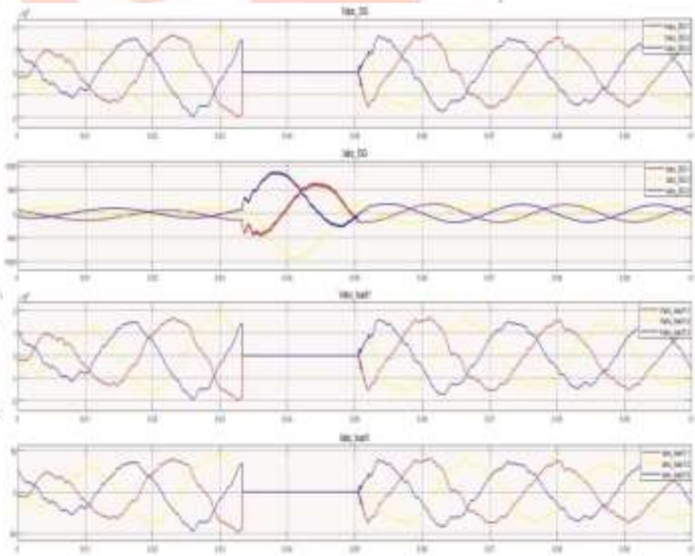

Fig. 14 DG Voltage and current for LLL fault on DG terminal at 'B'

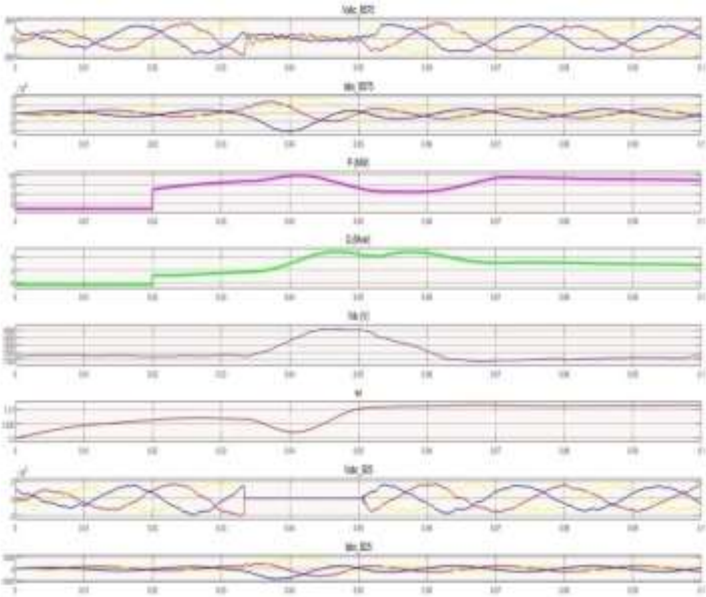

Fig.15 Wind Terminal Voltage and current for LLL fault on DG terminal at 'B'

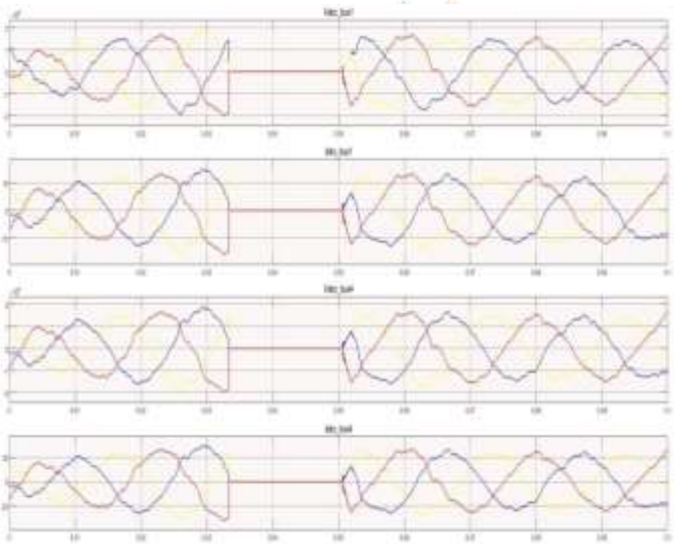

Fig.16 Bus 1, 4 Voltage and current for LLL fault on DG terminal at 'B'

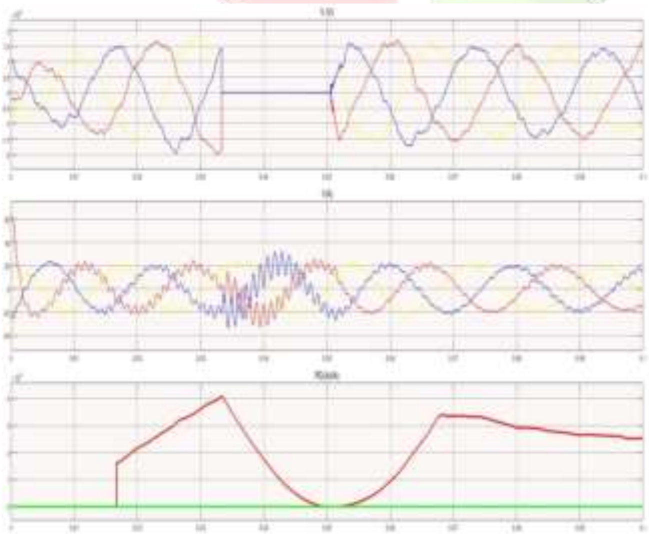

Fig. 16 Solar PV Array Voltage and current for LLL fault on DG terminal at 'B'

IV CONCLUSION:

We studied all the reference papers getting the knowledge about how can be analyzed the fault current in both islanded micro-grid and main interconnected systems. After that we got the knowledge about what is actual Islanded micro-grid and interconnected grid, also we studied which types of fault occur in system in brief. Then finding the methods of analyzed such faults as software, and then MATLAB Simulink software is used for the analysis of fault. Before that we get the knowledge about MATLAB Simulink. Then create a Simulink model to analysis the fault current. After we take analysis of fault current.

After the analysis of fault Current we can observe that the nature of fault current at different location is change. This is shown in the form graph.

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