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Comparative Analysis of PV Fed Induction Motor Drive System with Conventional System

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Abstract—*Whenever the power generation is concerned, the renewal energy is the best source of it .Modeling and simulation of photovoltaic (PV) source has an important role in modern power grid applications. This paper aims to determine the voltage and current variation by using conventional DC source and PV source. Fault analysis (short circuit fault, double line to ground fault, open circuit fault) has also been taken in account for comparison by using both sources. Current Transformer has been used for current sensing and three phase induction motor as a load. The results presented show reduction in faults as compared to the conventional DC source*

Index term*: Current sensing, induction motor, inverter,line to ground, open circuit, short circuit, solar cell*

1. INTRODUCTION

For the past few decades our earth has been facing constant environmental threats. The chemicals exhaled by the conventional energy user now grabbed the major portion of the fresh airs. These chemicals not only polluting the air but also the land and the water sources, which led to the birth of various health problems. These ill effect causes by the conventional sources force us to find out some alternate energy sources, and this has led us to shift towards non-conventional sources. Photovoltaic (PV) energy and its linked technology be different from other renewable energies in some important features, such as a wide power series (wind, hydro, and thermal energies are not so flexible for small power applications), appropriate for all climates and low need for maintenance. PV modules having advantage from a high consistency [1] and their warranties last at least 20 years [2].From the point of view of environmental safety and energy crisis, photovoltaic (pv) power systems are used as small scale power supplies for residences. Because PV module generate direct current and converted into alternating current by a conventional voltage source inverter to join between PV module and ac power line. References[7] [8] proposed the PV power system using a high frequency resonant inverter, and the system has advantage of a high frequency link system and the efficiency of the system is fairly high due to the use of resonant inverter.

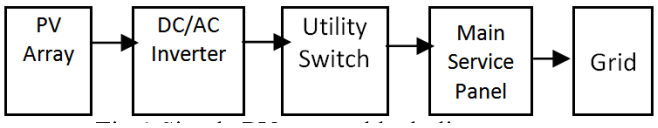

Fig. 1: Simple PV system block diagram

The performance of an ac module lies on its efficiency, cost effectiveness and reliability. Various inverter topologies has been used for it. Transformer less inverter [3]-[6] that have advantage of size and cost reduction. Isolated cascaded scheme that includes one or more dc voltage boosting stage and a conventional full bridge PWM inverter [4] [5] .This type of inverter has highest reported efficiencies compared to the other isolated inverters. Third one based on unfolding type inverter. Here voltage boosting and output current shaping all factors performed by a dc-dc converter that is then followed by a low frequency unfolding stage. A flyback inverter with center tapped secondary winding is adopted [15].In this scheme flyback is operated in the discontinuous conduction mode (DCM) ensuing high current stress and worse efficiencies.

2. METHODOLOGY

Modeling and simulation of dc source fed induction motor drive and conventional pv source fed induction motor drive are investigated here. The block diagram of the proposed work shown in Fig. 2, consist of PV source, current transformer for current sensing , inverter and three phase induction motor.

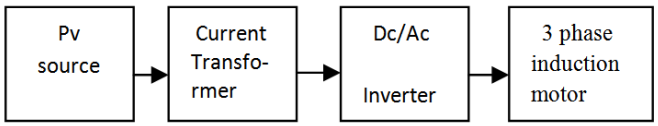

Fig. 2: Block diagram of proposed work

2.1. Matlab simulation of Induction motor drive system with DC Source without fault

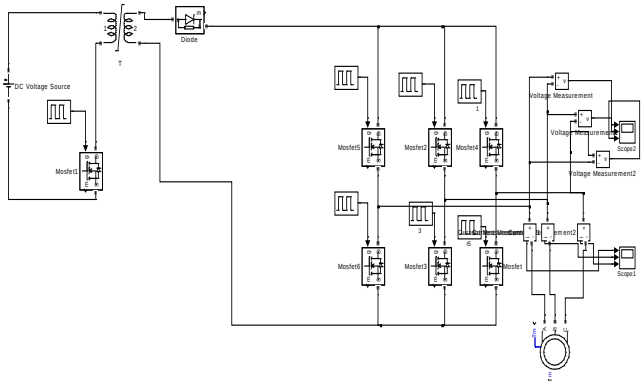

Fig. 3: Matlab simulation of dc source with CT and Three Phase Induction Motor

In this topology conventional dc voltage source in combined with three phase inverter and three phase induction motor. Voltage and current variation have been noted down.

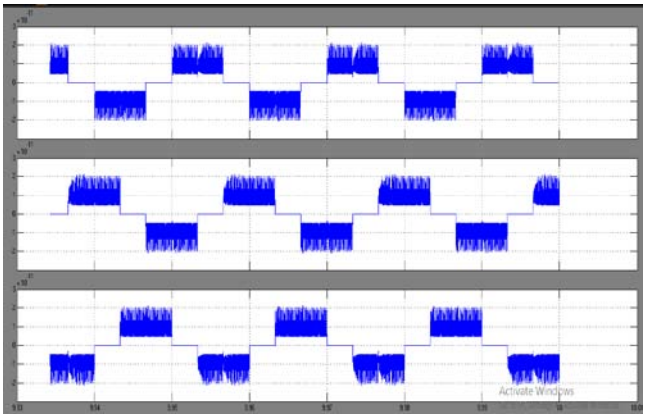

Fig. 4: Output Voltage Waveform

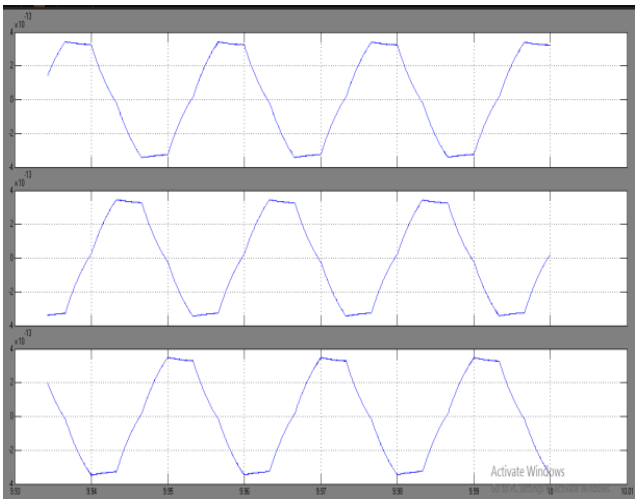

Fig. 5: Output current waveform

The parameter values are shown below

Table 1: Specifications of Parameters (DC 180V source)

Parameters	Value	Unit
Input voltage	180	V
CT Nominal Power	250*106	VA
CT Winding 1 parameters		
V1	30	V
R1	4	Ohm
L1	0.4	H
V2	35	V
R2	0.7	Ohm
L1	0.08	H
3 phase induction motor parameters		
V	400	V
Stator resistance	1.405	Ohm
Stator inductance	0.005	H
Rotor resistance	1.395	Ohm
Rotor inductance	0.005	H
Mutual inductance	0.1722	H
Output Current (Io)	4* 10-13	Amp
Output voltage (Vo)	3* 10-11	V

Table 1 shows the simulation results of voltage and current variation , when dc 180 volt has applied to the model. The results shows the

$$\text{Output voltage } (V_o) = 3^* 10^{-11} \quad (1)$$

$$\text{Output Current } (I_0) = 4^*10^{-13} \quad (2)$$

Now we have taken input DC source = 400v

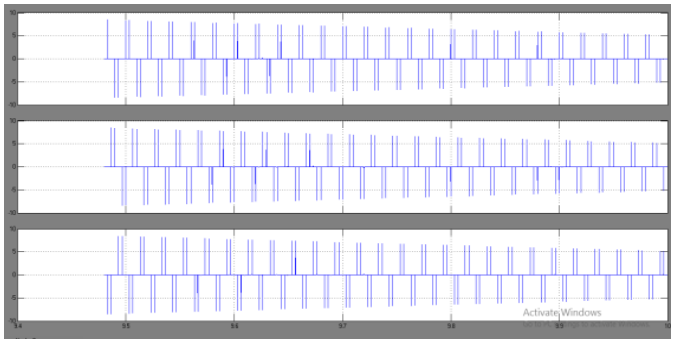

Fig. 6: Output voltage waveform

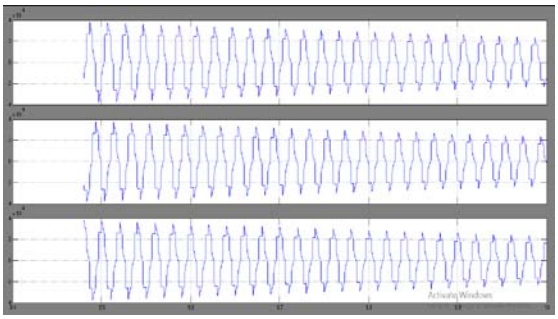

Fig. 7: Output current waveform

Table 2: Parameters Specifications (DC 400V source)

Parameters	Value	Unit
Input voltage	400	V
CT Nominal Power	$250*10^{6}$	MVA
Frequency	50	Hz
Load Power	4000	VA
Load Voltage	400	V
Output Current (I_0)	$4* 10^{-4}$	Amp
Output voltage (V_o)	10	V

Table 2 shows the simulation results of voltage and current variation, when dc 400 volt has applied to the model. The results shows the

$$\text{Output voltage } (V_o) = 10V \quad (3)$$

$$\text{Output Current } (I_0) = 4*10^{-4} \quad (4)$$

2.2. Matlab Simulation of Induction motor drive system with PV Source without fault

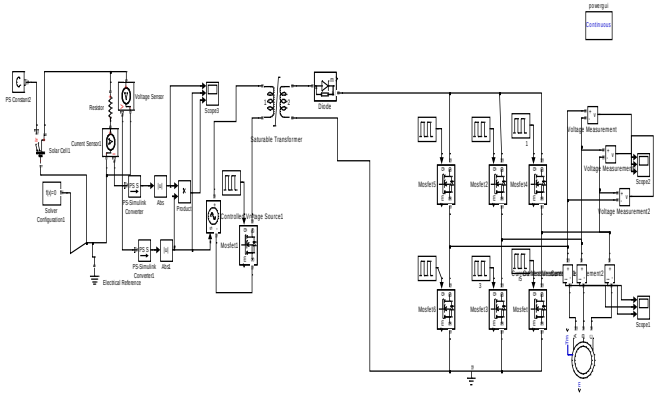

Fig. 8: Simulation circuit of PV source with three phase induction motor

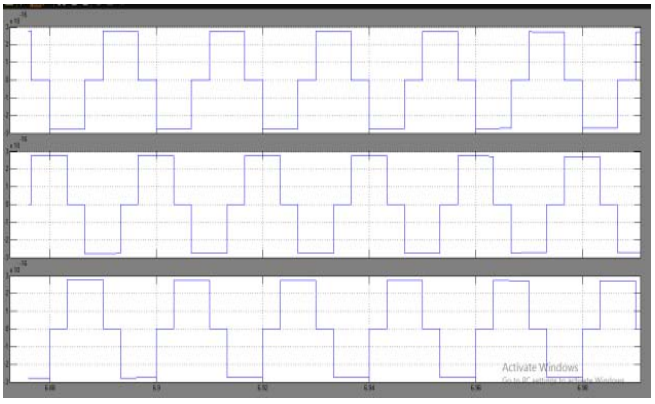

Fig. 9: Output voltage waveform with PV source

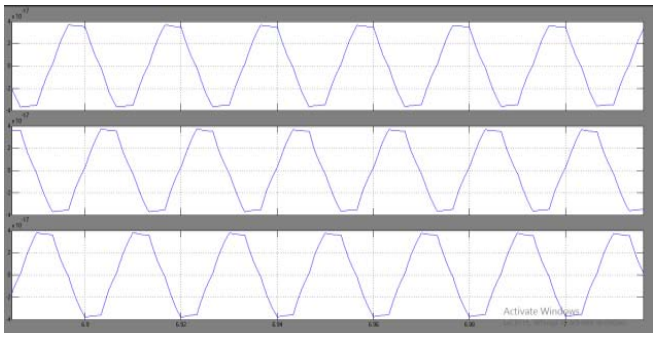

Fig. 10: Output current waveform with PV source

In this topology PV source (solar cell) is combined with three phase inverter using six MOSFET .Three phase induction motor is taken as a load. Voltage and current variation have been noted down with the help of scope.

Table 3: Sprcifications of Parameters (PV source)

Parameters	Value	Unit
Input voltage	180	V
Pv source parameter		
s/c current	24	Amp
o/c voltage	180	V
Irradiance	10000	ω /m2
Output Current (I_0)	$4* 10^{-17}$	Amp
Output voltage (V_o)	$3*10^{-16}$	V

2.3. Matlab Simulation Of S/C Fault With DC Source (180 volt)

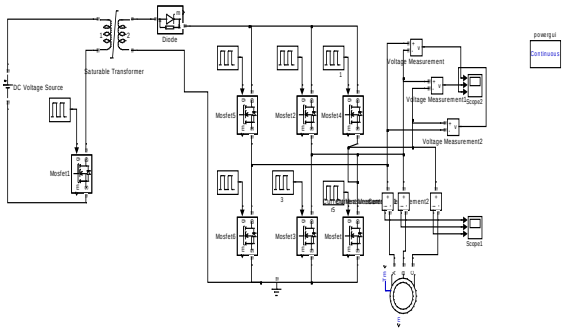

Fig. 11: Matlab Simulation circuit of dc Source with three phase induction motor(s/c fault)

In this topology two lines has been made short circuited and output current variation has noted down with the help of scope.

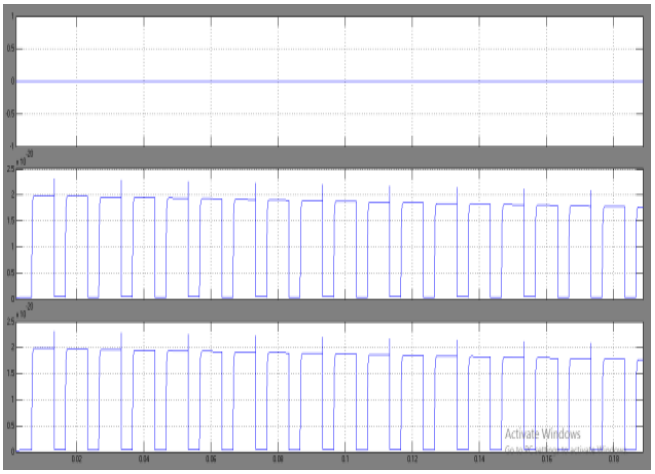

Fig. 12: Output current waveform (s/c fault) dc 180V

Output current (short circuit fault) for the given model we have found = $2* 10^{-20}$ (5)

2.4. Matlab simulation of line to ground fault With DC Source (180 volt)

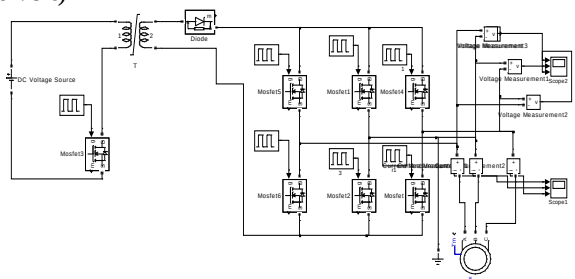

Fig. 13: Matlab Simulation circuit of dc Source with three phase induction motor (LG fault)

In this topology double line to ground fault has been taken in consideration with dc source and output current has been noted down.

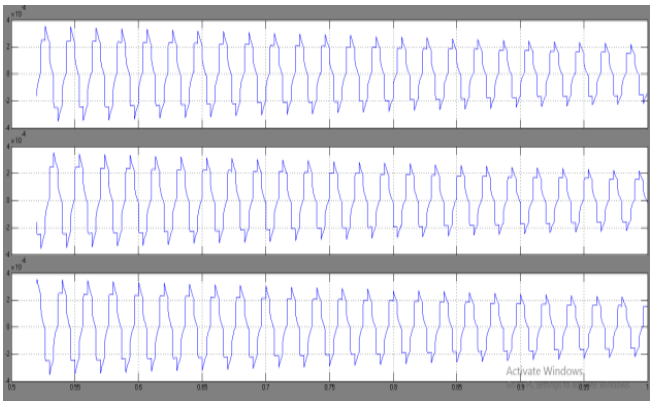

Fig. 14: Output current waveform (LG fault) dc 180V

Output current (LG fault) for the given circuit we have found I = $3 * 10^{-4}$ (6)

2.5. Matlab simulation of open circuit fault with DC source (180 volt)

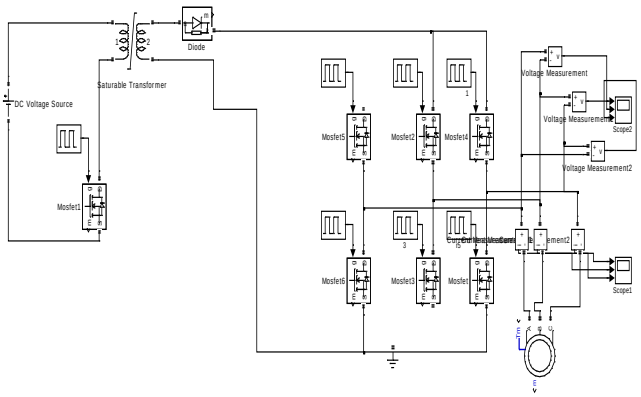

Fig. 15: Matlab Simulation circuit of dc Source with three phase induction motor (o/c fault)

In this topology open circuit test has been taken place. Model has been made by opening two mosfet switches and output current variation has been noted.

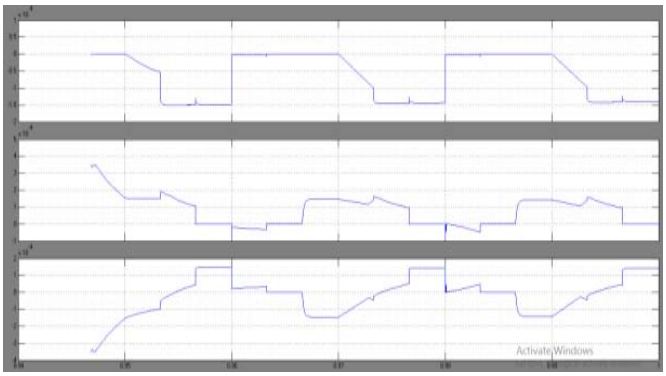

Fig. 16: Output current waveform (o/c Fault) dc 180 volt

Output current (o/c fault) for the given circuit we have found I = $- 1.5 * 10^{-4}$ (7)

Now we have taken all fault analysis with initial voltage = 400V

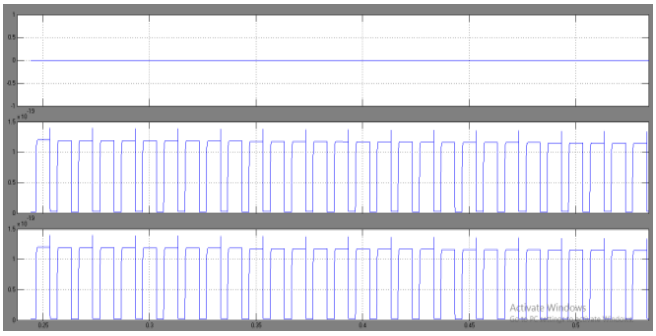

Fig. 17: Output current waveform (s/c fault) dc 400 volt

Output current we have found I = 1.5 * 10 $^{-19}$ (8)

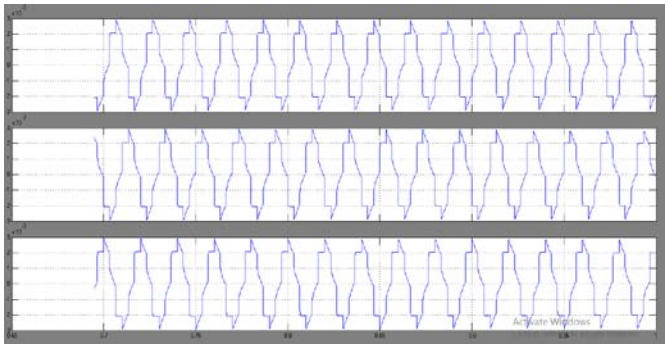

Fig. 18: Output current waveform (LG fault) dc 400 v

Output current for the given circuit we have found I = 3 * 10 $^{-3}$ (9)

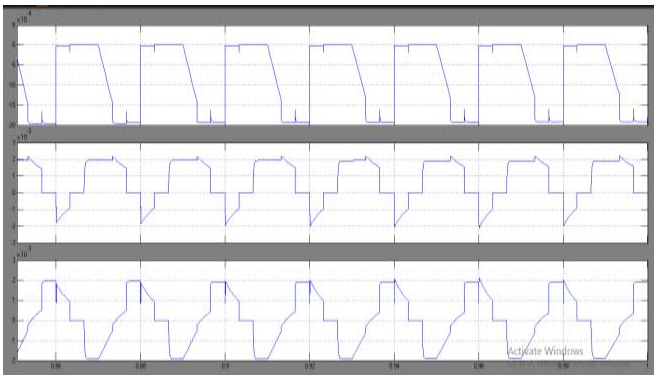

Fig. 19: Output current waveform (o/c fault) dc 400 v

Output current for the given circuit we have found I = - 20 * 10 $^{-4}$ (10)

2.6. Matlab simulation of s/c fault with PV source (180volt)

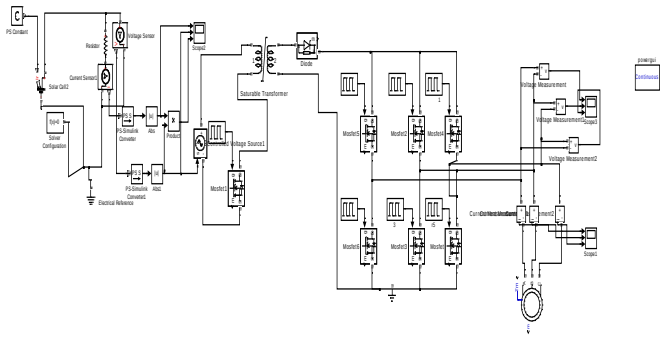

Fig. 20: Matlab Simulation circuit of PV Source with three phase induction motor(s/c fault)

In this topology pv source (solar cell) has been taken place and lines has been made short circuited to determine short circuit fault and current variation has been noted down.

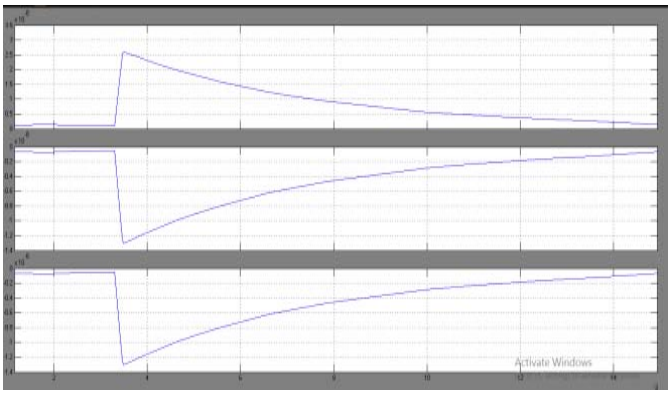

Fig. 21: Output current waveform (s/c fault) PV

Output current(s/c fault) using pv source for the given circuit we have found I = - 20 * 10 $^{-8}$ (11)

2.7. Matlab simulation of line to ground fault with PV source (180 volt)

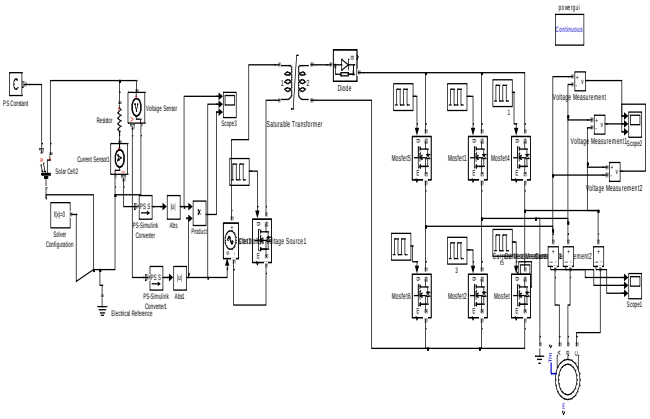

Fig. 22: Matlab Simulation circuit of PV Source with three phase induction motor(LG fault)

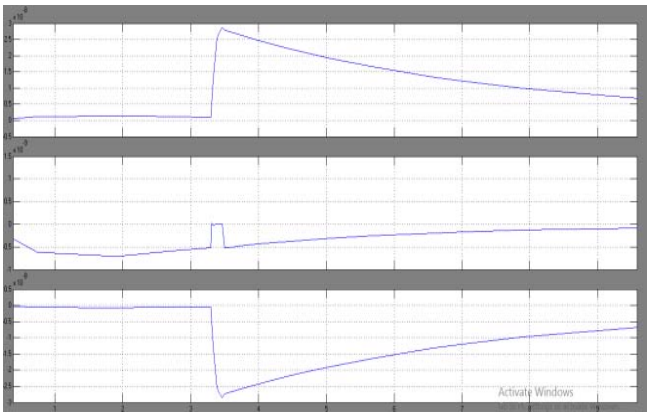

Fig. 23: Output current waveform (LG fault) PV

Output current (LG fault) for the given circuit using pv source we have found I = 3 * 10 $^{-8}$ (12)

2.8. Matlab simulation of open circuit fault with PV source (180 volt)

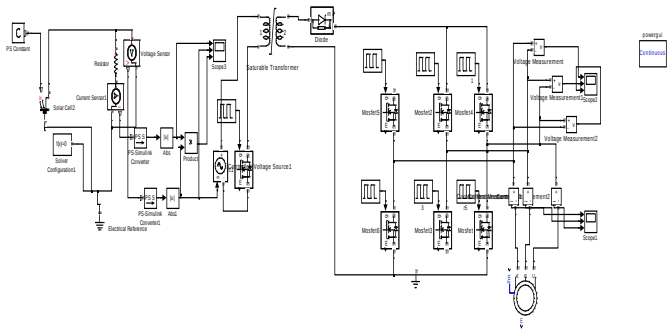

Fig. 24: Matlab Simulation circuit of PV Source with three phase induction motor(o/c fault)

In this topology two mosfet switches has been made open circuited for open circuit test and solar cell is used as a pv source.

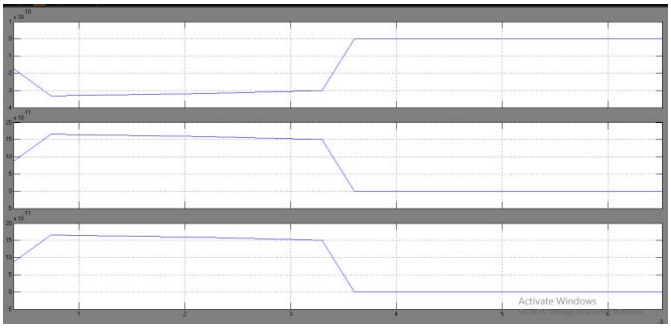

Fig. 25: Output current waveform (o/c fault) PV

Output current (o/c fault) using pv source we have found I = $-3 * 10^{-10}$ (13)

3. RESULTS

In this paper DC fed induction motor drive and PV fed induction motor drive have been investigated and compared. Design strategy has been proposed on the basis of faults (S/C,LG,O/C) .Current transformer has been used for current sensing purpose. For 180 volt dc source line to ground fault is ($3* 10^{-4}$) and for pv source it has value ($3* 10^{-8}$).For 180 volt dc source open circuit fault is ($-1.5* 10^{-4}$) and for pv source it has value about ($-3* 10^{-10}$) .By using PV source we have found that line to ground fault and open circuit faults have lesser values as compared to the conventional DC source. As the faults have lesser values it clearly shows that PV fed induction motor drive is better than the DC fed induction motor drive.

Table 4: Comparison between DC fed Induction Motor Drive and PV fed Induction Motor Drive on the basis of faults

Voltage Source	Without Fault	Short Circuit Fault	Line To Ground Fault	Open Circuit Fault	Unit
Dc 400V					
Voltage	10				Volt
Current	4* 10-4	1.5*10-19	3* 10-3	-20* 10 -4	Amp
Dc 180 V					
Voltage	3* 10-11				volt
Current	4* 10-13	2* 10-20	3* 10-4	-1.5* 10-4	Amp
PV Fed 180V					
Voltage	3* 10-16				Volt
Current	4* 10-17	2.5* 10-8	3* 10-8	-3* 10-10	Amp

4. CONCLUSION

Simulation is performed for the proposed PV source model and the conventional dc source model. The different response according to voltage and current has been figured out from both models. The different faults (short circuit, open circuit and line to ground) have been analyzed with DC fed induction motor drive system and PV fed induction motor drive system

REFERENCES

[1] N.G Dhere, "Reliability of PV modules and balance-of-systemComponents,"in Proc .Conf .Rec13st IEEE Photovoltaic Spec, Jan.2005,pp 1570-1576.

[2] A.Ristow, M.Begovic, A. Pregeli, and A.Rohategi, " Development of amethodology for improving photovoltaic reliability," IEEE Trans Ind. Electron, vol.55,no.7pp.2581-2592, Jul.2008.

[3] T.Kerekes,R.Teodorescu, and U. Borup "Transformerless Photovoltaic inverters connected to the grid," in Proc.22nd Annu. IEEE Appl. Power Electron.Conf. (APEC),2007.

[4] O.Abdel-Rahim,M.Orabi,andM.E.Ahmed,"Development Of high gain high efficiency grid connected inverter for PV module," in Proc. 2nd IEEE Ind.Symp. Power Electron .Distrib.Generat. Syst.(PEDG),2010,pp.368-373.

[5] C.Rodriguez and G.A.J.Amaratunga,"Long life time Power inverter for photovoltaic AC modules," IEEE Trans.Ind.Electron,vol.55,no.7,pp.2593-2601,jul.2008.

[6] S.V.Araujo,P.Zacharias,and B.Sahan,"Novel grid Connected non isolated converters for photovoltaic System with grounded generator," in Proc. IEEE Power Electron. Spec. Conf. (PESC), 2008,pp.58-65.

[7] A.K.S Bhat,S.B. Dewan:"A novel utility interfaced high-Frequency link photovoltaic power conditioning system",IEEE transactions on Industrial Electronics, vol.35, no.1,p.153(1988).

[8] A.K.S Bhat, S.B.Dewan: "Resonant inverters for photovoltaicArray to utility interface",IEEE transactions on Aerospace and Eletronics system,vol24,no4,p377(1988)

[9] D.Kastha and B.K.Bose,"investigation of fault modes of Voltage-fed inverter system for induction motor drive,"IEEETrans.Ind.Appl.,vol.30,no.4,pp.10281038,Jul.1994.

[10] F.Blaabjerg,J.K.Pedersen, U.Jaeger,andP.Thoegersen,"Single current sensor technique in the DC link of three -phase PWM-VS inverters: A review and a novel solution,"IEEETrans.vol.33,pp.1241-1253, Sep/oct.1995.

[11] S.Y.Kim,K.Nam,H.S.Song,andH.G.Kim,"FaultdiagnosisOf a ZVS DC-DC converter based on dc-link curret pulse Shapes,"IEEE Trans.Ind.Electron,vol55,no-3,mar 2008

[12] K.RothenhagenandF.W.Fuchs,"Performanceof diagnosis Methods for IGBT open circuit faults in voltage source activeRectifiers,"inProc.IEEEPower Electron.Spec.Conf.2004,pp 4348-4354.

[13] W.Sleszynski,J.Nieznanski, and A.Cichowski,"Open Transistor fault diagnostics in voltage source inverters byAnalyzing the load currents," IEEE Trans.Ind Electron, Vol.56,no.11,pp4681-4688, Nov.2009.

[14] S.M.A. Cruz,M.Ferreira, A.M.S Mendes, and A.J.M. Cardoso,"Analysis and diagnosis of open-circuit faults in Matrix converters," IEEE Trans. Ind.Electron,vol.8,no.5, pp.1648-1661,May 2011.

[15] N.P.Papanikolaou,E.C.Tatakis,A.Critsis,andD.Klimis,"Simplifie d high frequency converter in decentralized grid Connected PV systems: A novel low cost solution,"in Proc EPE'03 ,Toulouse, France, 2003,CD-ROM.