FAULT AND STABILITY ANALYSIS OF A POWER SYSTEM NETWORK BY MATLAB SIMULINK

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ABSTRACT- The steady state operating mode of a power system is balanced 3 phase ac. However, due to sudden external or internal changes in the system, this condition is disrupted. When the insulation of the system fails at one or more points or a conducting object comes in contact with a live point, then short circuit or fault occurs. As power lines are heavily interconnected to the systems. So fault analysis is very important for stability analysis. The one section faults will cause serious effects to other sections also. This idea has been analysis through this paper. In first case we have take a sample IEEE 14 bus system and creates the fault in one locations and which detects by the protection devices and clears but this fault is also creates the instability of voltages in nearby system(in bus----).As we know that relay circuit has detects the faults and give the tripping signals to the circuit breakers and circuit breakers open the faulty line from healthy lines but sometimes it requires delay that system will balanced by itself, but here we see that within delay timing this fault will effects other lines also and voltage will decrease from there rated conditions. So we must need to improve and analysis whole system to maintaining reliable supply to other lines. This work has been studied through mat lab.

Keywords- software analysis, mat lab model ,fault analysis, graphical analysis, stability analysis, improvement of stability, power factor improvement

1. INTRODUCTION

Electric power is generated, transmitted and distributed through large interconnected power systems. The electric power is generated in various types of power plants. Then the voltage level of the power will be step up by the transformer before the power is transmitted. Since electric power is the product of voltage and current, high voltage is used in transmission in order to reduce the line currents then the power transmission losses is reduced that is copper loss. The primary objective of all power systems is to avoid the load shading. However, lightning or other natural events like wind and ice, physical accidents, equipment failure, and other unpredictable events may cause a short circuit between the phase wires of the transmission line or from the phase wires to ground, which is called a fault. Then the short circuit current is produced and the value of the short circuit current is very much greater than the normal operating current. So if there is a fault persists, there is a severe damage shown in the electrical equipments.

. In order to reduce such an accident, it is necessary to disconnect the faulted part from the healthy system as soon as possible. This is done by the circuit breaker and protective relay. Circuit breakers are usually installed at both ends of the transmission lines. The relay detects the fault occurs in its protection zone of the transmission line and then it will trip the circuit breakers of that line to open. This way, the faulted line will be separated from the healthy line of the power system avoiding further damage. Shortly after the breaker operation, the relay will try to re-close the circuit breaker. If the fault is cleared, then the circuit breaker will successfully close the line with the remain healthy lines of the transmission system [1]

2. RESEARCH PAPER ANALYSIS

In this paper we have consider an IEEE 14 bus power system model for 3 phase fault analysis. When there is a three phase fault occurs in any of the bus of the test transmission line then the total system blackout occurred which shows in simulation graph and we concluded that the total system remain unstable. For providing system stability the circuit breaker is too connected between the faulty bus and the healthy bus. In a poly phase system a fault may affect all phases equally which is a "symmetrical fault". If only some phases are affected, the resulting "asymmetrical fault" becomes more complicated to analyze due to the simplifying assumption of equal current magnitude in all phases being no longer applicable. The analysis of this type of fault is often simplified by using methods such as symmetrical components .Design of systems to detect and interrupt power system faults is the main objective of power system protection, which we will show through in this paper.

In that paper the IEEE 14 bus system being chosen as it is the commonly used practical system in various types of transmission system model test. In that model there are two 3 phase fault occurs in the subsystem no 1 and the subsystem no 2 and these three phase faults are line to line fault .That types are fault takes place due to a short circuit between lines, caused by ionization of air, or when lines come into physical contact, for example due to a broken insulator. The total system is an interconnected system so for that reasons the whole system has been affected by these faults and oscillations occurred which creates unbalanced currents in lines so stability is also effected which we showed in our paper second portion. Voltage level decreases due to instability for the transient oscillations which is not desired at all.

So lastly we are improved the transient stability by introducing a series capacitors in the transmission lines. Capacitors, SVC are widely used for improvement of voltage stability. The capacitive lines are inserted in the 3rd subsystem and we can see that stability of the network has improved. By testing different circuit in the network (11th subsystem) we have improve the stability and power factor also.

Hence, research concerning the dynamic behavior of the three phase fault in the electrical power system is important to achieve a better knowledge.

3. SOFTWARE ANALYSIS

At first we have taken IEEE14 Bus system in Mat lab Simulink by drawing each area in subsystem block or with proper data's which are used for IEEE 14 bus system. Which shown in figure 1
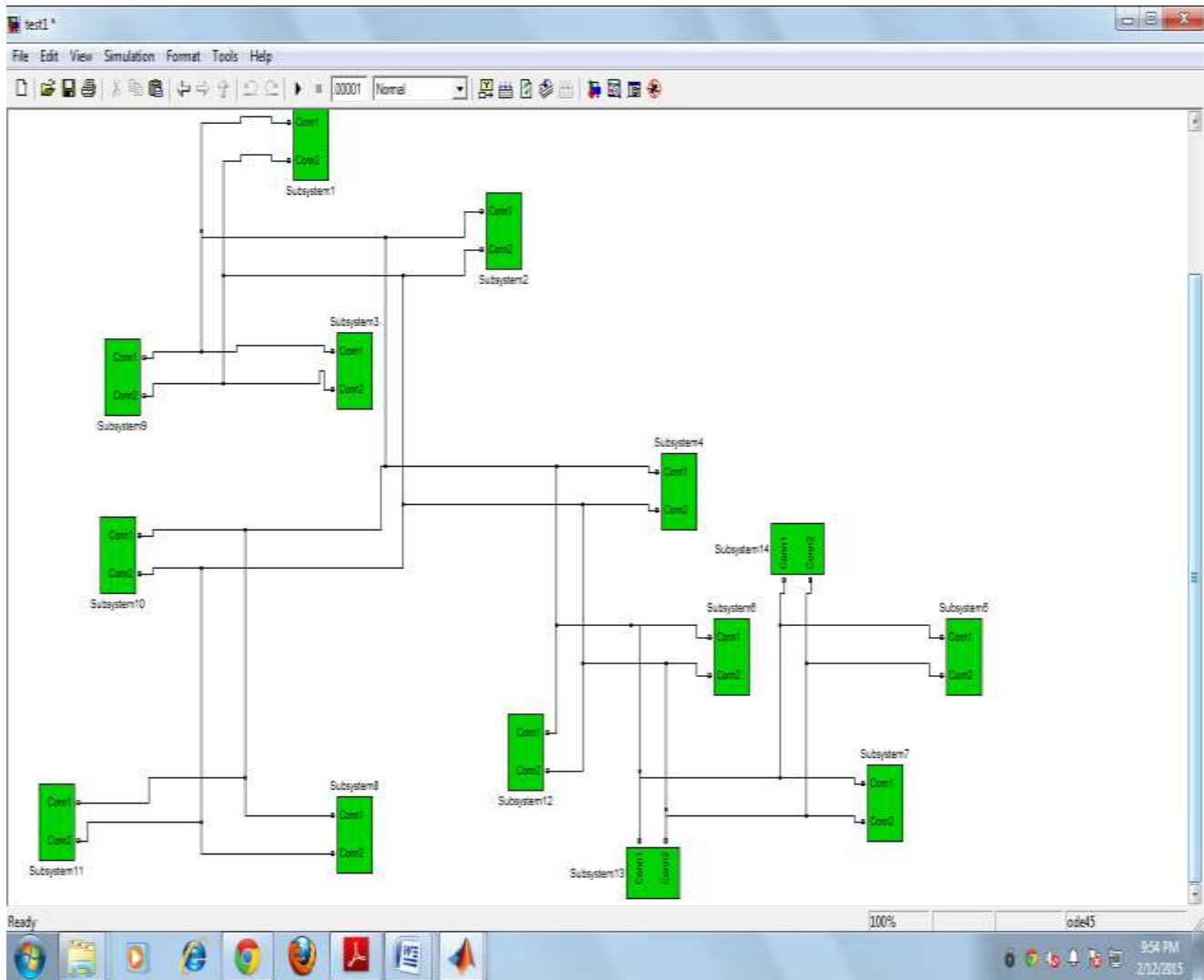
Figure1:- **IEEE 14 BUS POWER SYSTEM MATLAB MODEL**

In this simulink model each subsystem contains a power system network, which is similar as the real power network (Fig2, demo).after drawing simulink diagram we have tested its data in different ways, which are illustrated in the next page in different case study.
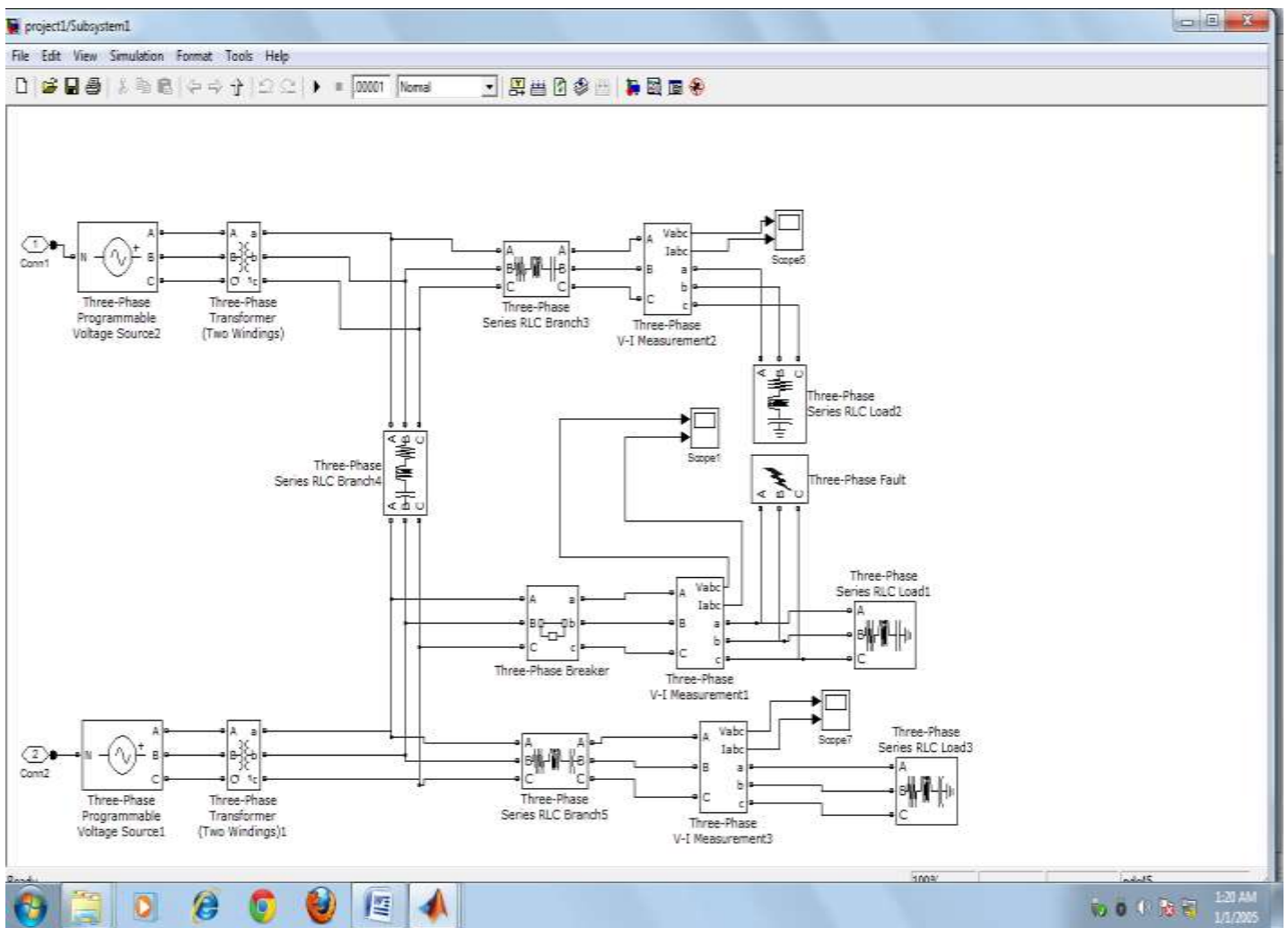
Figure 2 Power network in IEEE 14 bus network

3.1 IEEE 14 BUS POWER SYSTEM MATLAB MODEL ANALYSES

This system is consists of 14 no of sub system. each of these sub system is consists of two individual systems each of the system consists of one programmable 3 phase source of 11000 RMS line voltage one 3 phase RLC line and one 3 phase RLC load of 100 watt active power and 100 lagging VAR and 100 leading VAR and a 3 phase VI measurement block. Each of this system is connected by a 3 phase RLC line.

In the 3,4,5,6,7,8,9,10,11,12 and 13 number subsystem there is a 100 leading VAR (Capacitor) which is connected with 3-phase line to improve the voltage stability and also to improve the power factor

. The 12th and 13th no subsystem there are two numbers of RL of 100 w active power and 100 lagging VAR reactive power are connected. The 3 phase sources are connected with a (100 KVA 3 phase 50 HZ 11kv /400 volt) with two winding transformer to represent the power network for analysis.

In the 1st & 2nd no of subsystem there is a 3 phase fault is occurred in the intermediate line between the two 3 phase lines of each system. There is a circuit breaker is connected between the 3 phase RLC load and the line in each block. There is a VI measurement block is connected between the circuit breaker and the 3 phase RLC load to measures the output result. These four steps are analysis following ways.

3.2 THE FAULTY SUBSYSTEM1 & SUBSYSTEM2 MATLAB MODEL

At first we take the healthy power network and analyzing the network voltage, current for stability analysis. We observed the curves of voltage and currant, which are nearly maintained


Figure 3 (Output curves, when there are no fault occurred in transmission lines)

3.3 FAULT ANAYSIS.

3.3.1 THE FAULTY SUBSYSTEM1 &SUBSYSTEM2 MATLAB MODEL ANALYSIS

In both of subsystem1 and subsystem2 model let a three phase ground fault has occurred and the circuit breaker is capable to clear the fault's, our power system lines are heavily interconnected so one line fault will affect the other transmission lines also which are not desirable at all, because others bus voltages are affected which we can concluded by analyzing outputs of different subsystems. Where we saw that the output had one positive sequence phase voltage and current where there are another two negative sequence phase voltage and current wave formed which are find out in the voltage measuring scopes to the network. The outputs are shown in Figure4
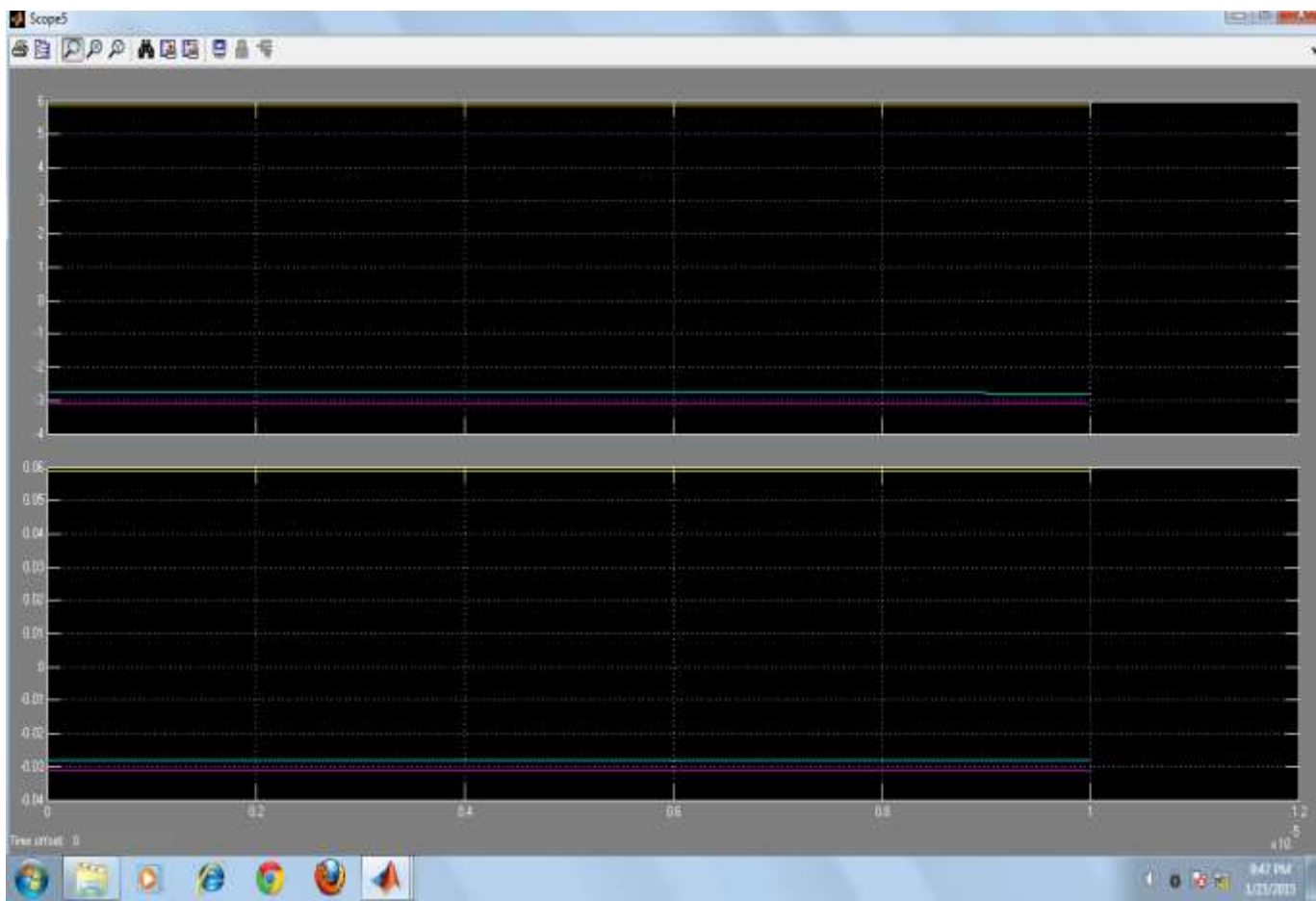
Figure 4 when fault occurred in subsystems, the other bus voltages and current waveforms

We can concluded that one bus or one area fault will affect others bus or areas and decreases or increases the voltage and current levels. Which are highly undesirable because the power systems faults are occurred suddenly, so if one area load is highly sophisticated than other area but due to irrelevant fault for one area or line will creates major or minor faults to others load area and breaks the reliability conditions, even this small fault creates a huge problem or fault in distribution company. So major area will be blackouts or voltage instability occurred.

So improvement is very much essential to maintain stability in power network. Which are discussing below .

3.3.2 IMPROVEMENT OF STABILITY

The main requirement of power system network to flow of the current minimum that voltage, power should be its desired levels and system becomes stable ,that there will be no oscillations, and give uninterrupted power supply to the load area. So stabilities main aim is to maintained reliability conditions always. So fault analysis is essential to maintained stability of a system.

Here we have see that one area fault is effected to other area also and creates instability of others system area and produces the unbalanced current as a result blackout will happen. In figure4 we see that one waveform(voltage and current) is positive though others two waves are negative ,so unbalance has created in the effected lines or area, and other network systems also fall in instability region. By analyzing from the above graph we have seen that there is two negative sequence currents and voltages and one positive sequence current and voltage .the positive sequence voltage is the summation of two negative sequence voltages and the positive sequence is current is the summation of two negative sequence currents. So these two subsystems are not maintaining their stability due to the three phase line to line fault.

For improve lines and area in proper stability, we should arrange some methods and steps thus system will back on its stability though fault is occurred in other lines. We have introduces capacitor bank or Super Capacitor in the transmission lines which is shown in figure 5.
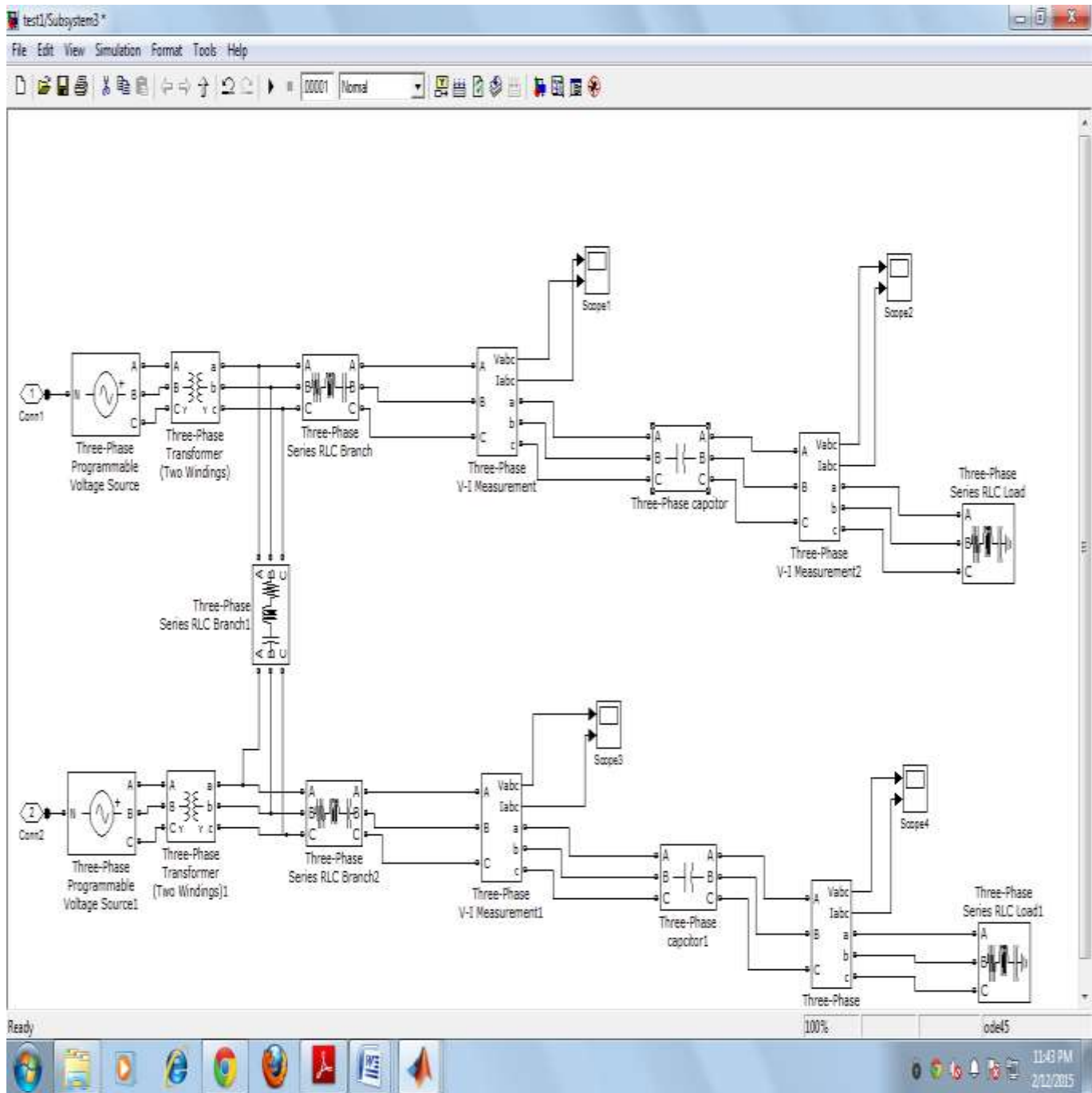
Figure 5 Arrangement of power line for improvement of stability by introducing capacitor bank

And we get clear output waveform from the system though the fault occurred others lines or area. The output wave form shown in figure 6.
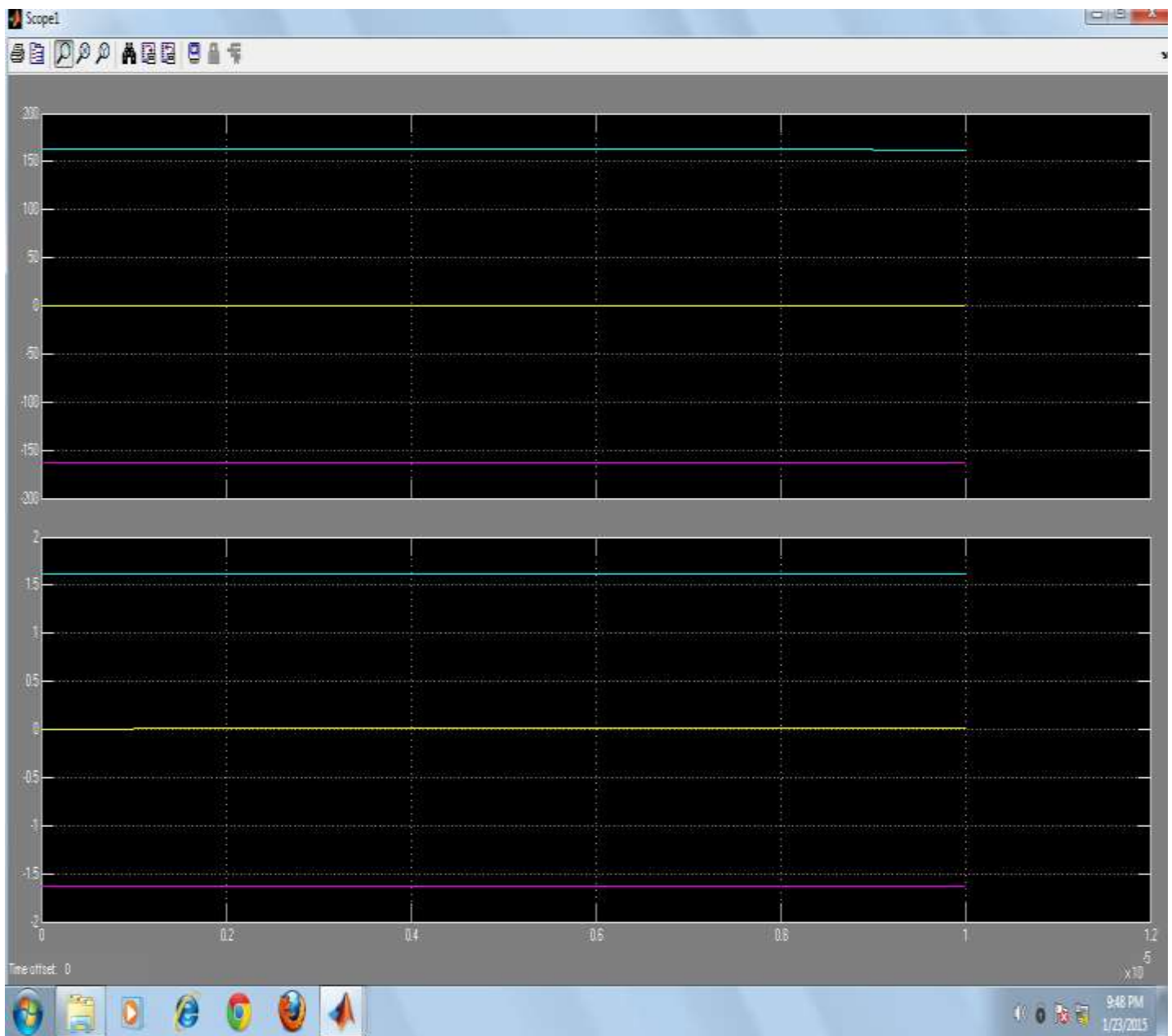
Figure the faulty line's of subsystem1 & subsystem2 voltage & current signals graphical model result analysis

From the above V-I graph we have seen that after the fault clearing by the circuit breaker the system remain stable. But due to the fault the healthy lines of subsystem 1 and 2 are affected and for that very reason the V-I graph of those lines are improve stability when we have introduced super capacitors in transmission lines which supplies leading VAR in the lines and improvement the stability.

In this system two numbers of three phase capacitors are connected between two three phase lines and loads to improve the power factor and power transmission capability. Then we can see that others affected lines voltage stability has been improved because we get the three positive output signals, which indicates that stability of others effected lines are improved though some lines have fall in faults in this network.

So we can conclude that if we use properly series compensation in transmission lines then voltage stability has surely improved and not affected by other area faults.

ACKNOWLEDGEMENT

.CONCLUSION

From the above discussion of IEEE 14 bus power system Mat-Lab model we can conclude that in a interconnected electrical power system if there is a fault occurs in any of the subsystem , all the system voltages and system currents are affected and must be improved otherwise it will creates fault of circuit parameters to other lines. If we will not improve or disconnected faulty lines or area from healthy lines or area then huge crisis of power will be occurred, even blackouts. So instability, transient stability, fault analysis are very important in power network.

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