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Three-Phase Fault Analysis on Transmission Line in Matlab Simulink

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Abstract: ***Now-a-days the demand of electricity or power areincreases day by day this results to transmits more power byIncreasing the transmission line capacity from one place to theother place. But during the transmission some faults areoccurred in the system, such as L-L fault (line to line), 1L-Gfault (single line to ground) and 2L-G fault (double line toground).***
These faults affect the power system equipmentswhich are connected to it. The main aim of this paper is tostudy or analysis of faults and also identifies the effect of thefault in transmission line along with bus system which isconnected to transmission line. Mainly the major faults in longtransmission lines is (L-G) single line to ground fault which areharmful to the electrical equipment.
A proposed model intransmission line is simulated in MATLAB software to analysisand identified the faults. Fault block was taken from the sim-power system block library. The whole modeling andsimulation of different operating and different conditions offault on transmission line, their faults are L-G fault, 2L-Gfault, 3L-G fault and three line short circuit of the proposedwork is presented in this paper.
Keywords:
L-L– Line to Line fault,
1L-G – Single Line toGround fault,
2L-G Double Line to Ground fault

I. INTRODUCTION

When different types of fault occurs in power systemthen in the process of transmission line fault analysis,determination of bus voltage and the rms line current are possible. While consulting with the power system the terms bus voltage and rms current of line are very important. Incase of three phase power system mainly two faults occurs,three phase balance fault and unbalance fault ontransmission line of power system, such as line to groundfault, double line to ground fault and double line fault. Thetransmission line fault analysis helps to select and develop a better for protection purpose[1].

For the protection oftransmission line we place the circuit breakers and its ratingis depends on triple line fault. The reason behind is that thetriple line fault current is very high as compare to other faultcurrent. Hence by using MATLAB simulation in computer,the analysis of transmission line fault can be easily carriedout.

The main purpose of this paper is to study the generalfault type which is Unbalance faults of transmission line inthe power system. Also to perform the analysis and obtainthe Result of various parameters (voltage, current, poweretc) from simulation on those types of fault UsingMATLAB.

A new modeling framework for analysis andsimulation of unbalance fault in power system is Procedureincludes the frequency information in dynamical models and produces approximate non linear Models that are welladopted for analysis and simulation. The transformer modelincludes Saturation.

The parameters have been obtainedfrom practical or experimental measurement. From the study it is seen that sags can produce transformer saturationwhen voltage recovers. This Leads to produce an inrushcurrent that is similar to inrush current produced durin g thetransformer Energizing. The study point out that the voltagerecovery instant can take only discrete value, since the fault-clearing is produced in case of natural current zeroes[2] .The instant of voltage recovery Corresponds to the instant offault clearing. For phase to phase fault and single phasefault, a single point-on-wave of voltage recovery can bedefined. On the other hand for two-phase-to-ground andThree-
phase fault, the recovery takes place in two or threesteps[3]. In petrochemical industry, the Grounding andground fault protection ar e very important factors. For thatfirst it is important to have the proper system grounding forthe particular system application, and al ong with this it iseually important to have the proper production againce the ground foult.

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II. LITRUTURE REVIEW

Normally, a power system operates under balancedconditions. When the system becomes unbalanced due to thefailures of insulation at any point or due to the contact oflive wires, a short circuit or faultis said to occur in the line.faults may occur in the power system due to the number ofreasons like natural disturbances(lightning, high-speedwinds,earthquakes), insulation breakdown, falling of a tree, bird shorting, etc. Faults that occur in transmission lines are broadly classified as:

1) Symmetrical faults
2) Unsymmetrical faults

A. Unsymmetrical Faults

As discuss above in three-phase transmission lineof power system mainly two types of fault occurs, balancefault which is also called symmetrical fault and unbalancefault called as unsymmetrical fault. But this paper only dealswith the unsymmetrical. Unsymmetrical faults are the faults which leads unequalcurrents with unequal phase shifts in a three phase system.The unsymmetrical fault occurs in a system due to presenceof an open circuit or short circuit of transmission ordistribution line. It can occur either by natural disturbancesor by manual errors. The natural disturbances are heavywind speed, ice loading on the lines, lightening strokes andother natural disasters[4].The open circuit or short circuits of transmission ordistribution lines will lead to unsymmetrical or symmetricalfaults in the system. In case of tree branches falling on lines,a short circuit of transmission lines will occur.These line faults are classified as

1) Single line to ground faults (LG fault)
2) Double line fault (LL fault)
3) Double line to ground fault (LLG fault)

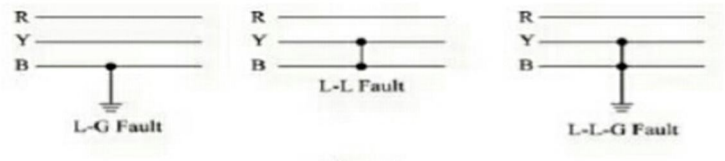


Figure 1

Single line to ground fault is the most frequently occurringfault (60 to 75% of occurrence). This fault will occur whenany one line is in contact with the ground. Double line faultoccurs when two lines are short circuited. This type of faultoccurrence ranges from 5 to 15%. Double line to groundfault occurs when two lines are short circuited and is incontact with the ground. This type of fault occurrenceranges from 15 to 25% of occurrence

B. Causes of Fault in Power System

1) Lighting strokes cause most faults on high-voltagetransmission lines producing a very high transientthat greatly exceeds the rated voltage of the line.
2) This voltage usually causes flashover between the phases and/or the ground creating an arc.
3) Since the impedance of this new path is usuallylow, an excessive current may flow.
4) Faults involving ionized current paths are alsocalled transient faults. They usually clear if poweris removed from the line for a short time and thenrestored[5].

C. Need of Fault Analysis in Power System

1) Electric systems occasionally experience short circuits.
2) This results in abnormally high currents.
3) Over current protective devices should isolatefaults at a given location safely, with minimaldamage.
4) The parts of system shall be able to withstandthe resulting mechanical and thermal stresses.
5) The magnitudes of fault currents are usually estimated by calculations.
6) The equipment is selected using the calculationresults

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D. Fault Limiting Devices

It is possible to minimize causes like human errors, but notenvironmental changes. Fault clearing is a crucial task in power system network. If we manage to disrupt or break thecircuit when fault arises, it reduces the considerable damageto the equipments and also property. Some of these faultlimiting devices include fuses, circuit breakers, relays, etc.and are discussed below[6].

1) Fuse
2) Circuit Breaker
3) Relay
4) Lighting power protection devices

III. METHODOLOGY

1) Project we were perform on IEEE 14 bus system without TCSC observe the voltage ,active power and reactive power waveform.
2) Connect the TCSC with IEEE 14 bus system and observe the voltage , active ,and reactive waveform.
3) Create the Three phase fault on IEEE 14 bus system and observe the effect of fault on 14 bus voltage waveform.
4) IEEE 14 bus system with three phase fault and TCSC connected it is observed that simulation result output TCSC improve the voltage stability and power flow control in power system network.

A. IEEE 14 Bus System

We were perform on IEEE 14 bus system having 14 bus and 20 lines. The system consists of 5 synchronous machine three of which are synchronous condenser and 2 synchronous generators. There are 11 loads in the system having net real and reactive power demand 259 MW and 81.1 MVAR, Respectively. The 14 system has been shown in figure.

B. Circuit Diagram

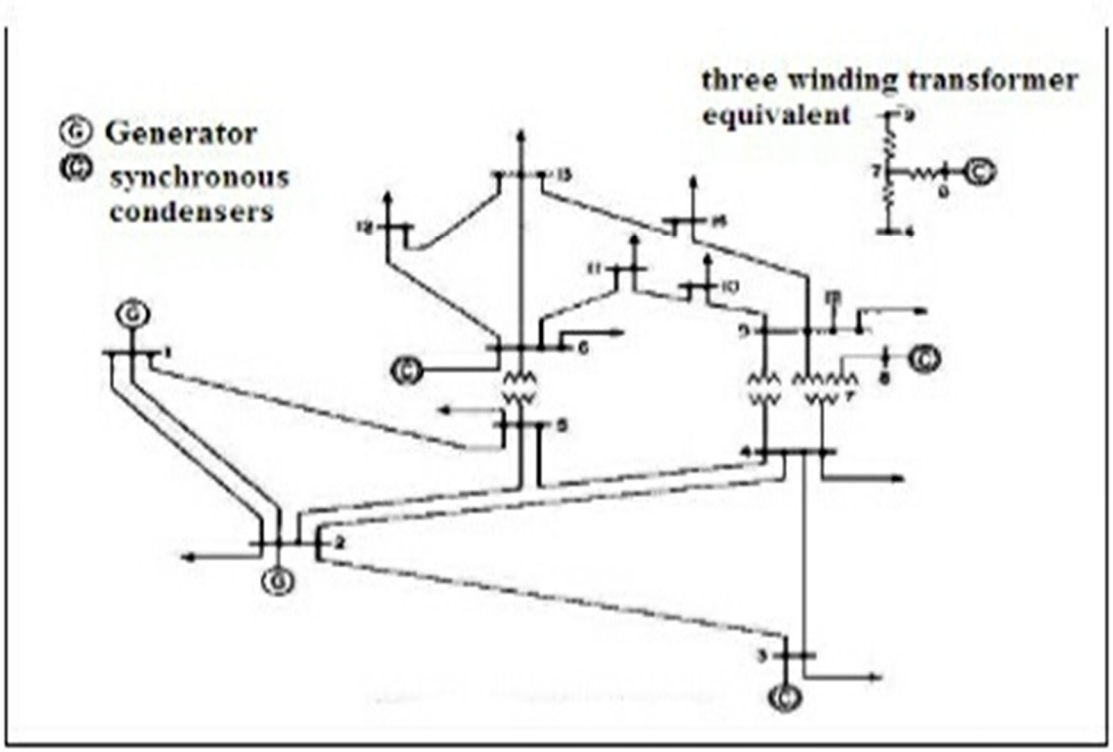


Fig. Single line diagram of IEEE 14 bus system

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C. Simulink Model Description

1) IEEE 14 bus system without TCSC

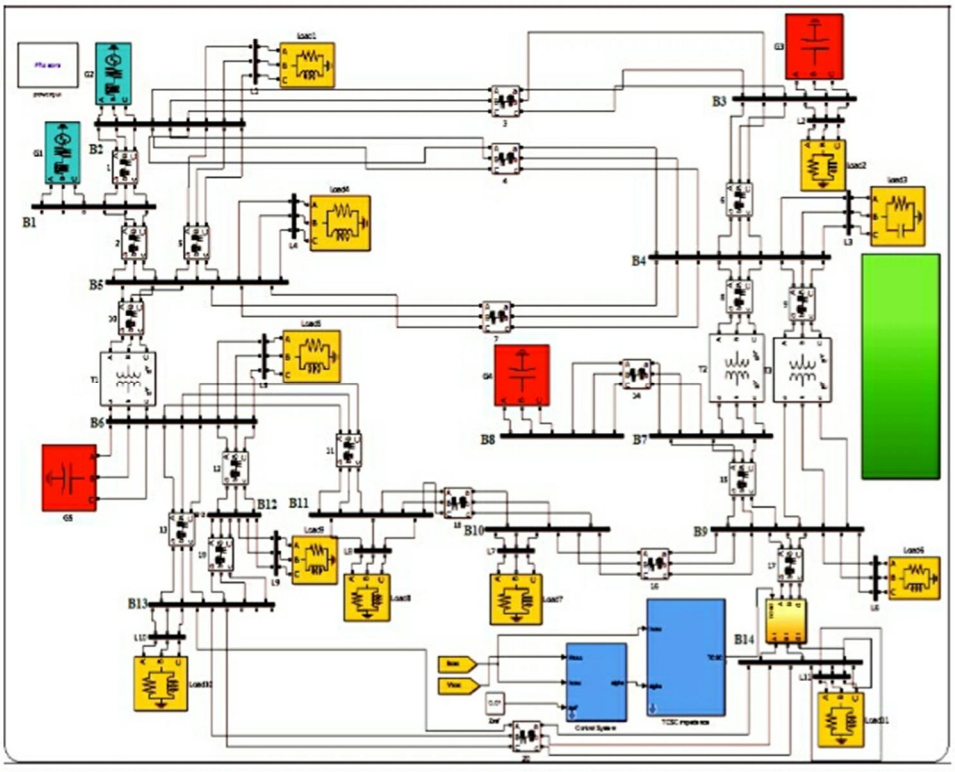


Figure 1: IEEE 14 bus system without TCSC

Project were perform on IEEE 14 bus system Having 14 buses and 20 line .the system consist of synchronous machine three of which are synchronous condensers. There are 11 loads in the system having net real and reactive power demand of 259 MWand 81.3 MVAR. Respectively.

2) IEEE 14 bus system with TCSC

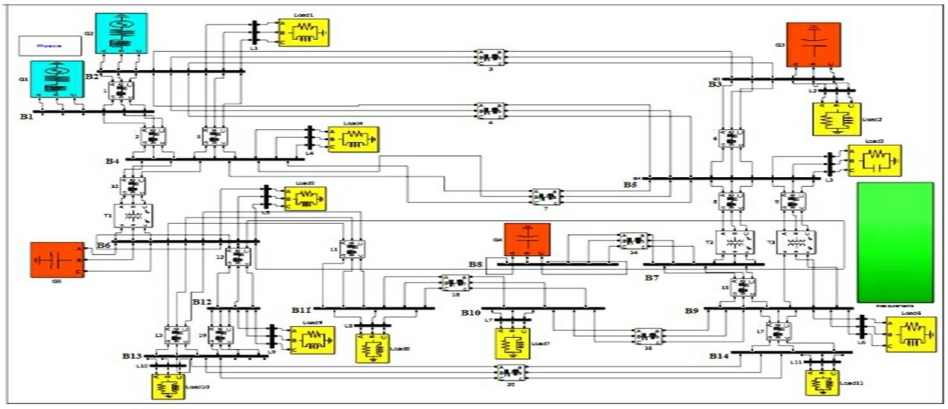


Figure 2: IEEE 14 bus system with TCSC

Figure 2 show the simulink model of IEEE 14 bus system with TCSC . TCSC connected to bus 14 . When TCSC operates in the constant impedance mode it uses voltage and current feedback for calculating the TCSC impedance. The reference impedance indirectly determines the power level, although an automatic power control mode could also be introduced.

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3) IEEE 14 bus system with Three Phase Fault

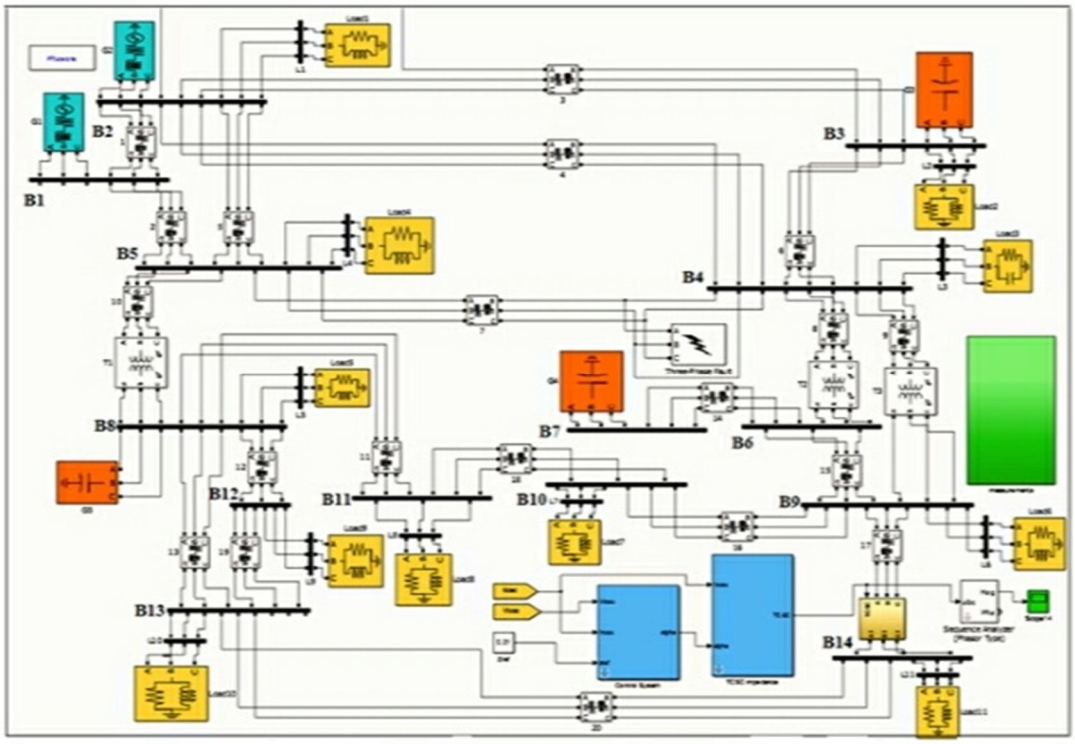


Figure 3: IEEE 14 bus system with Three phase fault.

Figure 2 show the simulink model of IEEE 14 bus system with Three phase fault .three phase fault created in between bus 4 and bus 5 for time duration of 10.00 to 10.05 sec.

4) IEEE 14 bus system with three phase fault and with TCSC

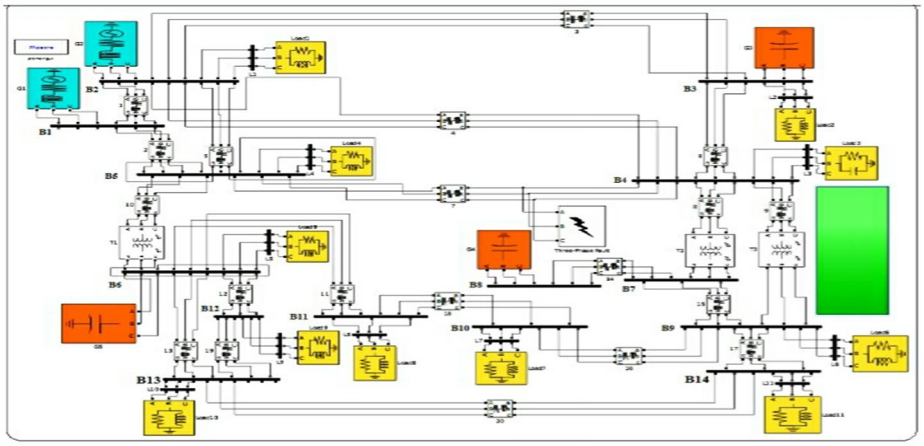


Figure 4: IEEE 14 bus system with Three phase fault with TCSC.

Figure 4 show the simulink model of IEEE 14 bus system with Three phase fault with TCSC .whenever fault occur in power system then TCSC improve the voltage stability and control the power flow in power system network.
Fig. Circuit diagram of 14 bus system in TCS

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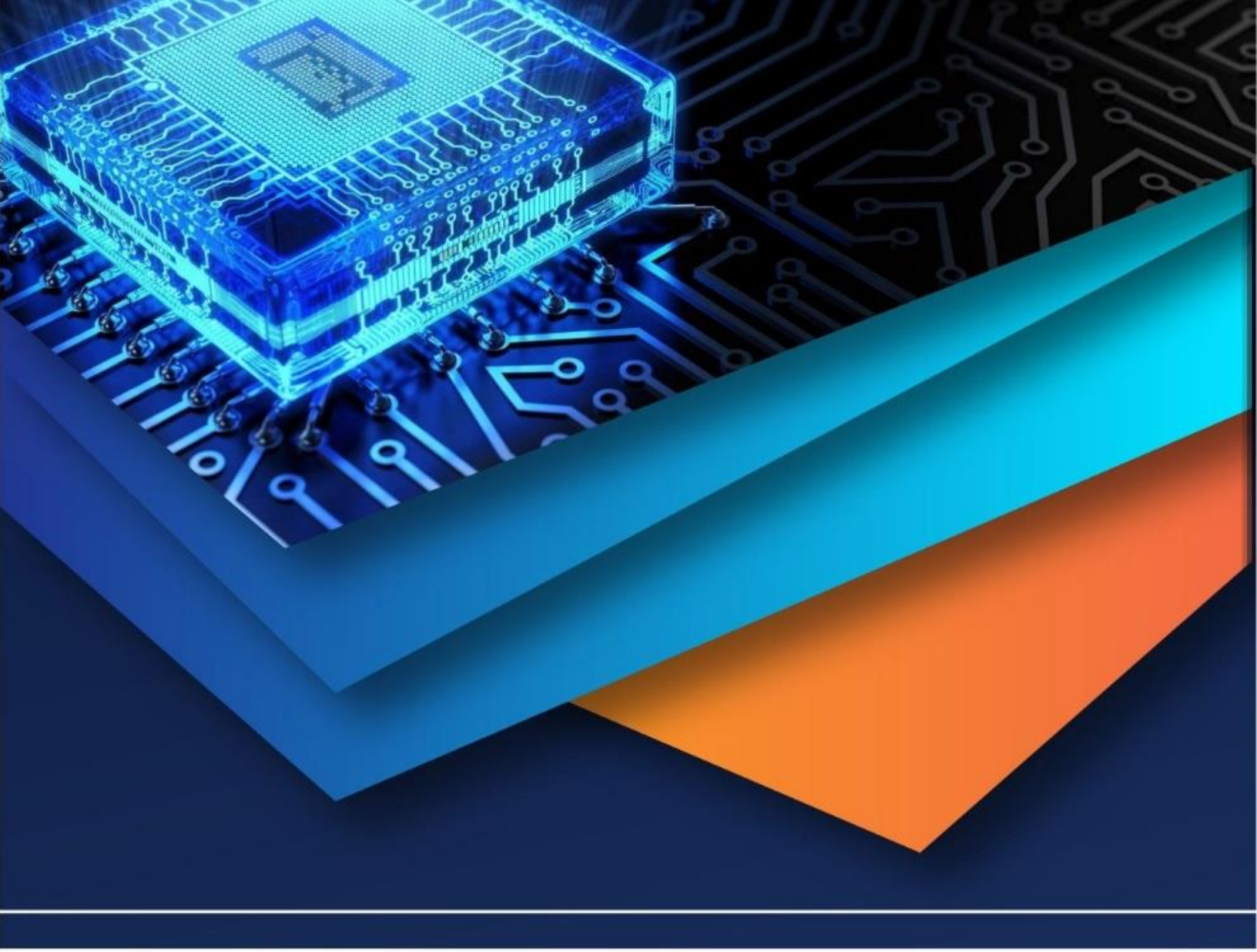
IV. CONCLUSION

In this dissertation, IEEE 14 bus system with 3 phase fault observe and TCSC FACTS controller is use to limit the fault and improve the voltage stability and power flow control in power system network .We reach at the conclusion that TCSC is one of the fast acting power electronic controller which can provide a smoothly variable series capacitive reactance. this is a new approach 14 bus system with TCSC to improve the voltage stability, limit fault and power flow control in power system network . IEEE 14 bus system with and without TCSC, comparative result and simulation result waveform show that, using TCSC we can improve the voltage stability and power flow control in power system network.and also limit the three phase fault

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