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Marks/Grade	

EXPERIMENT # 10

Modelling of Over Voltage-Under Voltage Relay in Simulink

Objective:

At the end of this lab session students will be able to

- Use “Sim Power Systems” for modelling the power system.
- Implement “Over Voltage/Under Voltage Relay” by using Matlab Simulink Libraries.
- Set the “Voltage Setting” of Over voltage/ Under Voltage Relay.
- Learn how to create an electrical subsystem.

Introduction:

Utilities are responsible for the generation, transmission and distribution of electricity to customers. Part of this responsibility is ensuring a safe but yet reliable power supply to customers. For the purpose of safety and protecting the transmission and distribution network from faults, utilities worldwide have sophisticated protective equipment. Collectively, these are known as secondary equipment and include the current transformers (CT), potential transformer (PT) and protective relays.

Protective relays:

A protective relay is one which monitors the current, voltage, frequency or any other type of electric power measurement either from a generating source or to a load for the purpose of triggering a circuit breaker to open in the event of an abnormal condition. In the electrical power system these relays are called as protective relays.

The function of protective relaying is to cause automatic removal of a part of the system, when it suffers a short circuit, or when it starts to operate in an abnormal manner that might cause damage or otherwise interference with the effective operation of the rest of the system. Relays are also used for the prompt removal of any part of the system from the service, for the purpose of maintenance.

Circuit Breakers:

Circuit breakers are generally located so that each generator, transformer, bus, transmission line, etc. can be completely disconnected from rest of the system. These circuit breakers must have sufficient capacity so that they can carry momentarily the maximum short-circuit current that can flow through them, and then interrupt this current.

Over Voltage Relay:

Relay that serves primarily the same purpose as an overcurrent relay except that it is connected in the line by a potential transformer which measures the voltage across the line. When an overvoltage exists, the relay operates and opens the circuit breaker.

Under Voltage Relay:

Relay that serves primarily the same purpose as an overcurrent relay except that it is connected in the line by a potential transformer which measures the voltage across the line. When an under voltage exists, the relay operates and opens the circuit breaker.

Laboratory Task:

Implement over voltage and under voltage relay in Matlab Simulink that protect the system in case when voltage increase or decrease the certain threshold value. It is obtained by programmable generator through which variable voltage is obtained. After sensing the fault relay should give a trip signal to the circuit breaker.

Procedure:

Step 1: Draw a simple power system having a **3- ϕ** Variable Source, **3- ϕ** phase circuit breakers, **3- ϕ** VI measurement unit, **3- ϕ** RLC series load and block of **3- ϕ** fault to implement different types of fault in system. Connect the blocks as shown below.

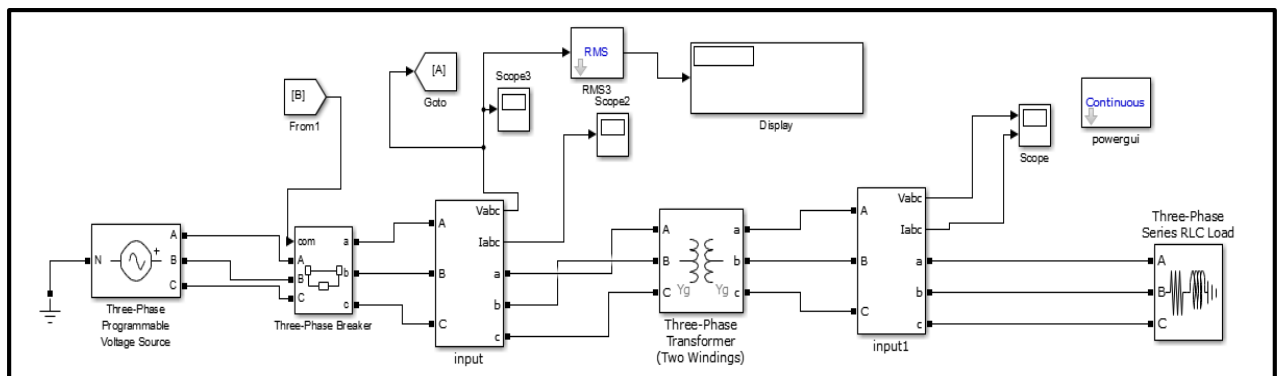


Figure 1: Block Diagram of three phase system

Set the parameters of each block as mentioned below. Accept default values for all other Parameters.

Total Simulation Time: ?

Solver: Ode23tb (stiff/TR-BDF2)

Note: To select the solver go to menu bar > Simulation > Configuration Parameters OR press (Ctrl + E) and select the solver. Also set following solver options.

Relative tolerance: 1e-3 (default)

Solver reset Method: Robust

System Frequency: 50 Hz

Three phase Programmable Voltage source:

Voltage (Phase to Phase): 11e3 V

Internal connection: Y grounded

Specify impedance using short-circuit level: Select this option

Three-Phase Breaker:

Initial status of breakers: closed

Enable switching of all Phases

External control of switching times: Select this option

Measurements: None

Breakers resistance **Ron**: 0.001Snubbers resistance **Rp**: 1e6Snubbers capacitance **Cp**: inf**Three-Phase V-I Measurement:**

Voltage measurement: phase-to-phase

Current measurement: Yes

(Uncheck **labels** and **per-unit** measurements)**Three-Phase Series RLC Load:**

Configuration: Y grounded

Nominal voltage: 11e3 V

Active Power (MW): 200e6 W

Inductive reactive power: 100 VAR

Capacitive reactive Power: 0 VAR

Step 2: The rms value of voltage is observed in Step 1, with programmable voltage source voltage is increased the rated value and system is observed. When voltage is increased the specific value than over voltage relay will send trip signal to breaker.

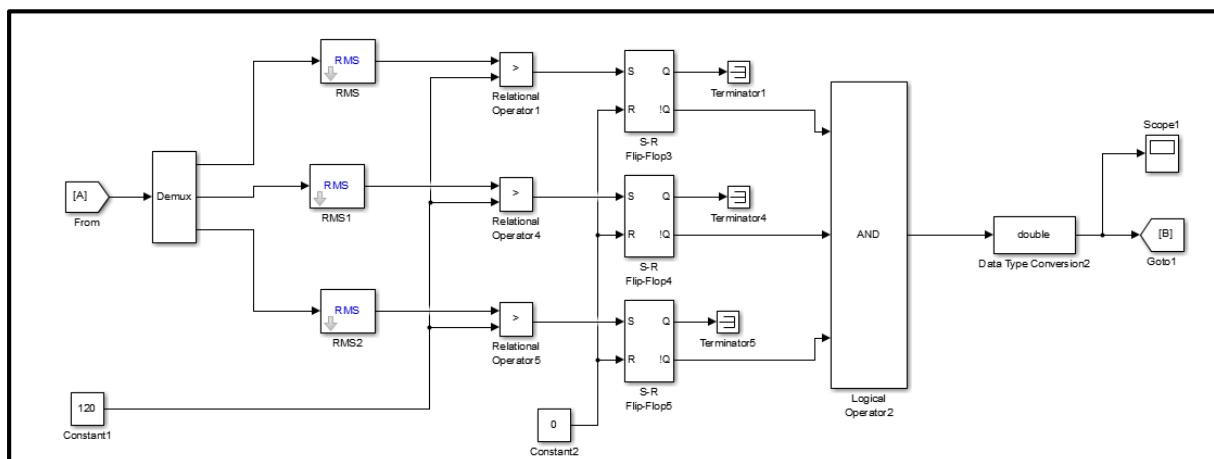


Figure 2: Over voltage Relay

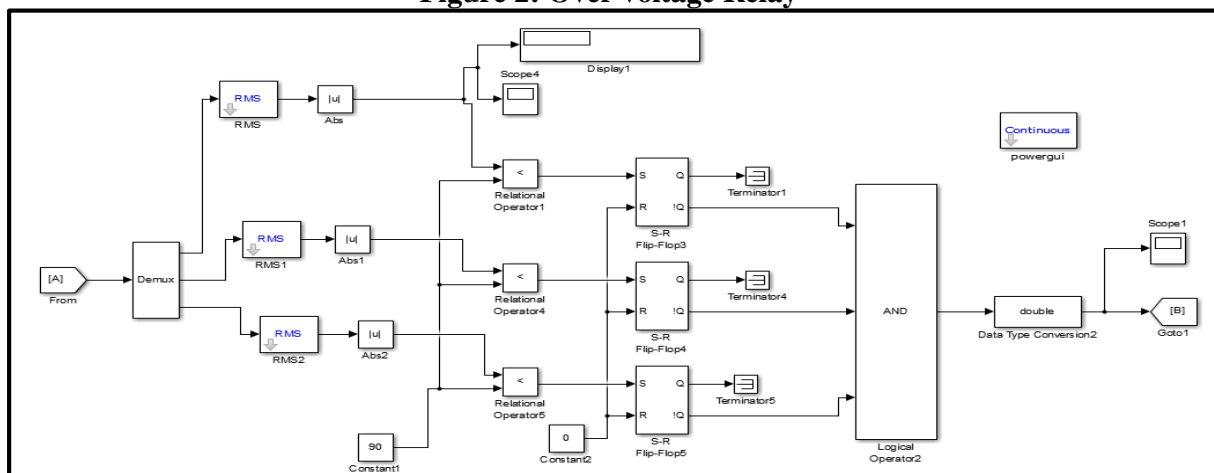


Figure 3: Under Voltage Relay

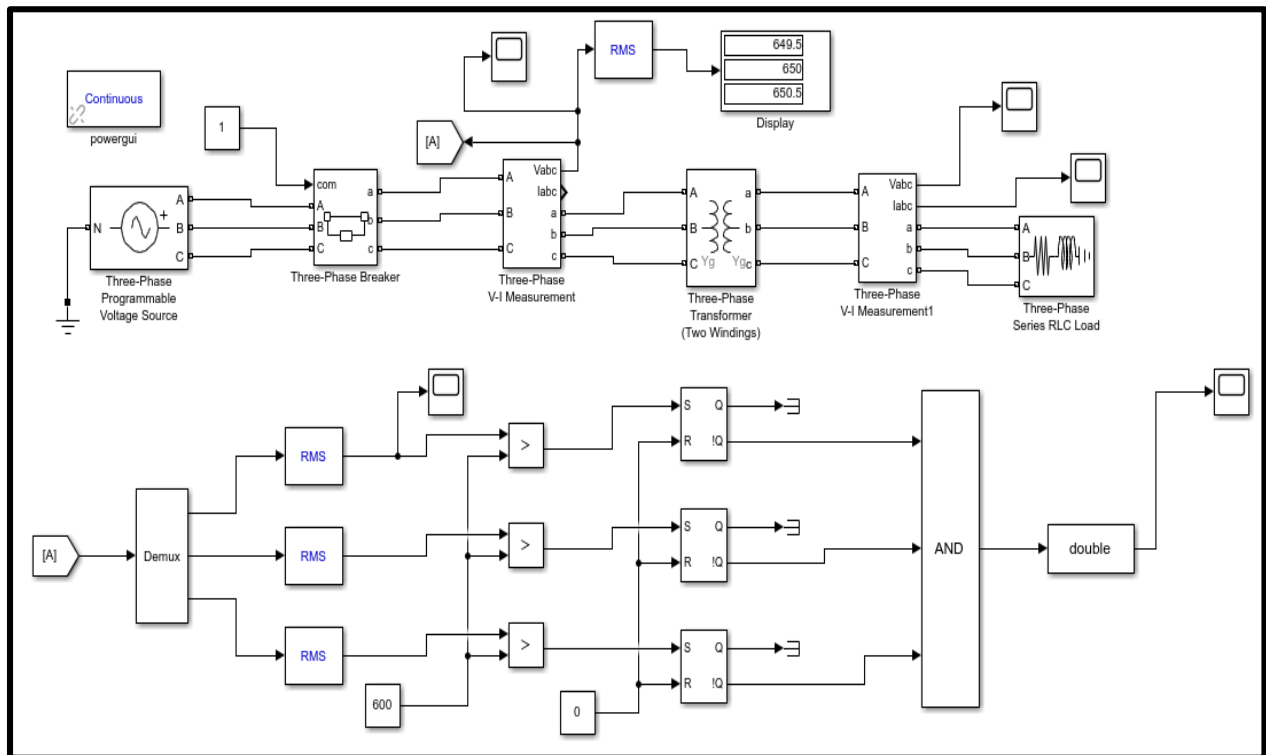
OVERVOLTAGE RELAY:

Figure 4: Simulink model of Over-Voltage Relay

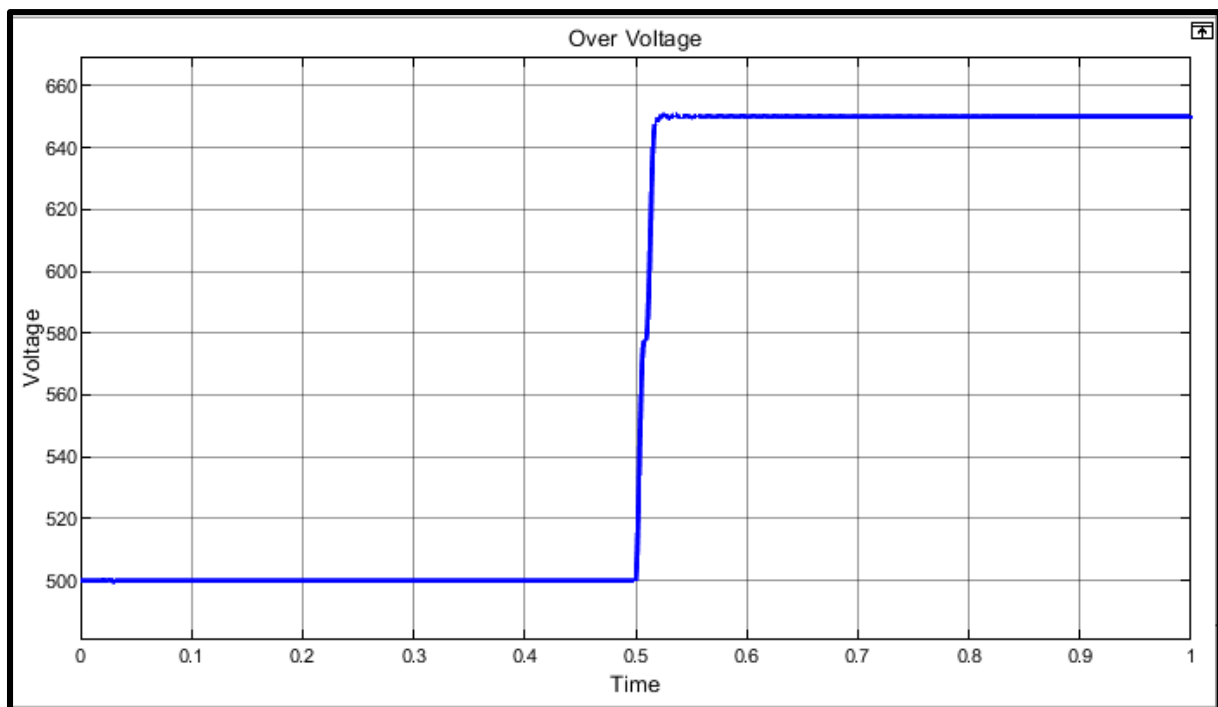
Over voltage condition:

Figure 5: show the over voltage condition graph

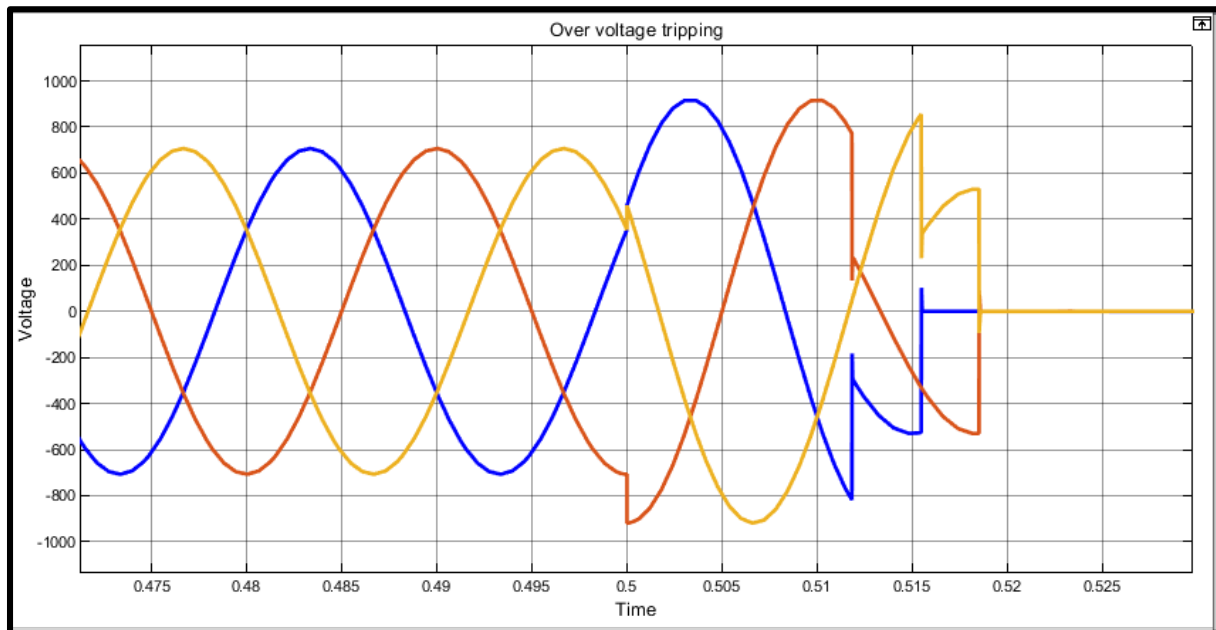
Over Voltage Waveform:

Figure 6: Tripping Waveform of three phase Over voltage

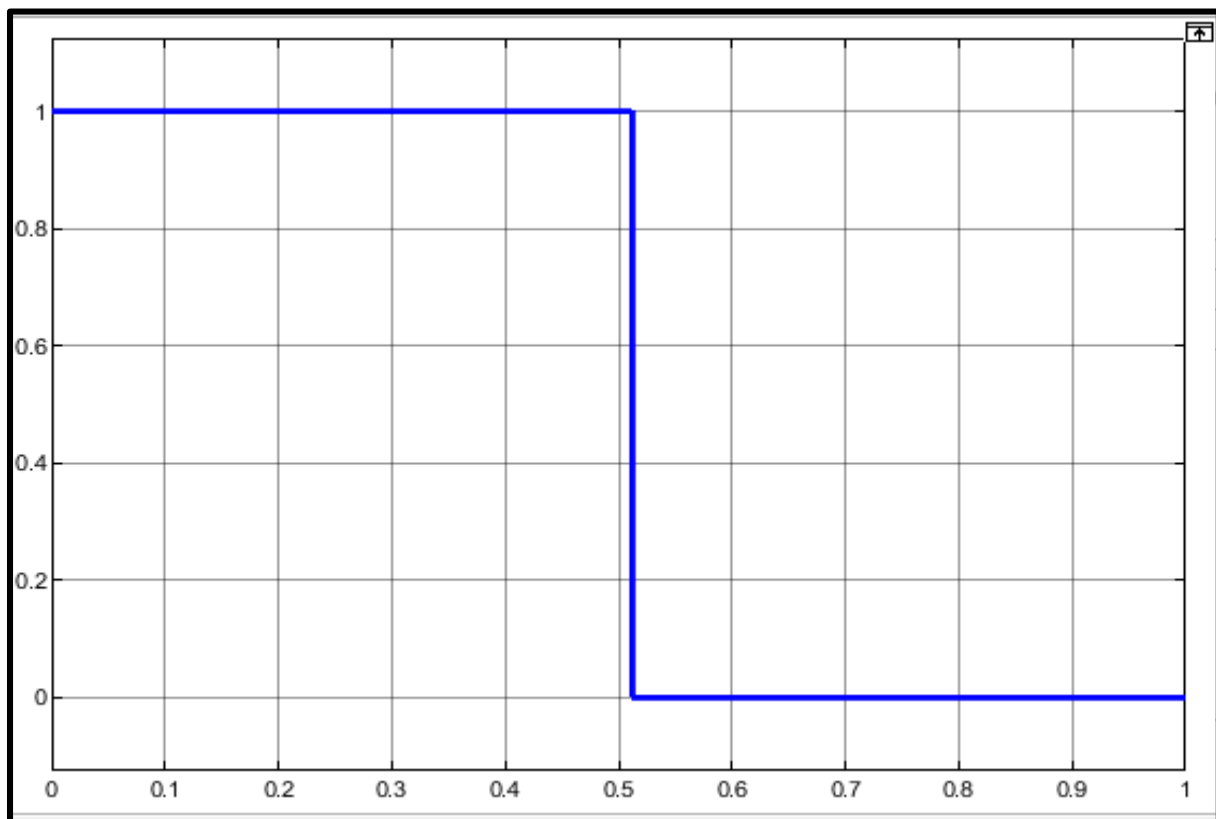
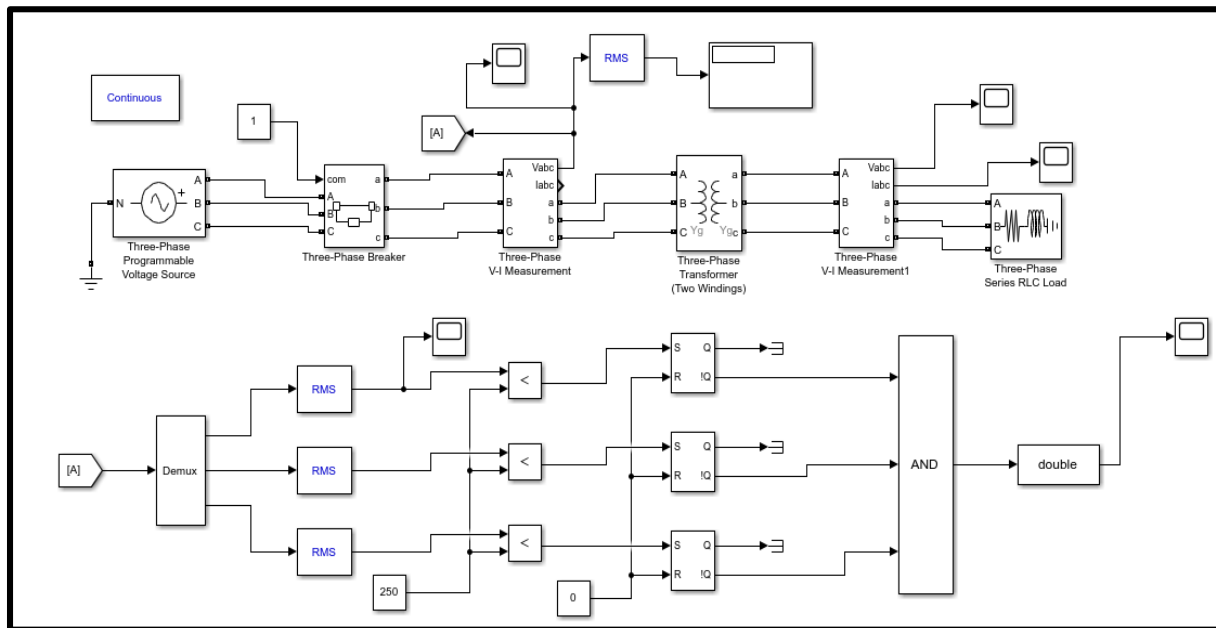
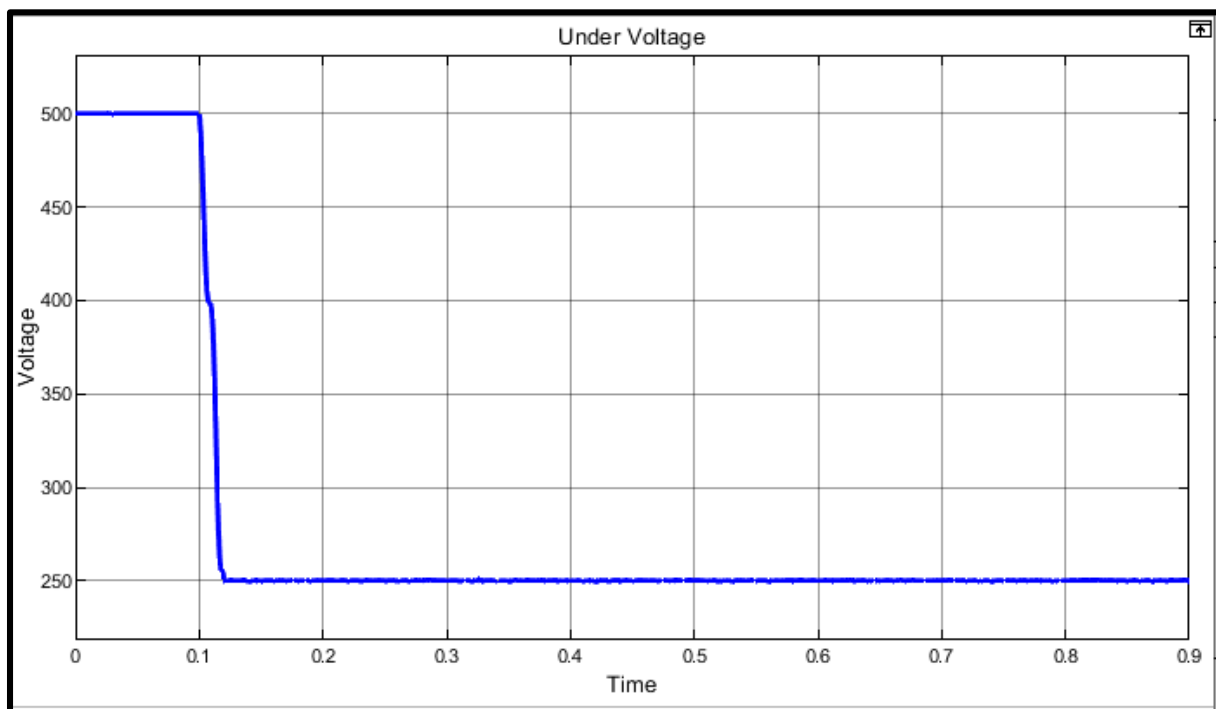
Relay Signal:

Figure 7: Show the Relay signal

Under Voltage Relay:**Figure 8: Simulink model of Under-Voltage Relay****Under Voltage Condition:****Figure 9: show the over voltage condition graph**

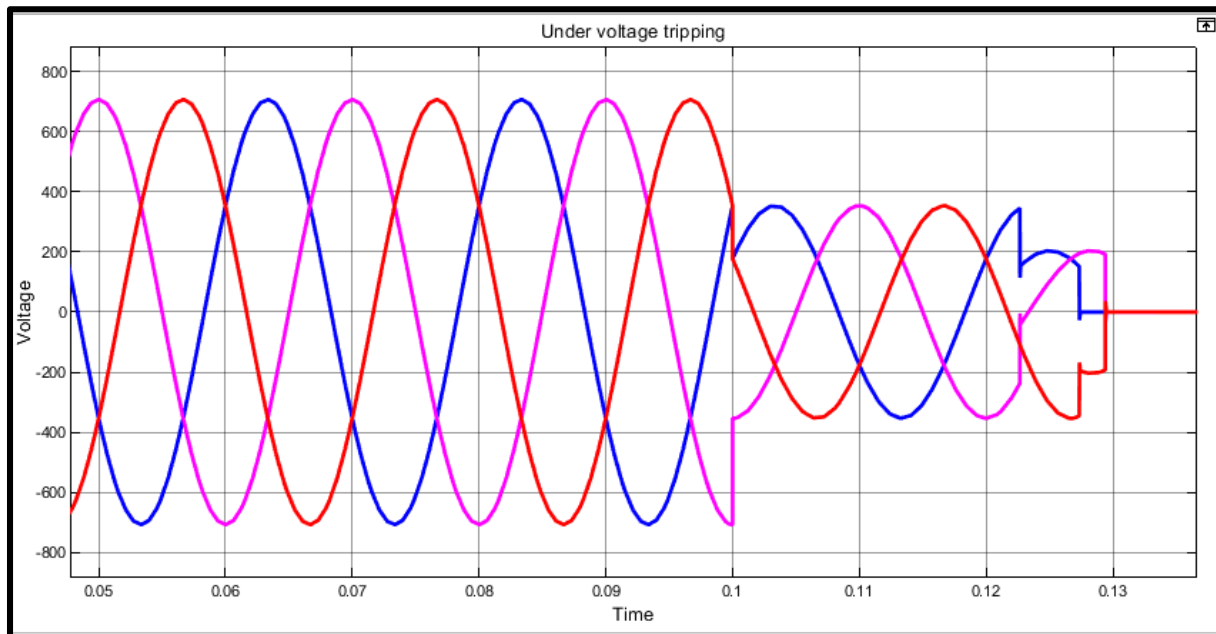
Under Voltage waveform:

Figure 10: Show the tripping waveform of three phase under voltage condition

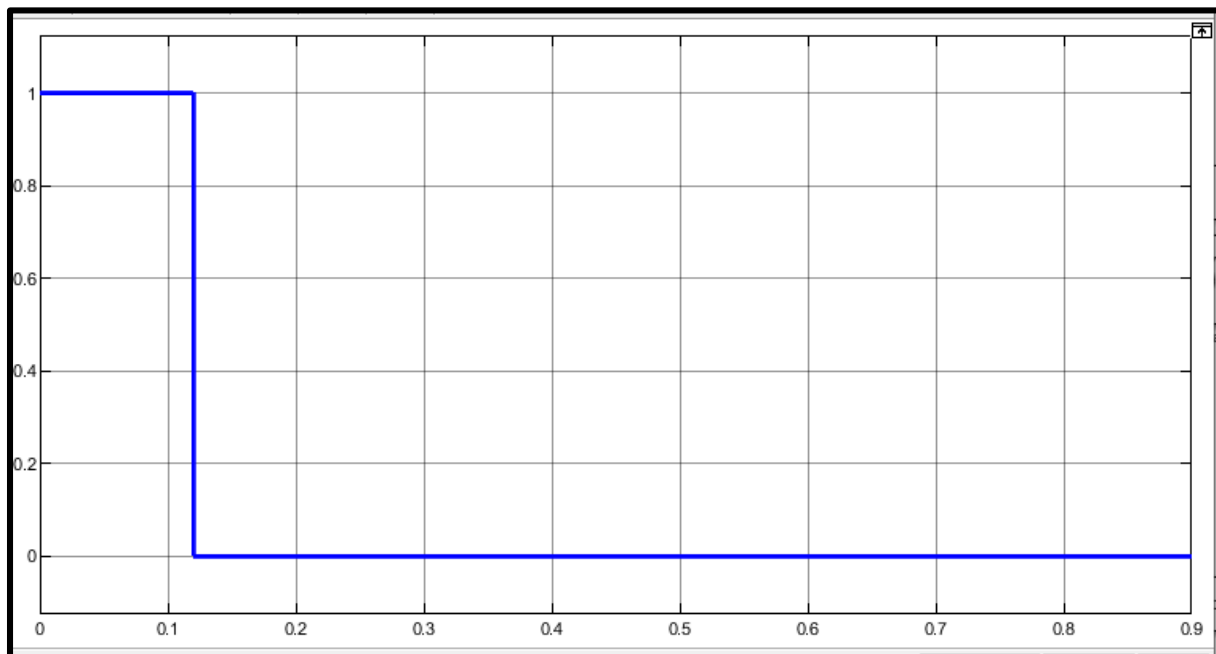
Relay Signal:

Figure 11: Show the Relay signal

CONCLUSION:

In this lab we have designed over and under voltage relay using the SIMULINK (MATLAB) software. The Over-voltage and under-voltage relays are used to limit the voltage of our system if the value of the system increases above the set value, the relay will operate and if the voltage of the system decreases below the set value the relay will operate. In Over voltage condition we set voltage value 600V. When voltages increase above this set value, over voltage relay send tripping signal to breaker to open the circuit. In case of under voltage condition e.g. we set voltage value 250V. So, when voltage fall below this value, under voltage relay sense this condition and send tripping signal to breaker. We also analysed both of them separately in our models and observed the graphs of both over and under-voltage relays.

After this lab we are able to:

- Use “SIMULINK” for modelling the power systems.
- Implement “Over Voltage/Under Voltage Relay” by using Simulink (MATLAB) Libraries.
- Set the “Voltage Setting” of Over voltage/ Under Voltage Relay.
- To create an electrical subsystem.