Automation of Substation Using Plc Andscada

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ABSTRACT

As we have adopted the concept of interconnected power system, the role of substation is become moreimportant.Substationconnectsgenerationstationtothedistributorortotheendconsumerviatransmission system depending upon the types of substation. Activities like switching of transmissionlines, parameter measurement, fault detection and storing of historical data are carried out in each ofthesubstationpremises.Earliertimethisallactivitieswascarriedoutmanually,ascomplexityofsystemincrease the role of substation become crucial and we need to move towards the use of IEDs andAutomation. Activities carried out at substation can broadly classify in to three term i.e. supervision,control and Data acquisition. In an automated substation this all three will done using ProgrammableLogic controller and SCADA. For system monitoring or supervision data is given to controllers fromRTU. Control command according to system parameter is produced by PLC and SCADA provides ahumanmachineinterference.Substationautomationsystemsmaketheircontrolandmonitoringpossibleinrealtimeandmaximizeavailability,reliability and safetyofthe system.

Keywords:Substation,PLC,SCADA,RTU.

INTRODUCTION TO SUBSTATION

Asubstationisapartofanelectricalgeneration,transmission,anddistributionsystem.Substationstransform voltage from high to low, or the reverse, or perform any of several other importantfunctions. Substations may be owned and operated by an electrical utility, or may be owned by alarge industrial or commercial customer. The word substation comes from the days before thedistributionsystembecameagrid.Ascentralgenerationstationsbecamelarger,smallergeneratingplants were converted to distribution stations, receiving their energy supply from a larger plantinstead of using their own generators. The first substations were connected to only one powerstation,wherethe generatorswerehoused,andweresubsidiaries ofthatpower station.

SubstationAutomation

Early electrical substations required manual switching or adjustment of equipment, and manualcollection of data for load, energy consumption, and abnormal events. As the complexity ofdistributionnetworksgrew,itbecameeconomicallynecessarytoautomatesupervisionandcontrolofsubstationsfrom acentrallyattendedpoint,toallowoverallcoordinationincaseofemergenciesandtoreduceoperatingcosts.Earlyeffortstoremotecontrolsubstationsuseddedicatedcommunicationwires,oftenrunalongsidepowercircuits.Power-linecarrier,microwaveradio,fibreopticcablesaswellasdedicatedwiredremotecontrolcircuitshaveallbeenappliedtoSupervisoryControlandDataAcquisition (SCADA)forsubstations.

Substationautomationtask:

Thereare3 main taskofautomation system

(1)   Dataacquisition
(2)   Supervision
(3)   Control

(1)   Dataacquisition:

Data acquisition means collecting data. The data collected from of measured current orvoltage values or the open or close contact of point. Collected data can be used locally with thedevise collecting it, sent to another devise in a substation, or sent from the substation to one orseveral data bases for use of engineers, operators, administration   and   planners.   Data   acquisition istheprocessofmeasuringphysicaloranelectricalphenomenonsuchasvoltage,temperaturecurrent,pressureorsoundwithacomputeritisconsistsofsensors,hardwaremeasurement,acomputerwithprogrammable software. Computer to other measuring systems pc base DAQ system has theprocessing power, display, productivity & connectivity. By using DAQ what data are collected isuse for in so many way like continuous power supply, set the schedule of maintenance of powerplantsor substationsalso.

(2)   Supervision:

Usingacquireddata.itisthecomputerprocess&personalmonitoringorpersonalsupervisethe conditions & status of power system by using data acquired from DAQ. The engineers &operators monitor. The information remotely on computer display & graphical small displayslocallyatdevice;onfrontpaneldisplay&computers.

(3)   Control:

Traditional SCADA system relay on operators to supervise the system. Control anothertask is to integration of power system. Which is act of communicating data to, from, or amongIED'S in I&C system and remote users. Integration of substation is to combining data from theIED'Slocaltoa substationsothereisa single pointofcontactinthesubstationforallI&Cdata.

Inthiswholeautomationtaskrelayondataacquisition,supervision&controlallareworkingtogather.

RemoteTerminalUnit(RTU):

RTUisanelectronicdevicewhichusedinIEDwhichcanbelocateinremotelocation&waysasaterminalpointforfieldcontacts.Agroupofpairconductorswhichismadeupofcopperoneusedto sense every transducers value, these conductors placed at the system's device. That can transferdatafroma controllingplace &alsocontrolthe commands fromvarious devices.

ProgrammableLogicController(PLC):

PLC is the most important part of automation system. It will be used for logical control byprogramingPLChasanumberofbenefitsfort0heSubstationautomation.Herearesomeapplicationsfor Substationautomation.

➢   RTUemulation&replacement.
➢   Protection&control.
➢   Automaticswitching.
➢   Voltageregulationmanagement.
➢   Transformermanagement.
➢   Remotecontrol.
➢   Demandcontrol.
➢   Easymaintenance.
➢   Emergencyloadshedding.

Programmable Logical controlling are extremely reliable. They designed to operate over widetemperature,veryhighelectromagneticnoise&highvibrationenvironment.Italsobeusedindusty,moisture, heat, cold, etc. conditions. In large number on installed base of PLC's offers a reducedcost,readilyavailable&lowcostspareparts&PLCofferslowcostsolutionsthentraditionalRTUforSCADAsystem.

The type of PLC used in this is a modular one because of uncertainty in the input and outputnumbers.WehavehadaccesstoaDeltamadePLC14SS2.ThisisamodularPLC.TherearemanyadvantagesofPLC overclassiccontrollers some ofthemare as follows.

Advantagesof PLCsoverRelaylogic:

☐   PLCsareprogrammable.
☐   Manycontrol relayscanbereplacedbysoftware,whichmeanslesshardwarefailure.

☐ It iseasiertomake changesinsoftwarethaninhardware.
☐ Specialfunctionssuchastimedelayactions,countersareeasytoproduceinsoftware.
☐ Reliabilityismore.
☐ ThereisalmostnotasklimittotasksforwhichPLCscanbeused.–Itiscosteffectivecontrolsystem

SupervisoryControl&DataAcquisition (SCADA):
InSCADAsystemtransmit&receiveslogicordatafromanyeventsofcontrolsmeteringmeasuringdomonitoringofprocessdevicesforexampleelectricequipment,instrumentationdevices,telecommunication on industrial applications. It is also used for safety or protection purpose. Inpower system by using SCADA entire power plant can be controlled remotely over long-distancecommunication links. SCADA also be used for remote switching, telemetering of grids likeshowingvoltage,current,power,direction,consumptioninKWH,evenautomaticsynchronizationisusedin some powersystems.
SCADAcouldbecomprisinganoperatorworkstation(OWS)withalocalhumanmachineinterfacefor displaying station of switch position of equipment current\voltage of equipment is used to it. Italso used for communication purpose with a network control centre (NCC) with other station alsowithe generatingstations.
ByusingSCADAthere aresomanybenefitsin the Substationsareasfollows:-
☐ Proper&accuratemeasurementdonebycollectingaccuratedataofloadconsumption.Wecanfor castthe load demand.
☐ Ithasreliable&robustness.
☐ Improveproductquality.
☐ Reduceyouroperating&maintenancecosts.
☐ Integratewithyourbusinesssystemsandpreserveyourcapitalinvestment.

Blockdiagram:
In substation the switching of lines are done on the basis of current and voltage limit. Asshown in diagram the current and voltage on both the side of transformer will convert inmeasureablerangewiththehelpofCTandPT,thanitwillconvertindigitalformwiththe
helpofanalogtodigitalconverter.ThatdigitalsignalwilluseasaninputtoPLC.PLCwillcompare standard reference with input signal of CT and PT. if any predefine limit getsviolated than accordance switching signals for switching of lines given to switching ofcircuitbreakerand isolators.
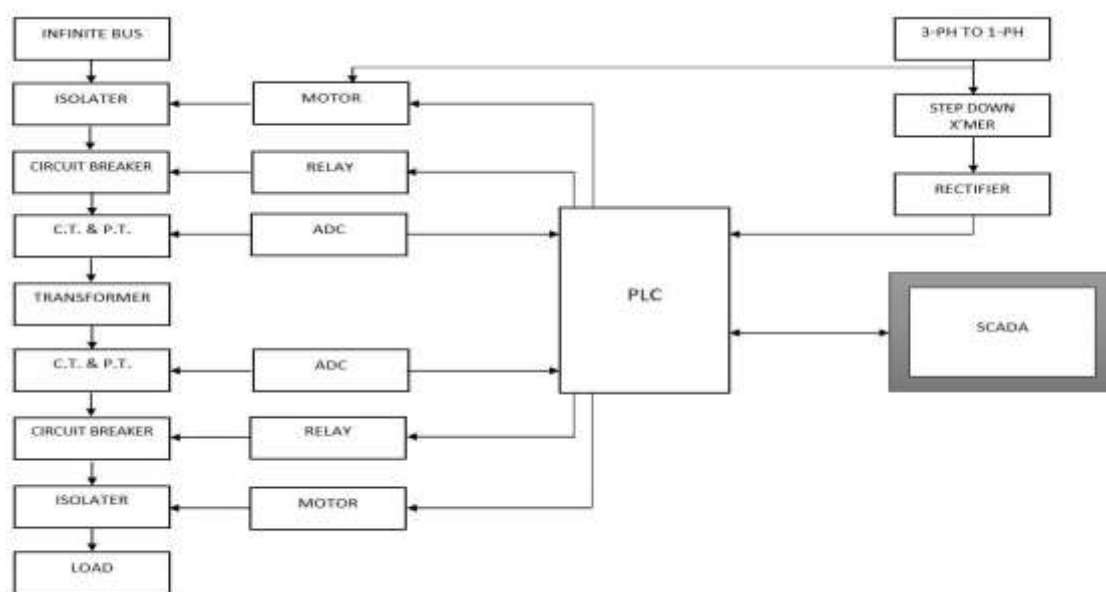
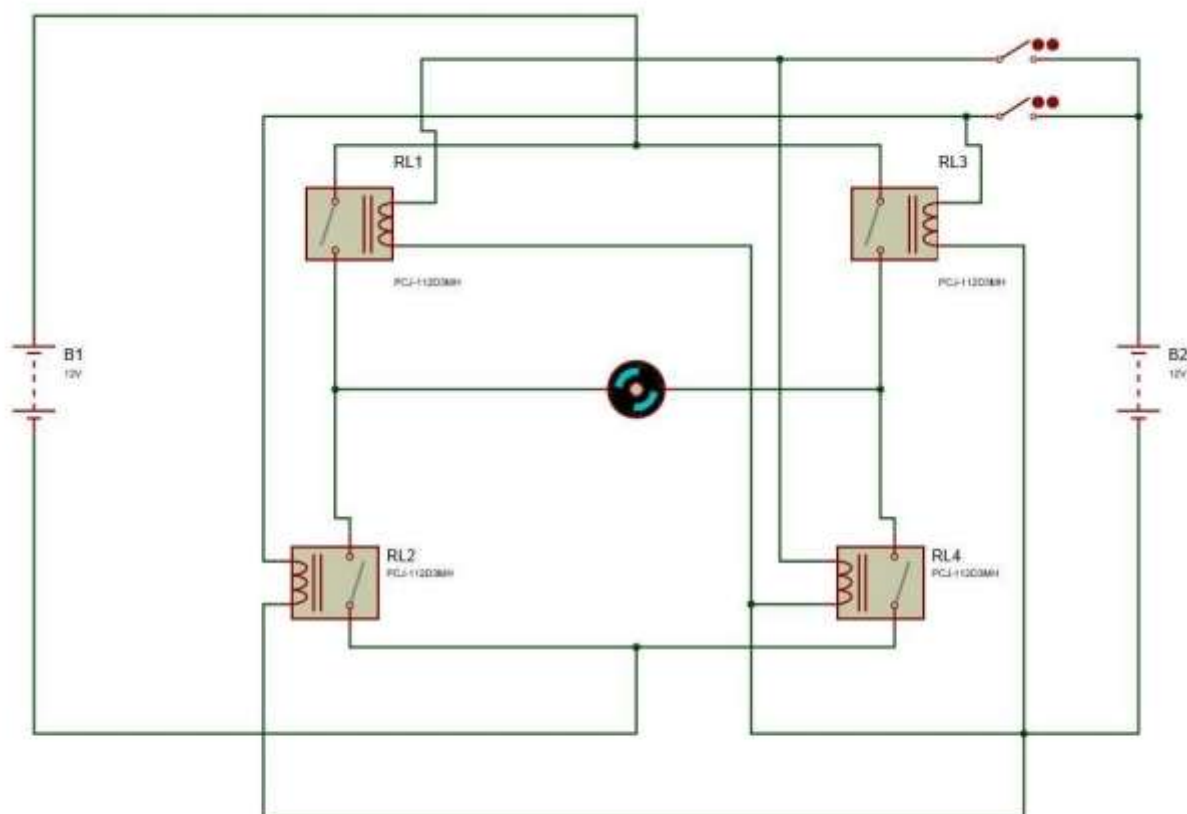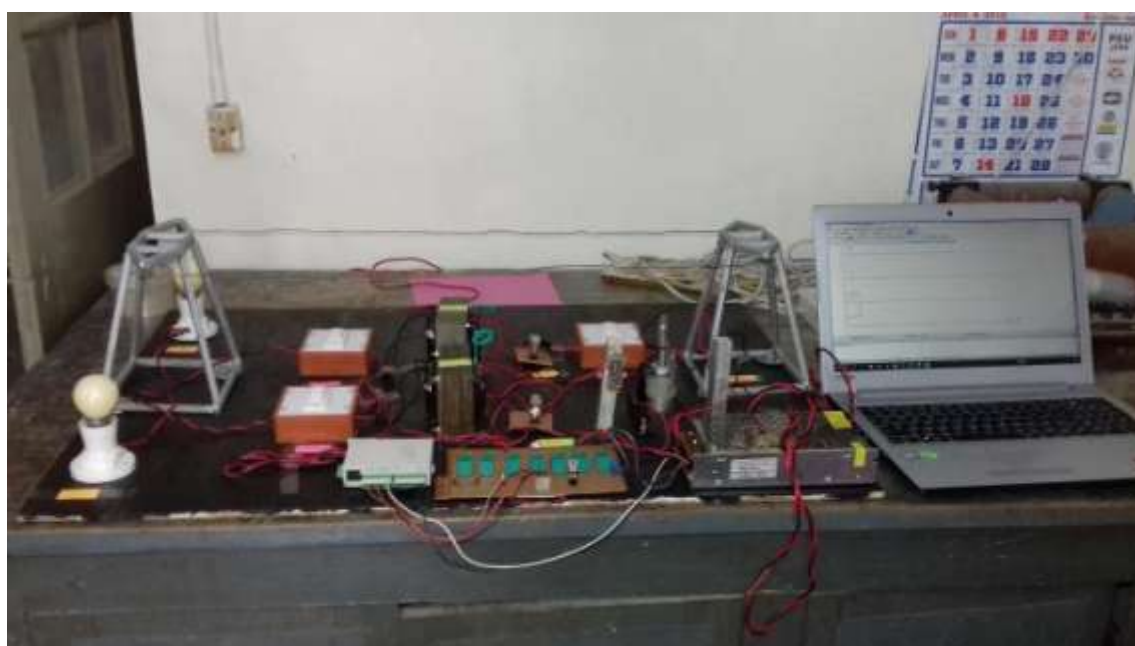**FUNCTIONAL BLOCK DIAGRAM**

Experimentaldetails:

Asshownincircuitdiagramwehavemademodeloftwotransmissionlinewithchangeoverswitch. For switching of circuit breaker and isolator was operated with relay card. Isolatorwasoperated with H-bridgeconfiguration.
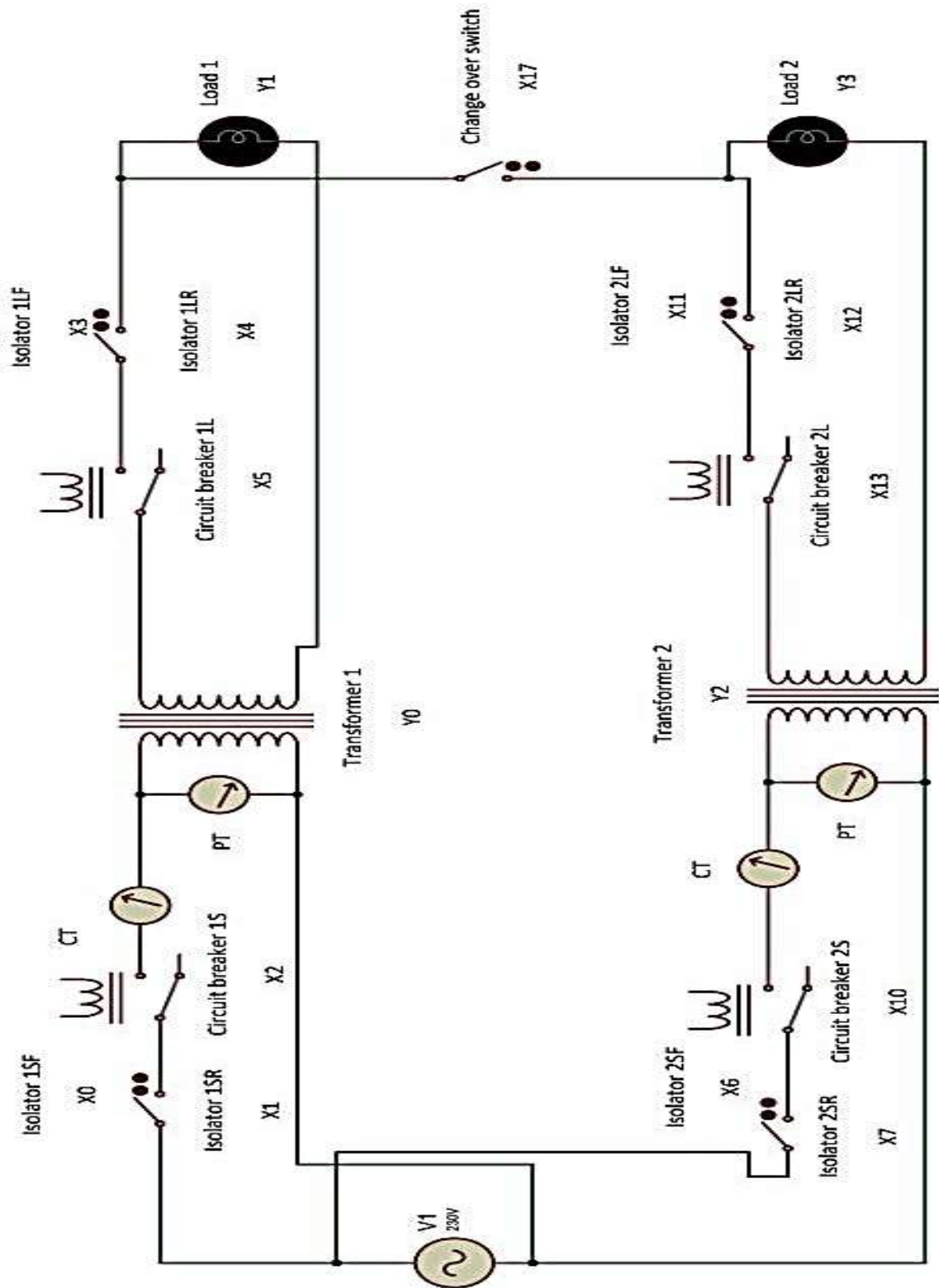
Relaycarddesignofmotoroperationforisolators

FinalModel:

This is our final model that we have made for the project. First we have two lineswe have tried to set them using only two towers. We have a SMPS which means switchmorepowersupply.ItprovidesregulatedpowertoourPLC.Oursis adeltamademodularPLC dvp14ss2. There is a relay card with 24v and 6v relays which controls the motor ofisolator and two circuit breakers and a change over switch. In the relay card there is a Hbridge connections to operate the isolator motor. It is giver power signals by the PLC wehave attached a voltage regulator because it contains some 6v relays. There is only oneautomated isolator. It can be implemented to all the four isolators. It has a motor to openand close the contacts. A switch has been put at the place of other three isolators tosymbolise the opening and closing of isolators. Two circuit breakers are there; one in eachline and relays have been used to symbolise the CB. There are two transformers and twobulbsareattached to symbolisetwo loads.

In operation mode the SMPS is connected to the power supply and it will supplypowertoallplacesnecessary.NowwegivesignalfromSCADAtoisolatormotorsoitwillrotate for the given time in the given direction and connect the circuit. Thus line one willbeON.NowifweopentheisolatorfromSCADAthecircuitwillbeopenedandloadwon'tbe supplied power. All the controlling signals are given by the PLC. Now if we want tochange load from one line to other to provide that load power because of some problem intheline wecan operatedthe changeover switch.
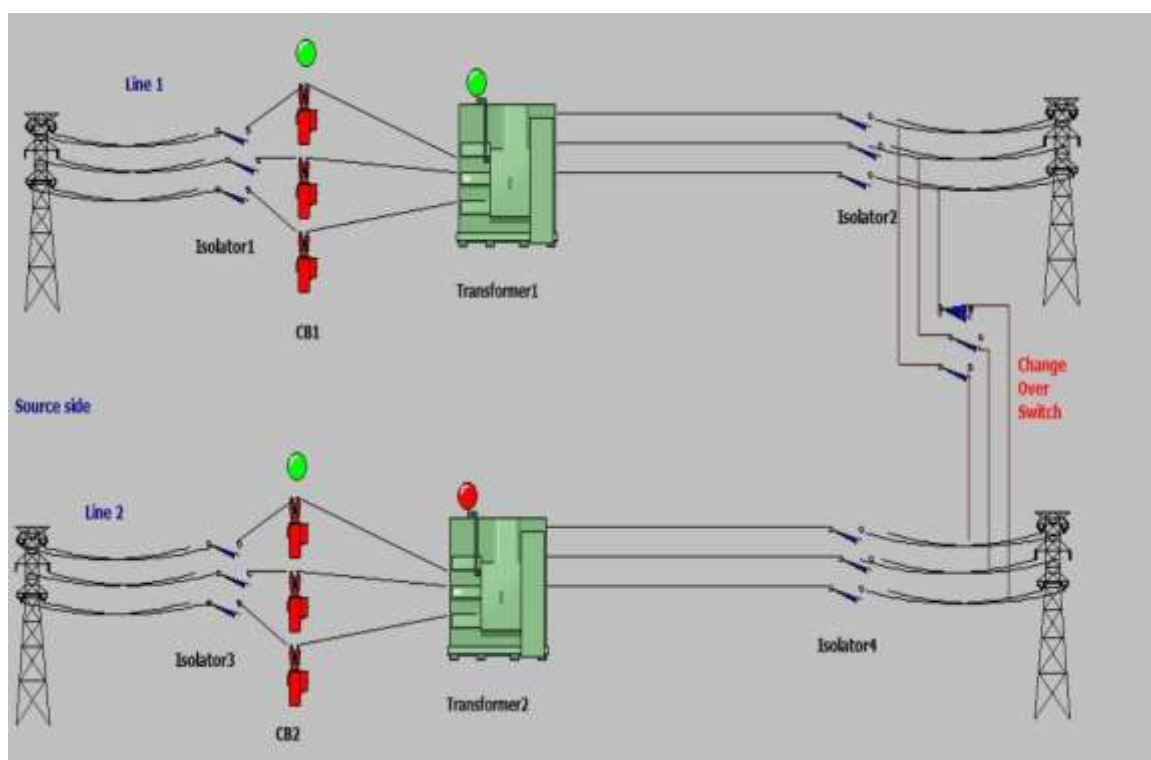
SCADAModelofSimpleTwo-lineSubstation

Conclusion:

We can see from above discussions of Substation Automation that Automation has become anessential part in designing a Substation. Automation removes human errors, automates the systemefficientlyandmoreoveratintellectualelectronicfasterdevices.PLCandSCADAaretheessentialparts of Substation Automation and every power system engineer should have knowledge of PLCand SCADA in order to satisfactorily automate the Power system/Substation. The AutomationDemonstration involved all kind of real time equipment required to properly understand the actualautomotivestructureofmodern substations. The modern substations are well equippedwithSCADA and IEDs such as PLC or RTU. SCADA HMIs are popular now-a-days which provide anexcellent human machine-interface unparalleledbyanyexistingmachineries.

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