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Automation Of Substation Using Plc And Scada

ABSTRACT
As we have adopted the concept of interconnected power system, the role of substation is become moreimportant. Substation connects generation station to the distributor or to the end consumer via transmission system depending upon the types of substation. Activities like switching of transmission lines, parameter measurement, fault detection and storing of historical data are carried out in each of the substation premises. Earlier time this all activities was carried out manually, as complexity of systemincrease the role of substation become crucial and we need to move towards the use of IEDs and Automation. 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 Programmable Logic controller and SCADA. For system monitoring or supervision data is given to controllers from RTU. Control command according to system parameter is produced by PLC and SCADA provides a human machine interference. Substation automation systems make their control and monitoring possible in real time and maximize availability, reliability and safety of the system.
Key words: Substation, PLC, SCADA, RTU.

INTRODUCTION TO SUBSTATION

A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. The word substation comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generatingplants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station.

Substation Automation

Early electrical substations required manual switching or adjustment of equipment, and manual collection of data for load, energy consumption, and abnormal events. As the complexity of distribution networks grew, it became economically necessary to automate supervision and control of substations from a centrally attended point, to allow overall coordination in case of emergenciesand to reduce operating costs. Early efforts to remote control substations used dedicated communication wires, often run alongside power circuits. Power-line carrier, microwave radio, fibre optic cables as well as dedicated wired remote control circuits have all been appliedto Supervisory Control and Data Acquisition (SCADA) for substations.

Substation automation task:

There are 3 main task of automation system

(1) Data acquisition
(2) Supervision
(3) Control

(1) Data acquisition:

Data acquisition means collecting data. The data collected from of measured current or voltage values or the open or close contact of point. Collected data can be used locally with the devise collecting it, sent to another devise in a substation, or sent from the substation to one or several data bases for use of engineers, operators, administration and planners. Data acquisition is the process of measuring physical or an electrical phenomenon such as voltage, temperature current, pressure or sound with a computer it is consists of sensors, hardware measurement, a computer with programmable software. Computer to other measuring systems pc base DAQ system has the processing power, display, productivity & connectivity. By using DAQ what data are collected is use for in so many way like continuous power supply, set the schedule of maintenance of power plants or substations also.

(2) Supervision:
Using acquired data.it is the computer process & personal monitoring or personal supervisethe conditions & status of power system by using data acquired from DAQ. The engineers & operators monitor. The information remotely on computer display & graphical small displays locally at device; on front panel display & computers.

(3) Control:
Traditional SCADA system relay on operators to supervise the system. Control another task is to integration of power system. Which is act of communicating data to, from, or among IED'S in I&C system and remote users. Integration of substation is to combining data from the IED'S local to a substation so there is a single point of contact in the substation for all I&C data.
In this whole automation task relay on data acquisition, supervision & control all are working togather.

Remote Terminal Unit (RTU):
RTU is an electronic device which used in IED which can be locate in remote location & ways asa terminal point for field contacts. A group of pair conductors which is made up of copper one used to sense every transducers value, these conductors placed at the system's device. That can transferdata from a controlling place & also control the commands from various devices.

Programmable Logic Controller (PLC):
PLC is the most important part of automation system. It will be used for logical control by programing PLC has a number of benefits for t0he Substation automation. Here are some applications for Substation automation.

- RTU emulation & replacement.
- Protection & control.
- Automatic switching.
- Voltage regulation management.
- Transformer management.
- Remote control.
- Demand control.
- Easy maintenance.
- Emergency load shedding.

Programmable Logical controlling are extremely reliable. They designed to operate over wide temperature, very high electromagnetic noise & high vibration environment. It also be used in dusty, moisture, heat, cold, etc. conditions. In large number on installed base of PLC's offers a reduced cost, readily available & low cost spare parts & PLC offers low cost solutions then traditional RTUfor SCADA system.
The type of PLC used in this is a modular one because of uncertainty in the input and output numbers. We have had access to a Delta made PLC 14SS2. This is a modular PLC. There are manyadvantages of PLC over classic controllers some of them are as follows.

Advantages of PLCs over Relay logic:

- PLCs are programmable.
- Many control relays can be replaced by software, which means less hardware failure.
- It is easier to make changes in software than in hardware.
- Special functions such as time delay actions, counters are easy to produce in software.
- Reliability is more.
- There is almost no task limit to tasks for which PLCs can be used. – It is cost effective control system

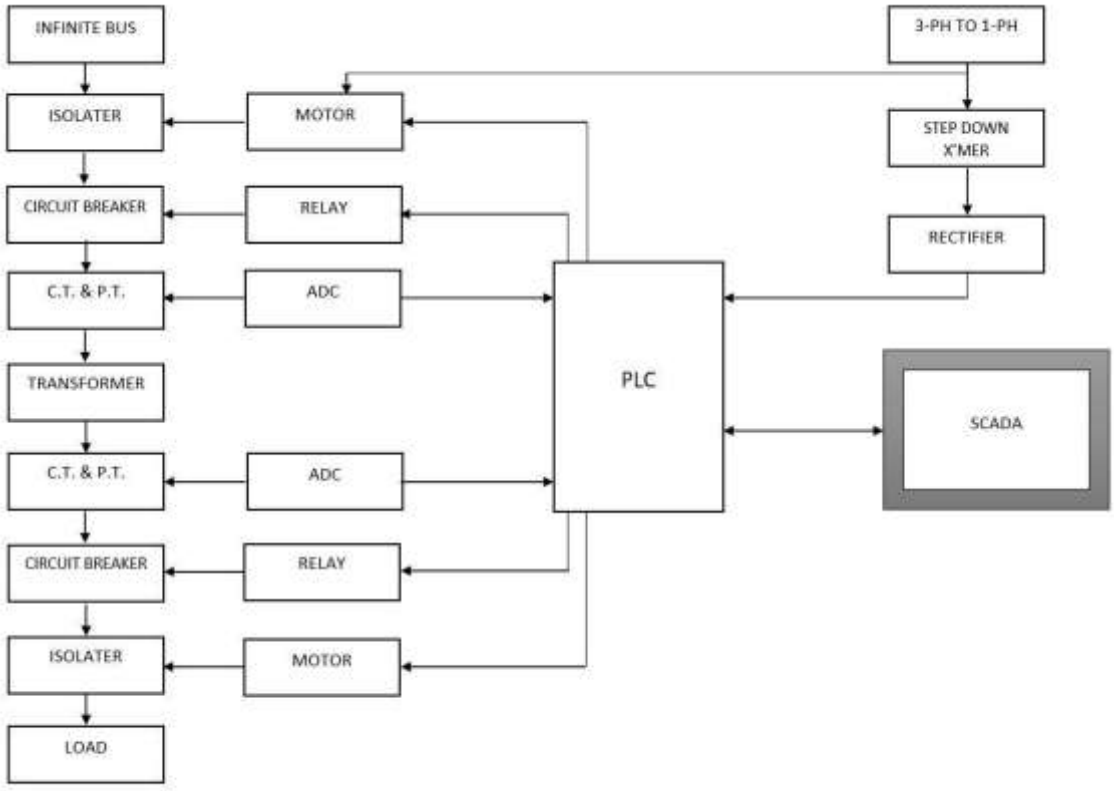
Supervisory Control & Data Acquisition (SCADA):
In SCADA system transmit & receives logic or data from any events of controls metering measuringdo monitoring of process devices for example electric equipment, instrumentation devices, telecommunication on industrial applications. It is also used for safety or protection purpose. In power system by using SCADA entire power plant can be controlled remotely over long-distance communication links. SCADA also be used for remote switching, telemetering of grids like showing voltage, current, power, direction, consumption in KWH, even automatic synchronizationis used in some power systems.
SCADA could be comprising an operator work station (OWS) with a local human machine interfacefor 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 also with the generating stations.

By using SCADA there are so many benefits in the Substations are as follows:-

- Proper & accurate measurement done by collecting accurate data of load consumption. Wecan for cast the load demand.
- It has reliable & robustness.
- Improve product quality.
- Reduce your operating & maintenance costs.
- Integrate with your business systems and preserve your capital investment.

Block diagram:

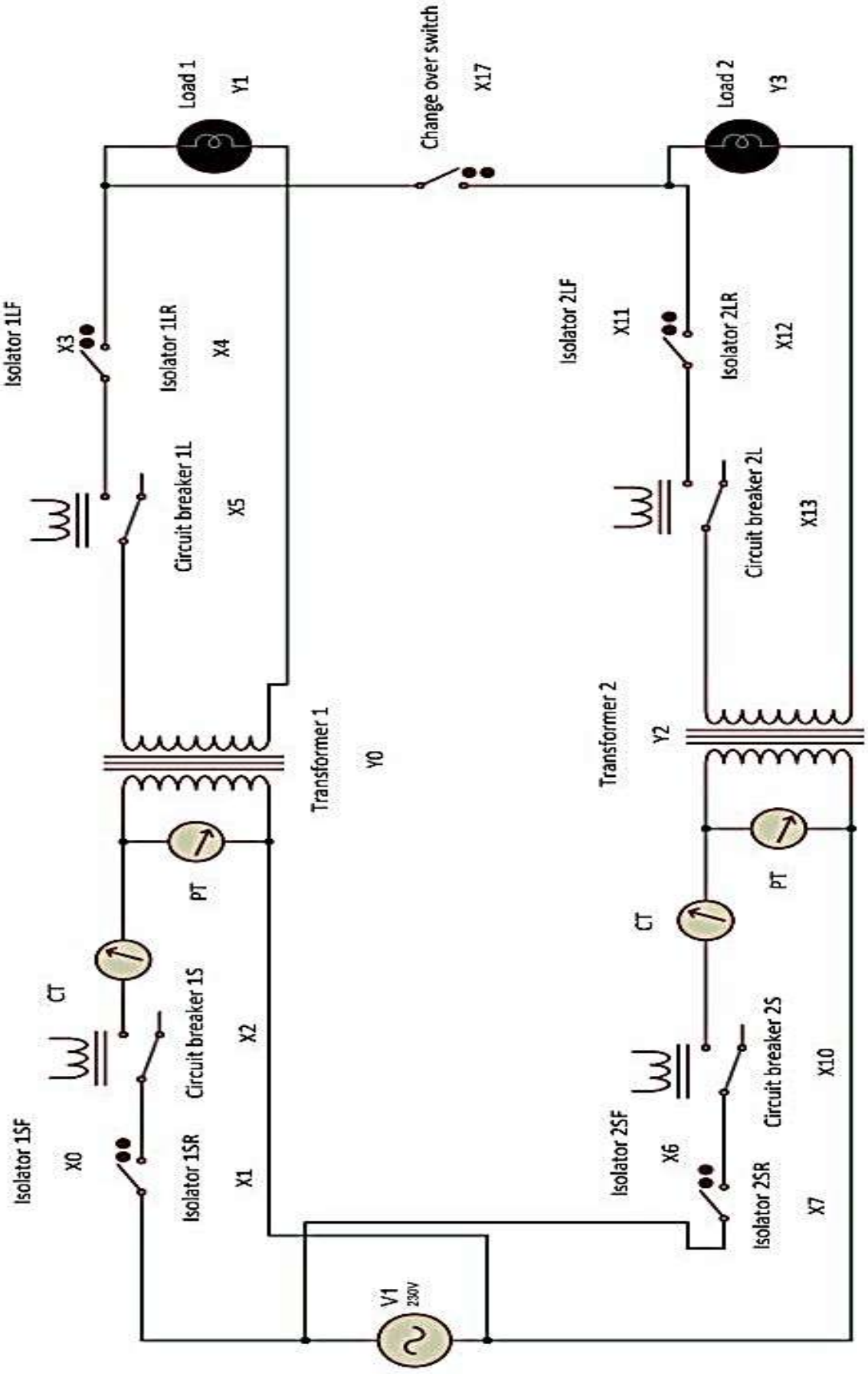
In substation the switching of lines are done on the basis of current and voltage limit. As shown in diagram the current and voltage on both the side of transformer will convert in measureable range with the help of CT and PT, than it will convert in digital form with thehelp of analog to digital converter. That digital signal will use as an input to PLC. PLC willcompare standard reference with input signal of CT and PT. if any predefine limit gets violated than accordance switching signals for switching of lines given to switching of circuit breaker and isolators.

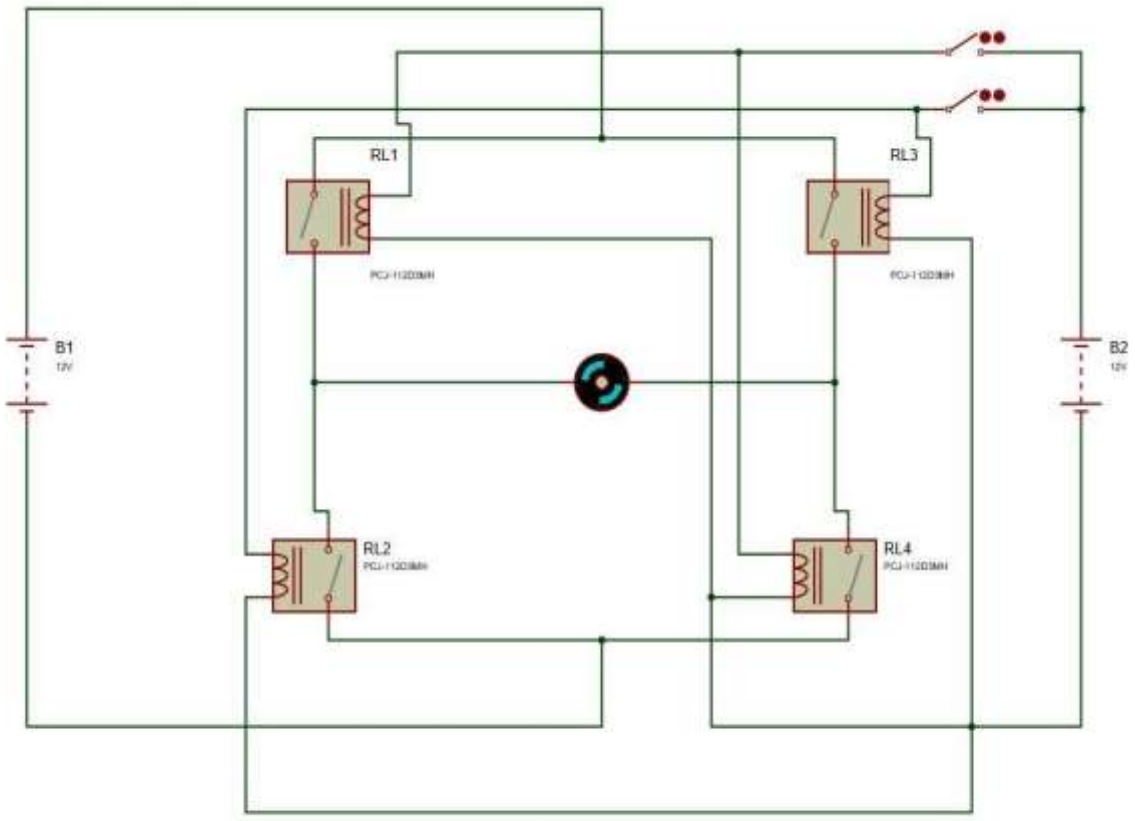


FUNCTIONAL BLOCK DIAGRAM

Experimental details:

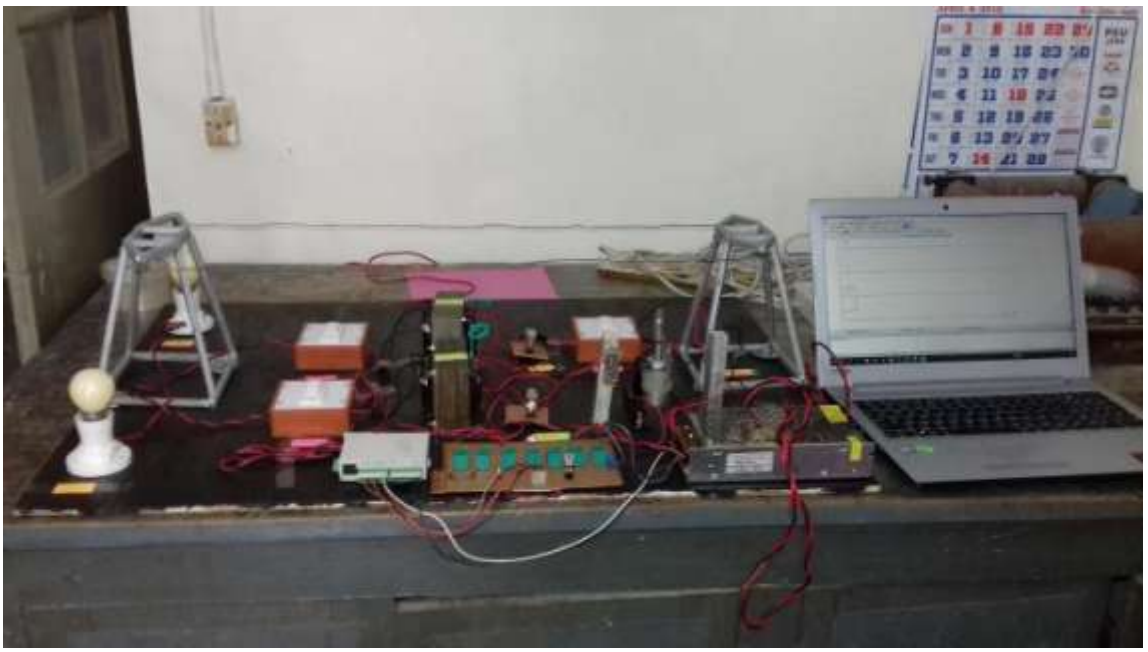
As shown in circuit diagram we have made model of two transmission line with changeoverswitch. For switching of circuit breaker and isolator was operated with relay card. Isolatorwas operated with H-bridge configuration.


Load 1
Y1
Change over switch
X17
Load 2
Y3
Isolator 1LF
X3
Isolator 1LR
X4
Isolator 2LF
X11
Isolator 2LR
X12
Circuit breaker 1L
X5
Circuit breaker 2L
X13
Transformer 1
Y0
Transformer 2
Y2
PT
PT
CT
CT
Isolator 1SF
X0
Isolator 1SR
X1
Circuit breaker 1S
X2
Isolator 2SF
X6
Isolator 2SR
X7
Circuit breaker 2S
X10
V1
230V



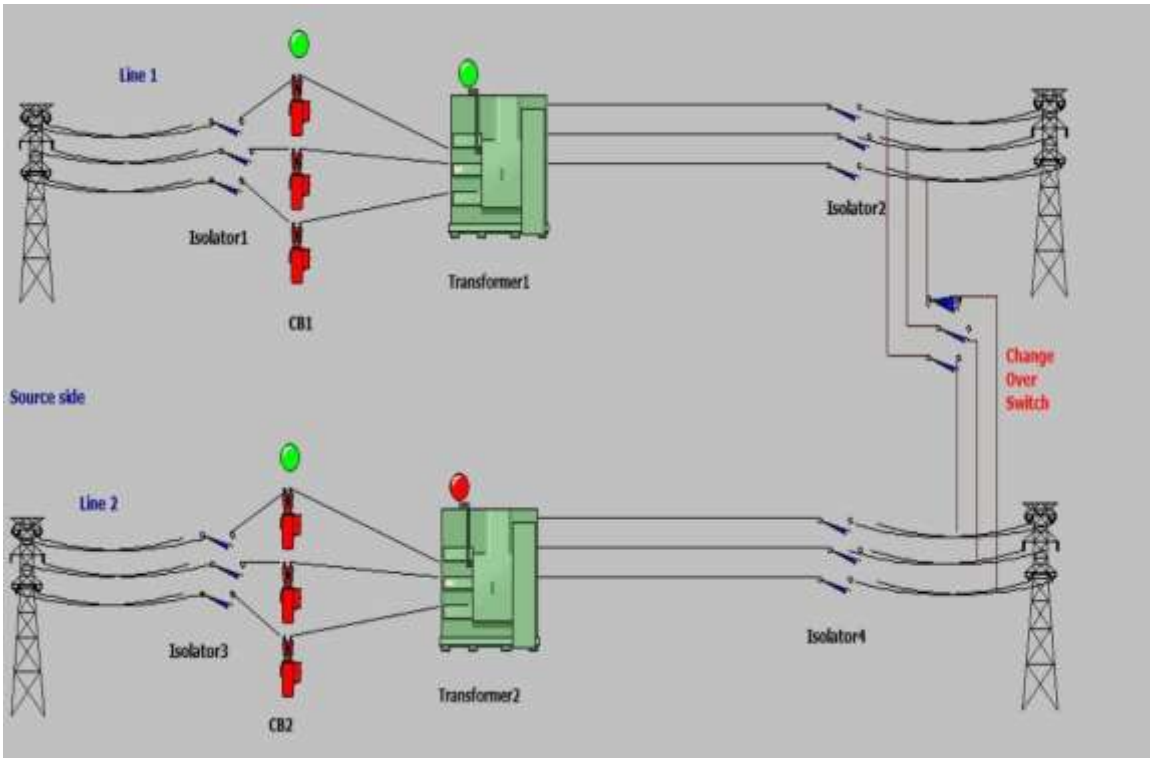
Relay card design of motor operation for

Final Model:



This is our final model that we have made for the project. First we have two lines we have tried to set them using only two towers. We have a SMPS which means switch more power supply. It provides regulated power to our PLC. Ours is a delta made modular PLC dvp14ss2. There is a relay card with 24v and 6v relays which controls the motor of isolator and two circuit breakers and a change over switch. In the relay card there is a H bridge connections to operate the isolator motor. It is giver power signals by the PLC we have attached a voltage regulator because it contains some 6v relays. There is only one automated isolator. It can be implemented to all the four isolators. It has a motor to open and close the contacts. A switch has been put at the place of other three isolators to symbolise the opening and closing of isolators. Two circuit breakers are there; one in each line and relays have been used to symbolise the CB. There are two transformers and two bulbs are attached to symbolise two loads.

In operation mode the SMPS is connected to the power supply and it will supply power to all places necessary. Now we give signal from SCADA to isolator motor so it will rotate for the given time in the given direction and connect the circuit. Thus line one will be ON. Now if we open the isolator from SCADA the circuit will be opened and load won't be supplied power. All the controlling signals are given by the PLC. Now if we want to change load from one line to other to provide that load power because of some problem in the line we can operated the changeover switch.



SCADA Model of Simple Two-line Substation

CONCLUSION:

We can see from above discussions of Substation Automation that Automation has become an essential part in designing a Substation. Automation removes human errors, automates the system efficiently and moreover at intellectual electronic faster devices. PLC and SCADA are the essentialparts of Substation Automation and every power system engineer should have knowledge of PLC and SCADA in order to satisfactorily automate the Power system/Substation. The Automation Demonstration involved all kind of real time equipment required to properly understand the actual automotive structure of modern substations. The modern substations are well equipped with SCADA and IEDs such as PLC or RTU. SCADA HMIs are popular now-a-days which provide anexcellent human machine-interface unparalleled by any existing machineries.

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