Substation Automation Using Plc and Scada

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Abstract- *Electrical power systems are a technical wonder. Electricity and its accessibility are the greatest engineering achievements of the 20th century. A modern society cannot exist without electricity. Smaller power systems (called regional grids) are interconnected to form a larger network called national grid, in which power is exchanged between different areas depending upon surplus and deficiency. The system needs to operate in such a way that the losses and in turn the cost of production are minimum. This paper discusses construction and testing of a scaled down model of a substation using SCADA (Supervisory Control And Data Acquisition) and PLC(Programmable Logic Controller) . The model fills in as a testing stage for leading different automation tests like unscheduled load shedding, time based load shedding, over voltage insurance and so forth. Our Project utilizes Wireless correspondence (by means of. WIFI) amongst PLC and SCADA which enables us to control the PLC and deal with the heap from long separations. Exchanging between the load lines of substation automatically and manually to give consistent power supply is the point of our venture.*

Keywords- SCADA software, Programmable logic controller(PLC), Over Voltage, Voltage, Unscheduled Load shedding, Time Based Load Shedding, Wi-Fi

I. INTRODUCTION

The essential thought behind substation control venture is to screen the switchyards in a substation. In a substation, numerous relays and circuit breakers are utilized. When anyone breaker is trip due to the issues, we can screen and control through SCADA windows. The electric supply is the most complex framework, so effectiveness and dependable activity is a noteworthy concern. Power system mechanization is the demonstration of automatically controlling the power framework by means of instrumentation and control gadgets. Load shedding is a major problem in today's world of Smart City and Digital India. If the electricity is not present in the area then our day-to-day tasks get affected by it. In some areas supply lines get broke or cut due rain, storms, winds etc. and other natural calamities. During emergency we need to quickly restore the power supply in these areas but due to lack of alternate supply line it's not possible. Our project aims to reduce this problem by making a switch from the faulty line to an alternate line in order to maintain a constant supply to the field. The fault in the line is detected by CT (current transformer) which is a sensor which shows the value of current in the line which is displayed on the SCADA screen. When the fault is detected we can either switch to an alternate line or inspect the site find the fault and then restore the supply. Switching to an alternate line can be done through SCADA or toggle switches. PLC acts as a controller and an interface between the field situations and SCADA. Many times RTU's (Remote Terminal Unit) are preferred over PLC's but as the cost of RTU is very high than that of PLC we have considered using PLC in our project.

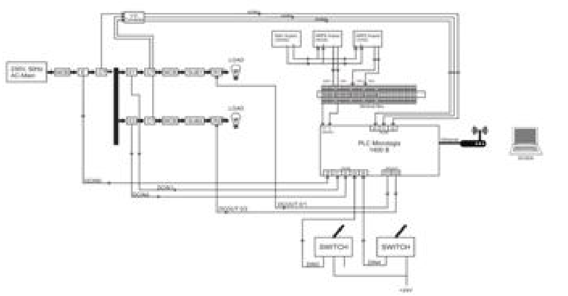
II. LITERATURE SURVEY

Jafary and Seppälä [1] proposed that Substation automation systems provide high level of automation for both substation and distribution network. Communication in modern substation automation systems is based on Ethernet, TCP/IP and interoperable protocols within standard network infrastructure. Communication security and unwavering quality wind up imperative and must be considered to guarantee to adjust the activity of substation mechanization frameworks.This paper described an experimental lab setup with three goals: modelling a modern substation with three logical levels, applying IEC 61850 data communication in all the levels, and substation local and remote monitoring. However this method requires more number of parameters to improve the performance. Kanakasabapathy et al [2] proposed construction and testing of a scaled down model of 33 kV substation using SCADA (Supervisory Control And Data Acquisition). The model functions as a testing stage for directing different sorts of computerization tests like unscheduled load shedding, time-based load shedding, overvoltage insurance and so on.The prototype model of the substation provides a robust platform for testing and automating various experiments. This can be used for performing load flow studies, fault analysis including stability analysis, before practically implementing in the system. It can also be used as a testing platform for performing vulnerability studies on SCADA used in networked substations where the risk of communication mismatch might happen due to cyber-attacks on the SCADA software.

MusseMohamud Ahmed [3] proposed a new supervisory control and data acquisition (SCADA) based fault isolation system on the low voltage (415/240 V) distribution system. The commitment of this research incorporates building up an entire fault separation calculation in light of an open loop distribution system as TNB dispersion is an open loop distribution type. However this technique there's a difficulty of configuration working in SCADA and executing it, the procedure of HMI is likewise basic to actualize.

Dahal and Cheten [6] proposed Power utilities, as a standard, adopt Supervisory Control and Data Acquisition (SCADA) systems for efficient power system operation, maintenance and development. The automation systems (viz. SCADA) need exibility in design and its maintenance, for utilities to leverage maximum benefit apart from possibilities of being vendor locked. The data acquisition and storage functions as envisaged for substation monitoring application on an open platform were achieved with the RTU reporting to the OPC server. However this system uses RTU which is very expensive to implement.

III. METHODOLOGY



i. There are three MCB's used in order to protect the circuit from the faults that occur due to variations in the power supply.
ii. After the MCB the next section is the emergency switches. When these switches are pressed, manual fault is generated and therefore the first substation will get disconnected but still the supply continuous to flow through the second substation.
iii. During this switching also the load is still continuously getting the supply through any one of the substation.
iv. Along with these switches three current transformers (CTs) are also installed one near the main supply and the other two near the substation. This circuit can be handled by software or manually as well, for this manual control two toggle switches are interfaced with the PLC. The output ratings of CT is 0 to 5mA.
v. The output of CT is given to I to V box i.e. current to voltage converter because PLC can read only voltage values.The output voltage of operational amplifier is directly proportional to the current given to the inverting terminal of the op-amp.Therefore the current ratings are changed into voltage ratings scaling from 0 to 10mV.
vi. The next section is the interfacing between PLC and SCADA through WIFI via router and for this connection an Ethernet cable is used. The current ratings of the CTs are displayed on the SCADA screen. For communicating between PLC and SCADA RSLinx Classic is used in which when the IP address of the PLC is visible that means the PLC is communicated with the circuit.

IV. HARDWARE AND SOFTWARE

PROGRAMMABLE LOGIC CONTROL (PLC)

A Programmable Logic Controller is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a ladder program to control output devices. The Allen-Bradley RSLogix 1400b from Rockwell Automation complements the existing RSLogixfamily of small programmable logic controllers. RSLogix 1400b has features such as Ethernet/IP, online editing, and a built-in LCD, plus provides you with enhanced features, such as: higher I/O count, faster High Speed Counter/PTO and enhance network capabilities.For operating PLC various programming languages are used out of which Ladder Logic (LAD) is selected as the best and compatible language for automation of substation with minimum number of commands and gives greater accuracy. Biggest comfort in using a PLC is the ability to change and reproduce the operation or process while collecting and communicating crucial information. Here Allen Bradley PLC is used for controlling g the substation model. For building the ladder diagram RSLogix 1400b is used.

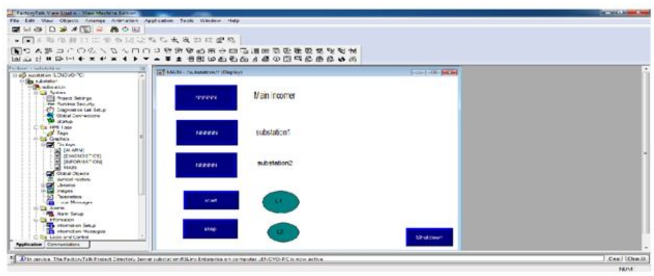
MINIATURE CIRCUIT BREAKER (MCB)

An MCB is normally used when excessive current is flowing through the circuit. When the current level in the circuit increases the MCB trips and when the circuit returns to normal it goes back to its initial condition. MCBs are fundamentally used as a substitute to the fuse switch in most of the circuits. These days distinctive sorts of MCBs are as of late been utilized with breaking limit of 10KA to 16 KA, in different fields, for example, household, business and modern applications for assurance and security reason.An MCB or miniature circuit breaker is an electromagnetic device that demonstrates complete enclosure in a sculpted insulating material. The main motive of using an MCB is to switch the circuit, i.e., to open the circuit automatically (to which the MCB is connected) when the current passing through it exceeds the specified value. It can be manually switched ON and OFF as compared to normal switch if needed. MCBs are of time delay tripping devices, to which the relevance of overcurrent manages the operating time .Therefore MCBs do not react to transient loads such as switches surges and motor starting currents. They are constructed to operate at less than 2.5 milliseconds during short circuit faults and 2 seconds to 2 minutes in case of overloads (depending on the level of current).

EMERGENCY STOP SWITCHES (E-STOP SWITCH)

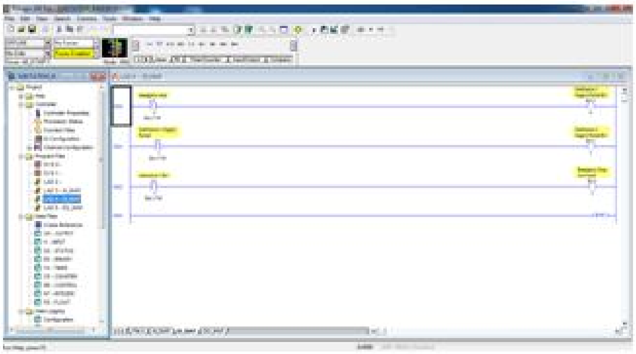
Emergency stop switches, also called as E-Stops, assures the safety of an individual and the machinery and contribute a persistent, predictable, reliant control response. An extensive range of electrical machinery must have these particular switch controls for emergency shutdown in order to prevent any hazard that might take place in the workspace. E-Stops are analytical human machine interface (HMI) devices that differ from normal stop switches (that only turns off the equipment) in that they offer "foolproof" equipment shutdown. This is honed through driving switch plan that requires a turn, draw, or key to discharge electrical contacts that enable the apparatus to execute their work. E-Stops are conventionally designed for reliable operation so the stop command has superiority over the sustaining function. This has led to contemporary switch designs that prevent blocking and exasperating. Several switch companies in the market are developing new remedies to the complication that emerges when contact block and actuator are inadequately equipped or even abstracted because of vibration or any other impairment

SUPERVISORY CONTROL AND DATA ACQUISITION



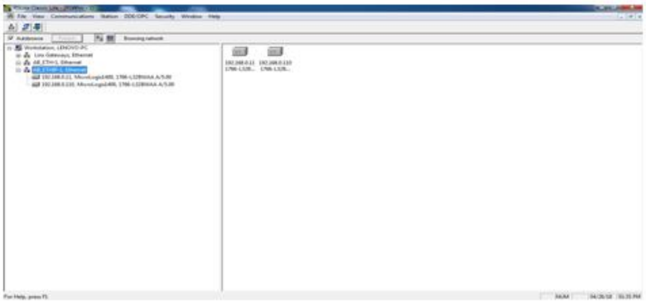
The amalgamation of telemetry and data acquisition is referred to as SCADA (Supervisory Control and Data Acquisition system). The main elements used in SCADA will be supervisory computers that are responsible for accepting the data processing it and forwarding to further controllers, Remote Terminal Unit (RTU), Programmable Logic Controller(PLC) which are used for developing the logic by building ladder logic diagram which can be modified as per the working of the process, Human Machine Interface(HMI) is basically the window through which the operator can interface with the plant and on this screen the complete graphical representation the plant is visible because of which the further happenings of the process can be easily predicted. For this the software required is factorytalk view in which the application i.e. the program is to be made and based on that instructions the working will be implemented.

RSLOGIX 500



In RSlogix, the logic is built as a ladder diagram and it is downloaded in PLC.RSLogix 500 was the principal PLC programming that offered powerful efficiency with a mechanical driving UI.

RSLINX CLASSIC



It is software that communicates PLC with SCADA window which is developed laptop screen. The data received by the PLC is transferred to the SCADA system wirelessly via a router. For the transferring data, the driver needs to be configured. A ladder logic diagram for monitoring three analogue signals is developed. Among them, three analogue signals are from current transformers of outgoing feeders and one analogue signal is from potential transformer of low voltage side bus. The major faults that occur in most substations are symmetrical faults, unsymmetrical faults, over-voltage, over current and overloading etc. Practically these currents did not meet the required current ratings of the PLC. Hence these faults were not implemented in the constructed model of the substation.

FACTORYTALK VIEW STUDIO

Factory Talk View Studio is configuration software for developing machine-level applications. This software runs on Windows 7 SP1, Windows 8, Windows 8.1, Windows 10, Windows Server 2008 R2 SP1, and Windows Server 2012 operating systems. An application is the software application you create in FactoryTalk View Studio to monitor and control your plant processes. An application comprises of at least one information servers and a HMI venture (otherwise called a HMI server). The data servers provide communications for the project. The project or HMI server comprises of graphic displays, alert data, client data, and different settings.

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VI. CONLUSION

The prototype model of the substation provides a robust platform for testing and automating various experiments. Thiscan be used for managing load variations, fault analysis including substantiality analysis, before actually implementing the system. It can also be used as a testing platform for performing accountability studies on SCADA where the risk of communication imbalance might happen due to virtual-attacks on the SCADA software. The impact of data transmission discrepancy between the PLC and the field devices can also be tested using the testing platform. The substation model is built in a fiscal manner with required monitoring and control over the entire system.The dependability analysis of various dynamic appliances like electric bulbs, generators can be performed on the testing platform by connecting different types of loads. The provision for the occurrence of faults is given in the form of E-stop switches in the system helps in analysing the occurrence of faults that generally occur in substations. These faults can be tranquilized and the system can be restored as before by providing proper control logics in automation within time, based on the harshness of the problem. The SCADA substation platform can be also be used for monitoring and regulating, in order to give a hand on experience on SCADA systems and construction of substation.

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