Substation Fault Monitoring and Controlling using PLC and HMI

Bhushan Keda Ahire, Swapnil Shankar Bhagvat , Pooja Kishor Akole, Trupti Tanaji Pagar
Department Of Electrical Engineering
Sandip Institute of Engineering and Management, Nashik

Abstract- In this paper the use of PLC & HMI in substation for the purpose of monitoring & controlling. At the substation the power is managed between the generator set and main incoming supply. As the use of PLC in the substation automation application increases and the demand for substation and distribution automation increases .Utility engineers are seeking way to implement applications. PLC on the other hand is like the brain of the system with the joint operation of PLC & HMI ,it is possible to control and operate the power system remotely .The task like opening of CB, changing transformer taps & managing the load demand can be carried out efficiently.

Keywords- *Programmable Logic Controller, Current Transformer, Potential Transformer, Circuit Breaker, relay action.*

I. INTRODUCTION

The idea of distribution Automation began in 1970s. The motivation at that time was to use the evolving computer and communications technology to improve operating performance of distribution system.

Distribution automation also provides many intangible benefits which should be given consideration while deciding for implementation of distribution automation. After the deregulation and restructuring issues are settled, distribution automation activities should increase. The economic growth and development of a country depends heavily on the reliability and quality of power supply. Generally, rigorous planning is done for the addition of the generation and expansion of transmission network. However, the distribution system have generally grown in an unplanned manner resulting in high technical and commercial losses in addition to poor quality of power.

Substation automation can be defined as system for managing, controlling, and protecting a power system. This is accomplished by obtaining real time information from the system having powerful local and remote control application and advance electrical protection. The core ingredients of a substation automation system are local intelligence, data communications and supervisory control and monitoring.

II. EXISTING SYSTEM DESRIPTION

a) *Existing Monitoring Systems*- A standalone equipment monitoring system centrally calculates information from numerous pieces of data received from sensors installed in the field to verify the actual conditions of the equipment and predict the need for maintenance using preprogrammed analysis.

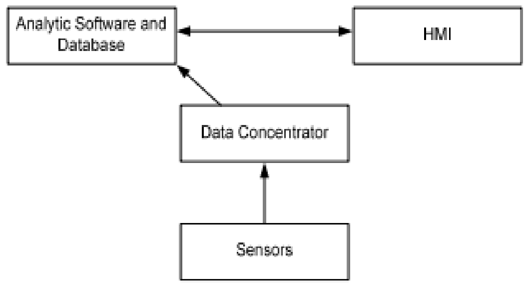

Fig. 1 Conventional Monitoring System

The basic structure of this system is illustrated in. Conventional monitoring system Sensors collect the quantities in the field, process the signals, and send them to a data concentrator unit. Normally, the sensors installed are potential transformers (PTs), current transformers (CTs), resistance temperature devices (RTDs), moisture sensors, position sensors, signal transducers, and so on. In order to concentrate the data into a single location within the substation, data collectors such as remote terminal units (RTUs), programmable logic controllers, industrial computers, data acquisition modules, and other devices are used. After collection and concentration, the data are sent to a relational database. Analytic software uses algorithms that process the received data, define the actual situation of the monitored equipment, and estimate a time interval until the next maintenance action.

The human-machine interface (HMI) allows the user to visualize the treated and stored data using the analytic software. However, conventional monitoring systems require installation of new, specialized equipment and sensors and a specific communications network for this data traffic. Also, they fail to take advantage of the existing SAS communications network and the equipment monitoring information already being calculated within the PCM IEDs.

b) *Needs of Distribution Automation*

The economic growth and development of a country depends heavily on the reliability and quality of the electric power supply. Generally, rigorous planning is done for the addition of the generation and expansion of the transmission generally grown in an unplanned manner resulting in high technical and commercial losses in addition to poor quality of power.

Efficient operation and maintenance of distribution system are hampered by non-availability of system topological information, current health information of the distribution Components such as distribution transformers and feeders, historical data etc. Other reasons include the lack of efficient tools for operational planning and advanced methodology for- quick fault detection, isolation, and service restoration, etc.

All these lead to the increased system losses, poor quality and reliability of power supply in addition to the increased peak demand and poor return of revenue.

Keeping the above problems in mind, it becomes necessary to improve the operation of distribution systems and hence the quality of power supply. This can be achieved by use of better methods, proper monitoring and control of the distribution system. In view of the extensive size of the network, this task can be effectively achieved through the intervention of information technology (IT) utilizing the available high speed computers and communication networks. This system of monitoring and control of electric power distribution networks is also called as the Distribution Automation System. IEEE has defined Distribution Automation (DA) system as a system that enables an electric utility to remotely monitor, coordinate and operate distribution components, in a real-time mode from remote locations.

Distribution Automation System encompasses data acquisition, telemetry and decision making system. It involves collecting information, transferring it to a DCC, displaying the information and carrying out analysis for control decisions and improvement in system operation.

c) Challenges of Distribution Automation

The key technical challenges for distribution automation functions include the following: Electronic equipment: Electronic equipment covers all field equipment which is computer- based or microprocessor-based, including controllers, remote terminal units (RTUs), intelligent electronic devices (IEDs), laptops used in the field, handheld devices, data concentrators, etc. It can include the actual power equipment, such as switches, capacitor banks, or breakers, since often the power equipment and its controller electronic equipment are packaged together, but the main emphasis is on the control and information aspects of the equipment.

III. CURRENT COMMUNICATION SYSTEMS

Communication systems cover not only the media (e.g. fiber optic, microwave, GPRS, multiple-address radio (MAS), satellite, WiFi, twisted pair wires, etc.), but also the different types of communication protocols (e.g. Ethernet, TCP/IP, DNP, IEC 61850, IEC 61850-lite for narrow band, Web Services, VPNs, etc.). It also addresses communications cyber security issues.

a) Data management: Data management covers all aspects of collecting, analyzing, storing, and providing data to users and applications, including the issues of data identification, validation, accuracy, and updating, time-tagging, consistency across databases, etc. Often data management methods which work well for small amounts of data can fail or become too burdensome for large amounts of data – a situation common in distribution automation and customer information.

b) Systems integration: System integration covers the networking and exchanges of information among multiple disparate systems. The key issues include interoperability of interconnected systems, cyber security, access control, data identity across systems, messaging protocols, etc.

c) Software applications: IT applications cover the programs, algorithms, calculations, data analysis, and other software that provides additional capabilities to distribution automation. These software applications can be in electronic equipment, in control center systems, in laptops, in handhelds, or in any other computer-based system.

It is clearly recognized that "financial challenges" as well "regulatory and legal challenges" play key roles in determining the cost-benefit of any particular distribution automation function. Assessing the importance of these financial challenges can be very difficult since they can be vastly different for different utilities, the technologies are changing so rapidly that any assessment is obsolete almost before it is stated, and often the costs are directly associated with particular regulatory and tariff environments.

.

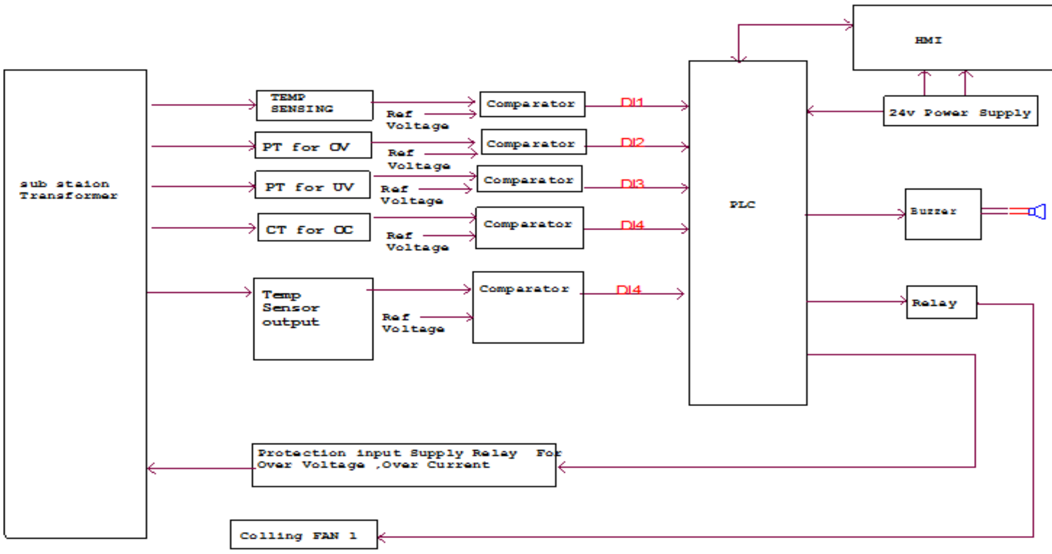

Fig 2- Block diagram of PLC and HMI base monitoring and controlling circuit

IV. DISTRIBUTION AUTOMATION SCENARIOS

In this paper, the Distribution Automation Scenarios briefly describe their purpose, and then point to the primary and secondary DA functions that are needed to meet those purposes. The following is the list of selected DA scenarios described in the report: 1. Basic Reliability Scenario – Local Automated Switching for Fault Handling. Each of the Distribution Automation Scenarios focuses on specific purposes that distribution automation may be used for. The supporting Primary and Secondary DA functions provide the details of how those purposes may be met.

a) Monitoring and controlling circuit.

Programmable Logic Controllers (PLCs), also referred to as programmable controllers, are in the computer family. They are used in commercial and industrial applications. A PLC monitors inputs, makes decisions based on its program, and controls outputs to automate a process or machine. This course is meant to supply us with basic information on the functions and configurations of PLCs. A PLC is user-friendly microprocessor-based specialized computer that carries out control functions of many types and levels of complexity. Its purpose is to monitor crucial process parameters and adjust process operations accordingly. It can be programmed controlled, and operated by a person unskilled in operating computers, but, who is, nonetheless, PLC-literate.

b) Description:

In electrical system there are many kind of devices are connected these devices are for controlling purpose of the electrical system. If any fault is generated in system let us say the line-line fault due to which the current exceeds at unspecified limit which is overcurrent. This current flows in opposite direction which is harmful to the substation equipment. To overcome it in less time we use current transformer as a sensing device. The current transformer give signal to PLC and HMI displays the fault on screen PLC gives command to relay to operate circuit breaker on the path of fault current.

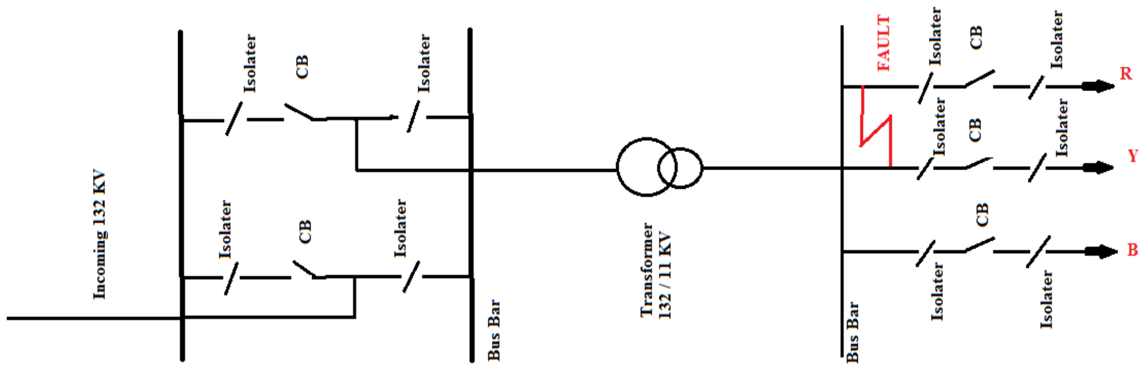

Fig 3 System Line Diagram – A faulty power line

V. CONCLUSION

The use of PLCs in Substation and Distribution Automation application has grown in recent years. Many Technical issues affect the cost benefit analysis of implementing different type of distribution automation system however this technology for meeting those equipment have key challenge to implementing automation. Time required to operate is 50% less than existing Electromechanical system, life span of this system is more than electromechanical system, as this system has static devices so Maintenance cost is very less than existing electromechanical system.

VI. REFERENCE

[1] IEC 61850: Communication Network and System in Substation, Part 1, August 2003.

[2] K.N. Clinard "Comparison of IEC 61850 and UCA 2.0 data models" in Proceedings of IEEE Power Engineering Society Summer Meeting, Volume 1, July 21-25 2002 pp 289-290.

[3] Holger Schubert and Gordon Wong, "IEC 61850- The Way to Seamless Communication in Substations", in the proceedings of the 3rd IASTE International Conference on Power and Energy System, Sep. 3-5 2003pp 252- 256.

[4] IEC 61850: Basic communication structure for substation and feeder Equipment – Compatible logical node classes IEC 61850-7-4.

[5] IEC 61850: Basic communication structure for substation and feeder Equipment – Common data classes IEC 61850-7-3.

[6] B. Shephard, M.C. Jannssen, H. Schubert "Standard Communication in Substation", in proceedings Seventh International Conference on Power System Protection, April 9-12 2001, pp 270—274

[7] R.P. Gupta N. Srivastava, "Substation Automation Communication Protocol" in the proceedings of ICSCI 2004 vol. 1, Feb. 12-15 2004, pp 499- 503.

[8] R.P. Gupta, M. Pandey and N. Srivastava, "Data Communication Architecture using IEC 61850 Protocol for Substation Automation", The proceedings of International Conference on Distribution India 1, April 15-16 2004, pp 113-121.