IDEA OF POWER SYSTEM AUTOMATION

Deepak Jangid,Parveen Kumar Choudhary and MohitRathi
B.Tech Students, Department of Electrical Engineering, SLBS Jodhpur
djangid171998@gmmail.comroyalpkc121@gmail.commohit.rathi9723@gmail.com

***Abstract*—Power providers continuously face problems to reduce costs and improve productivity. Therefore steps are taken to make smarter devices that can collect and communicate information. Automation is defined as the usage of machines thus eliminating human efforts to finish a task. It helps in improving overall system productivity and the time needed to do a task is reduced. Power system Automation can be defined as managing, protecting and controlling an electrical power system. Real time information is obtained from systems having local and remote control applications with advanced power system protection. This paper deals with the types, component, architecture, advantage and disadvantages of Power system automation. This paper also include the working of scada.**

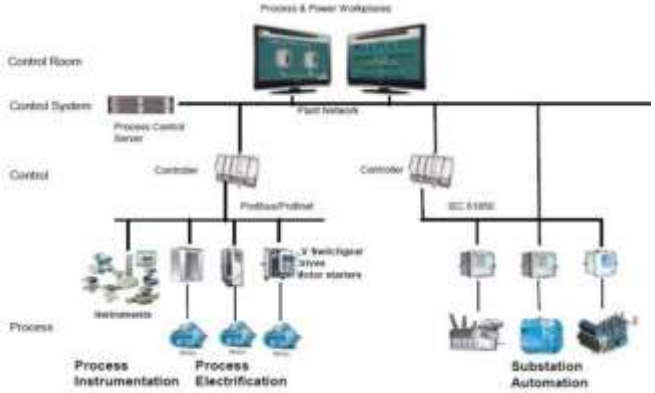
I. INTRODUCTION

Automation is the use of machines, control systems and information technologies to optimize productivity in the production of goods and delivery of services. Automation reduces operation time cycle and provides high degree of accuracy in control. Automation replaces human operators in tasks that involve hard physical work and monotonous and repetitive activities. Automation also helps performing tasks that are beyond human capabilities i.e. working in an unusual condition and dangerous environment.Automation varies with respect to purposes and requirements within a manufacturing structure. In this paper, we examine *Power System* Automation[7].

A power system consists of devices that generate, transmit, and distribute power. Power system automation is the act of automatically controlling the power system via automated processes within computers and intelligent I&C devices. It consists of three major processes, namely, data acquisition, power system supervision and power system control all working in a coordinated automatic fashion. Data acquisition refers to collecting data in the form of measured analog current or voltages values or the open or closed status of contact points. Power system supervision is carried out by operators and maintenance engineers through this acquired data either at a remote site represented by computer displays and graphically wall displays or locally, at the device site, in the form of front-panel displays and laptop computers. Control refers to sending command messages to a device to operate the I&C (A collection of devices that monitor, control and protect the system is referred as instrumentation and control (I&C) system) and power system devices, The idea of distribution automation began in 1970s[3].

Automation at the substation involves use of SCADA and data communication. Substation Automation requires the use of SCADA, data communication to control, monitor and protect the functions and equipment's. It plays an important role in the global economy by eliminating the need for manpower and reducing costs involved.

Power-system automation is the act of automatically controlling the power system via instrumentation and control devices. Substation automation refers to using data from intelligent electronic devices (IED), control and automation capabilities within the substation, and control commands from remote users to control power-system devices



Fig(1) Power system automation

II. TYPE OF POWER SYSTEM AUTOMATION

A. Substation Automation

At substations functions such as automatic reclosing, capacitor switching and reclosing are performed. Earlier these functions used to be performed with the help of devices such as relays, switches, lights and transducers. Currently Intelligent Electronic Devices [IED] consisting of programmable logic controllers and communication ports which send data and carry out control commands like meters, specialized sensor and relays. Inside the substation the expensive

Cables are replaced by local area networks to send data and execute control commands. Many techniques are available to send data outside the substation like telephone lines, dial up phone lines, cellular telemetry and fibre optic networks. This results in transmitting information at lesser cost per bit. PLC and other techniques enable to obtain more information about power system variables and equipment's. Information is obtained regarding location of fault and its analysis. [1]

A.1 Substation automation function

1. Interfacing to the switch equipment
2. Control and monitoring of the switch yard equipment
3. Alarms and recording
4. Protection of the power equipment

5. Revalue metering
6. Automation function. [4]

B. Distribution Automation

Distribution Automation systems have been defined as system that enable an electric utility to monitor, coordinate and operate system components in a real time mode from remote locations the distribution automation is modular and may be implemented in phases to include remote monitoring and control of substation, feeder and consumer devices and loads.[5]

Distribution automation optimizes the flow of electricity from the utility to consumers, and ensure that the service is delivered efficiently and reliably. Most utilities have long wished for real-time monitoring and remote control of system & assets such as substations, voltage regulators, capacitor banks, feeder switches, distribution transformers, and other physical facilities. Distribution automation systems enable the ability to monitor and control assets, identify and isolate faults, restore service, and increase distribution network efficiency and reliability.

B.1 Features of Distribution Automation include

1. Improved public image
2. Better information
3. Increased System Efficiency
4. Consumer Satisfaction
5. Reduced Expenses.

B.2 Goals of Distribution Automation

1. Less Costs
2. Improve service
3. Improve reliability of Service
4. Improve Government Relations. [2]

III. COMPONENT OF POWER SYSTEM AUTOMATION

The functional structure of power system automation will be as shown in fig 6.1.

- Electrical Protection
- Control
- Measurement
- Monitoring
- Data Communications

Power system automation may be best described by referring to Figure 2.

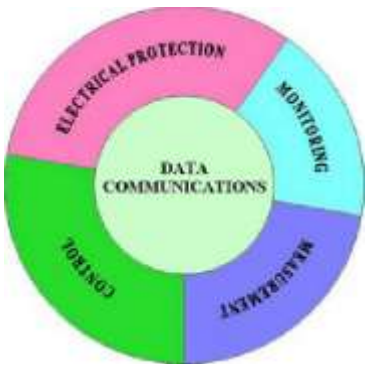


Fig2

Electrical Protection

Electrical Protection is the most important concept of the Power system Automation, to protect theequipment and personnel and to limit the damage at fault. It is a local function and it has the capabilityto function independently from the Automation if necessary, although it is a part of Power systemAutomation the function of electrical protection never restricted in Power system Automation.

Control

Control application of a Power system Automation includes local and remote control. Local controlconsists of actions the control device can logically take by itself (Bay interlocking, switching sequences, and synchronizing check). Human intervention is limited and the risk was greatly reduced.Remote control functions to control Substations remotely from the SCADA. Commands can be givendirectly to the remote control devices (open and close of circuit breakers, relay settings, requests forinformation from the SCADA station). This eliminates the personnel performance switchingoperations, actions can be performed faster. A safe working environment is created for personnel andthe operator or engineer at the SCADA has a complete over view of the entire Power network.

Measurement

Measurement is one of important concept in Power system Automation. The real time informationabout a substation or equipment is collected and displayed in the control centre and stored in a database for further manipulations, It erases the personnel to go to substation or switching area collect theinformation cutting down workloads. The information collected can assist in doing network studies likeload flow analysis, planning ahead and preventing disturbances in the Power network. Previously theword ‘Measurement’ refer to voltage, current and frequency, and the word ‘Metering’ refer to power,reactive power and energy (KWh). The different terms used because different instruments were usedfor these applications, now the two functions are integrated in modern devices hence the terms areused interchangeably in the text.

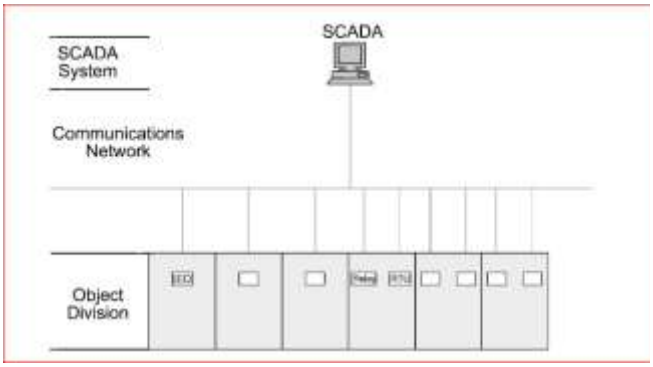
Monitoring

Monitoring is specified for the maintenance of the Power system Automation. It monitors sequence ofrecords, status and condition of the system, maintenance information and relay settings etc. Theinformation can help in fault analysis, what where when why it happened. It is used to improve theefficiency of the system.

Data Communication

Normally Communication forms a core for any system, in Power system Automation Data Communication forms core of the power system Automation. Without communication the local device and protection tasks can be performed individually. But without data communication there is no mean to say Power system Automation.[5].

IV. POWER SYSTEM AUTOMATION ARCHITECTURE



The modern system consists of three main divisions:

1.The object division of the power system automation system consists of intelligent electronic devices (IEDs), modern, third-generation microprocessor based relays and/or remote terminal units(RTUs). (PLCs also continue to play an important role in some systems). They receive analogue inputs from the current transformers (CTs), voltage transformers (VTs) and transducers in the various switchgear panels, as well as digital inputs from auxiliary contacts, other field devices rides, or the SCADA master. They can perform complex logical and mathematical calculations and provide an output either to the SCADA master, other field instruments or IEDs, or back to the switchgear to perform some command, for example open a circuit breaker.

2. The communications network is virtually the nervous system of power system automation. The communication network ensures that raw data, processed information, and commands are relayed quickly, effectively and error-free among the various field instruments,IEDs and the SCADA system. The physical medium will predominantly be fibre-optic cables in modern networks, although some copper wiring will still exist between the various devices inside a substation.The communication network need to be an 'intelligent' subsystem in its own right to perform the functions required of it, and is not merely a network of fibre-optic and copper wiring. The communication network serves as the interface between the bay level and the SCADAstation level, which might be a SCADA master station in the substation itself, or remotely in a central control room.

3. SCADA MASTER (supervisory control and data acquisition) master station(s) forms the virtual brain of the power system automation system. The SCADA master receives data and information from the field, decides what to do with it, stores it (directly or after some form of processing), and issues requests and/or commands to the remote devices. Therefore, the SCADA master is effectively in control of the complete power system automation system. Now, a SCADA master consists simply of an advanced, reliable PC or workstation (with its peripheral and support hardware) and a SCADA software. (In contrast with a few years ago whenSCADA systems used to run on big main-frame computers or some form of complex proprietary hardware).A SCADA master station may be installed in each substation of a power transmission network (station level), with all the substation SCADA stations forming part of a LAN or WAN (network level); or one SCADA master station may be directly in control of several substations, eliminatingthe station level. [6]

V. How SCADA Works

A SCADA system for a power distribution application is a typically a PC-based software package. Data is collected from the electrical distribution system, with most of the data originating at substations. Depending on its size and complexity, a substation will have a varying number of controllers and operator interface points.In a typical configuration, a substation is controlled and monitored in real time by a Programmable Logic Controller (PLC) and by certain specialized devices such as circuit breakers and power monitors. Data from the PLC and the devices is then transmitted to a PC-based SCADA node located at the substation.

One or more PCs are located at various centralized control and monitoring points. The links between the substation PCs and the central station PCs are generally Ethernet-based and are implemented via the Internet, an intranet and/or some version of cloud computing.In addition to data collection, SCADA systems typically allow commands to be issued from central control and monitoring points to substations. If desired and as circumstances allow, these commands can enable full remote control.[8].

VI. ADVANTAGES AND DISADVANTAGES OF POWER SYSTEM AUTOMATION

A. **Advantages**

1) Better quality of service and reduction in labour required

2) Reduced operating costs

3) Flexible payment options and less outage minutes

4) Improved access to information for customers and to take decisions

5) Portable and less maintenance costs

B. **Disadvantages**

1) Absence of trained personnel

2) Large initial capital investments

3) Troubled Alarms [1].

VII. Conclusion

Different components, types of Distribution Automation System have been indigenously designed, developed and successfully implemented under the mission mode project on Power Distribution Automation.The application of digital computers to such systems has provided very powerful tools for system dispatchers, so that they can be kept aware of system status and can also be provided with automatic logging, automatic generation control, and other applications considerations.

The main purpose of power system management (EMS) or SCADA system is to generate, transmit and distribute electric energy efficiently. SCADA main function is to

supervise, control and manage power networks in an integrated manner

.

VIII. REFERENCES

[1], [2].A Study On Power System Automation by AnkitaPai, TejasKopte.

[3].INTELLIGENT AUTOMATION SYSTEM FORELECTRICAL ENERGY DISTRIBUTION bySanjeevSharma, Sonia, Sushil Kumar

[4].http://slideplayer.com/slide/5964786/

[5].Power system automation, NPTEL, Dept. of elect engg. page no. 1-16, Sept. 2015

[6].Practical Distribution and Substation Automation (includingCommunications) for Electrical Power Systemsbyidc technologies.

[7].Process Automation versus Power System Automation by Anannya Mukherjee

[8].SCADA Systems Automate Electrical Distribution by*A White Paper from InduSoft*.