



Substation Automation and Remote Operation

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ABSTRACT: The substation which forms a vital role in the transmission of electrical power system. Due to the high financial implication for construction, maintenance and manpower of substation, experts started exploring the possibilities of reducing cost. As an outcome during 1900 a new concept of substation automation evolved and improved stage by stage attained to control the substation from a remote control centre. Modern substation automation system provides communication between bay level and station level also to the remote station with reliability, redundancy in India. Remote operation is the control and the operation of substation and equipment from remote location which reduces the maintenance cost by controlling more number of stations from same place. This project also gives a brief introduction of the latest protocol IEC-61850 developed for the automation of the substation.

KEYWORDS: Remote operation, Substation automation, IEC-61850, Standards, Communication protocols.

I. INTRODUCTION

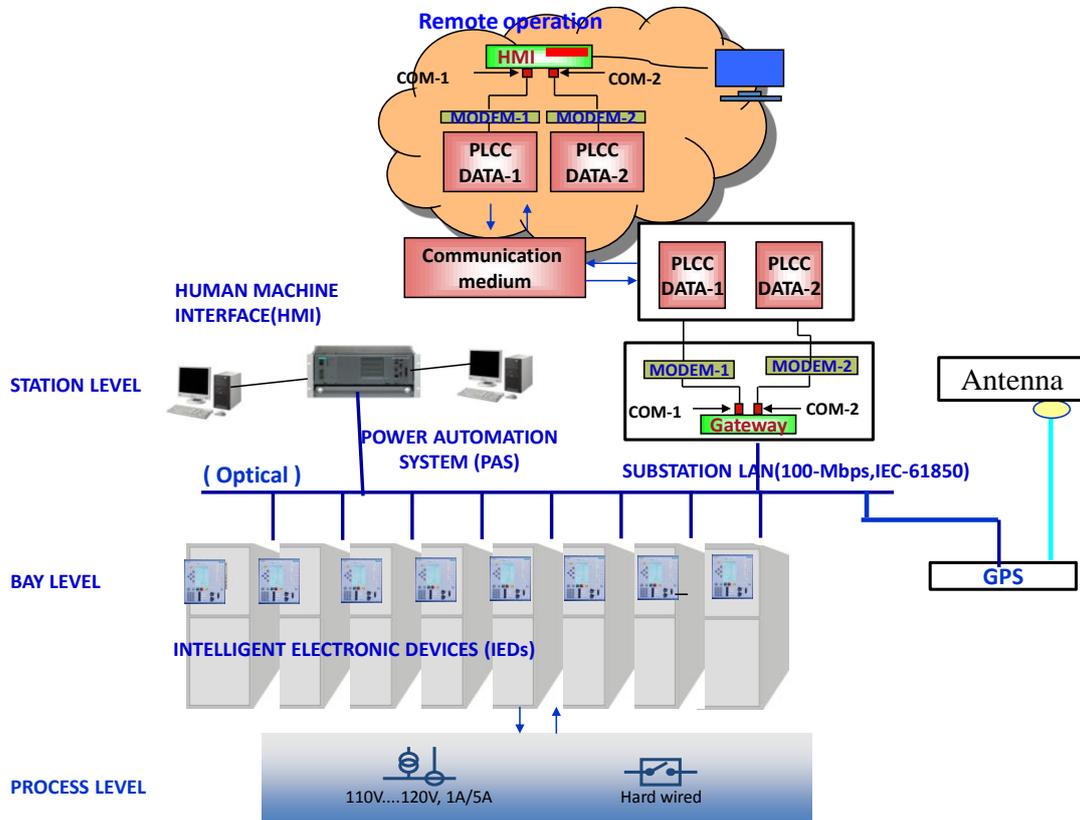
Substation automation is an supervisory management and control system. The interest on substation automation have been increasing rapidly due to its numerous benefit to utilities, SCADA providing additional capability and information that can be used for improved operations, maintenance and efficiency in substation.

A substation of closely connected subparts with some common functionality like switch gear between an incoming and outgoing line and the Bus-bar the bus coupler with its circuit breaker and related isolators and earth-switches, the transformer with its related switch gear between the two Bus-bar representing the two voltage levels. It consists of three levels mainly, process level, bay level and station level. The process level is hard wired system in which all the equipment connected through wires in the underground to the next level called bay level. In this level, the Intelligent Electronic Devices (IEDs) are connected in series. Using power automation system, the acquired data are given to the higher level called station level. The Human machine Interface is used to convert the machine level language to human language. These substation process can be monitored and controlled using remote operation.

II. SUBSTATION AUTOMATION

Process level the power line function extracts the information from auxiliary switches, sensor or transducers in the substation and send them to upper level device, called bay level device. The other major task of this level is to receive the command for control from bay level device and execute it at the appropriate switch level.

Bay level functions acquire the data from the bay then mainly act on the primary (power circuit) equipment of the bay. The different conceptual subparts of a substation are bay level devices. They are monitoring and control unit and protection unit. These subparts are called bays and designated by bay1, bay2 etc. In bay3, a transformer with related switch gear between the two bus bars representing the two voltage levels forms this bay. Bay level devices collect data from the same bay or from different bays and perform actions on the primary equipment in its own bay.



Intelligent Electronic Devices (IEDs) is a term used in the electric power industry to describe microprocessor based controllers of power system equipment, such as circuit breakers, transformers and capacitor banks. IEDs received data from sensors and power equipment and are used to control commands such as tripping circuit breakers if they sends voltage, current or frequency anomalies. This is generally controlled by a setting file. The testing of setting files is typically one of the most time consuming rules of a protection tester. A typical IED can contain around 5-12 protection functions, 5-8 control functions controlling separate devices and auto reclose function, self-monitoring function, communication function. Hence they are aptly named as Intelligent Electronic Devices. Common types of IEDs include protecting relaying devices, on load tap changer controllers, circuit breaker controllers, capacitor band switches, voltage regulators. Nowadays some IEDs are designed to support the IEC61850 standard for substation automation.

In the station level, process related functions act on the data from multiple bays or substation level database. These functions are used to submit the control commands for the primary equipment (circuit breakers) and collect the substation data like voltage, current, frequency, etc., from the bay level devices. As described above, each bay includes one primary equipment such as transformers and feeders. HMI (Human Machine Interface) or a remote control centre TCI (Tele Control Interface) or to the remote monitoring centre for monitoring and maintenance TMI (Tele Monitoring Interface).

III. REMOTE OPERATION

A human machine interface is typically local to one machine or piece of equipment and is the interface method between the human and the equipment or machine. The industrial design field of human machine interaction is the space where interaction between human and machine occur. The goal of this interaction is to allow effective operation and control of the machine occurs. Generally, the goal of user interface design is to produce a user interface which makes it easy to explain, efficient and user friendly to operate the machine in the way which produces the desired result. So it means that the operator needs to provide minimal input to achieve the desired output and also the machine minimizes undesired



outputs to human. A gateway contains devices such as protocol translators, devices, rate converters, signal translators as necessary to provide system interoperability. Nowadays, a computer or computer program configured to perform the tasks of a gateway.

Gateway is also called as protocol converters, since it can operate at any network layer. In the network, a computer server acts as a gateway node, which also acts as a proxy server and a firewall server. A gateway is an essential feature of most routers. The internet connection sharing is the standard networking feature which acts as a gateway for offering a connection between the internet and an internet network. A modem which is actually a modulator and a demodulator. It is a network hardware device that modulates one or more carrier wave signals to encode digital information for transmission. Demodulates signals to decode the transmitted information. It is mainly used to produce a signal that can be easily transmitted and original digital data is reproduced by decoding.

Power line communication carrier in modern electrical power system is mainly used for telecommunication, teleprotection, telecontrol, telemonitoring and telemetry between electrical substation through power lines. Tele means remote. At high voltages, such as 110KV, 220KV, 400KV. The major benefit is the combination of two applications in a single system, which is useful for monitoring electric equipment and advanced energy management technique. To sectionalize the transmission network and protect against failure, a "wave trap" is connected in series with the power line (transmission). Wave traps are used in switch yard of most power stations to prevent the carrier from entering the station equipment. Each wave trap has a lightning arrester to protect from surge voltage. Power line carriers may change its transmission system from analog to digital to enable internet protocol devices.

IV. RESULT AND DISCUSSION

During olden days, number of generating stations and substations were less and the manpower cost was less. All the substations had a conventional system, in which each substation is controlled individually. Each vendor had introduced their own communication protocol and implemented the substation automation vendors specifically. Due to this customer has lost their freedom to choose their vendor. So by using IEC-61850 protocol, it is easy to operate with the same platform. And also it reduces the cost of the vendor. Due to technological improvement in protection and control devices, communication facility had become an added facility to it. Which provided freedom to control, configure and operate the same from the remote equipment.

V. CONCLUSION

Thus IEC 61850 standard offers free configuration, overall cost saving and simple architecture. Substation automation system functional issues are such as proper architecture, right degree of redundancy, back up system for security. The factors need to be recognised during planning stage are cost, substation automation system expandability and manpower. The remote operation used here is to control and monitor many stations from same place.

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