SCADA in Transmission Line

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ABSTRACT: Transmission line equivalent circuit parameters are often 25% to 30% in error as compared to values measured by the SCADA system. These errors cause the economic dispatch to be wrong, and lead to increased costs or incorrect billing. The parameter errors also affect contingency analysis, short circuit analysis, distance relaying, machine stability calculations, transmission planning, and state estimator analysis. An economic example is used to demonstrate the affect of transmission line errors. SCADA measurements from several utilities are used to compute the 'real world' value of the transmission line parameters. State estimation with the estimated parameters is compared to the computations using the theoretica

I. INTRODUCTION

Demand for power is increasing very fast due to continual improvement in quality of urban life style as well as expansion of industrial sector. The rapid increase in demand for power is associated with growing level of power system network complexity in terms of need for unified grid operation while maintaining the operational parameters. Further increased openness in the power sector economy has put additional pressure on the power companies to manage the power system resources in the most optimum manner within regulatory constraints imposed by Regulator. It is the Load Dispatch Centre that monitors these operations and keeps the account of quantity of electricity transmitted through a grid. SCADA is a part of it (Of course there are a lot of other application of SCADA).

Supervisory Control and Data Acquisition System (SCADA) is a high tech computer system with: SCADA is supervisory control and data acquisition.

Supervisory control of equipments e.g. closing and tripping of switchgear and tap changing of transformer in power plants, controlling process parameter in process plant.

Data acquisition i.e. ability to get various information from the field by some mean.

PLC i.e. programmable logic controller or programmable controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or lighting fixtures. PLCs are used in many industries and machines.

II. SCADA IN TRANSMISSION LINE

POWER SYSTEM AUTOMATION

A power system consists of devices that generate, transmit, and distribute power.Power s

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 Systems 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.

III. WORKING

The above figure has shown the single line diagram of SCADA system in load dispatch centre. It's consist of different elements like Transducer, RTU (Remote terminal unit), PLCC(power line carrier communication), MMI(Man machine interface), Tele control interface.

Initially the data sense by Transducer, the Transducer is device which sense the changes in power system parameter like voltage, load current, reactive power, real power and status of circuit breaker, isolator and when converted in suitable form ,which is useful for further process. The Transducer is connected at an

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auxiliary terminal of current transformer and potential transformer. The Transducers are two types, first is Analog Transducer and second is Digital Transducer. The Analog current Transducer is used for measuring the current, Similarly the Analog voltage Transducer used for measuring the voltage. If we required measuring the Reactive power and real power of the line, at this instant both current and potential transducers are used. The Digital Transducer is used for observing the status of the circuit breaker and isolator. The digital transducer is transfer the signal in binary form or 0and 1.If the circuit breaker and isolator is open, then the value of signal is zero and vice- versa .the signal is transmitted from transducer to RTU.

The output +/- 10mA is indicates that the SCADA system is bidirectional. The RTU send a massage to the master unit, after receiving a massage the master unit is send the acknowledgement signal to the RTU.If due to any reason a massage is not display in proper manner then this instant the master unit is send the request signal to RTU.The RTU consist of three unit 1) AE (analog input card), 2) DE (digital input card) and 3) FWP (frequency width pulse).

The analog input card is collected the analog data like Load current, Voltage, Reactive power, Real power and Frequency. The digital input card is collected the digital data like status of circuit breaker and isolator .In RTU this analog and digital signal is converted into a digital form by protocol.

The width of the pulse is maintained or control by FWP, the frequency width pulse maintains the pulse at 0 to250 binary value. This binary value is transferred to the variable frequency telemetry is increases the frequency level from 2.5KHz to 4KHz.It transfer the signal at 4KHz and received a signal at 2.4KHz.This signal is transferred to the power line carrier communication. The PLCC is a communication media; it's depending on frequency range and the distance between RTU and master unit. The data is transferred through the protection line of the power system.

The signal is received by PLCC and VFT in Load Dispatch Center after this unit, a signal is received by Tele control interface, the Tele control interface is converted the signal in spectrum form. The MMI (man machine interference) is continuously data on the monitor, which is helpful for the dispatcher to take the decision as per system requirement.

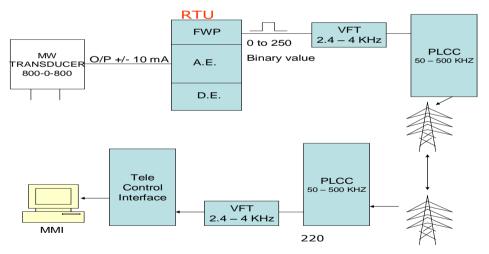


Fig. 1 single line diagram used in SCADA system

IV. SCADA PROCESS

It can be classified into three parts:

Input-

a) ANALOG: Continuous Electrical Signals Ex. Active power (*MW*), *Reactive Power (MVAR)*, *Voltage (KV)*, *Frequency (Hz).etc*.

b) DIGITAL: Switching Signals High (1) or Low (0) Signal Ex. Breaker Close (high) or Open (low), Isolator Closed (high) or Open (low).

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Process-

The signals are converted into digital format. Implement protocol between Master and Slave. It operates with Real Time Operating System (RTO).

Output-

The results are exposed with user friendly environment. *Through displays can be possible to control the substation and generating station.*

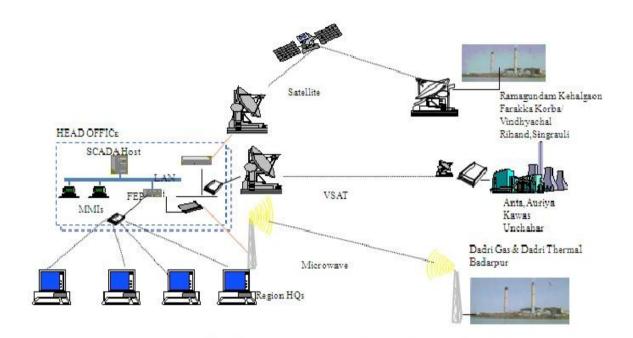
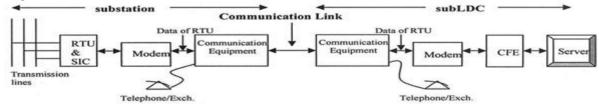
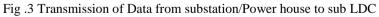


Fig. 2 Acquisition of generation of all plants of NTPC at head office.

Transmission of Data

Below in Figure 2.3, main equipment from substation/power house to its subLDC has been shown in a very simple form.





Current Transformers (CTs) and Potential Transformers (PTs), installed on transmission lines, provide inputs to transducers of SIC (Supervisory Interface & Control) & RTU (Remote Terminal Unit) panel. Circuit breakers & isolators' status are extended up to SIC panel. If for such extension extra potential free contacts are not available in the Control Panels, Contact Multiplying Relays (CMRs) are used to provide potential free contacts. The output of RTU is connected to the communication equipment, through Modem. In between substation & subLDC, a communication link has been shown. Telephone exchanges are connected with the communication equipment. Such communication links can be of any type. UPPTCL has got its own three different type of communication systems, i.e. PLCC (Power Line Carrier Communication), microwave and fibre-optic. PLCC system is more prevalent in UPPTCL. Modem output at receive side is connected with the CFE (Communication End Frame). Its output is connected with data takes over. Each RTU is automatically

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polled by Server of subLDC to obtain each data of repeats at least once in 10 sec and is stored in the database of subLDC. This data is processed in database formats and is retrieved for different applications. These formats or graphics are displayed or printed as per requirement. At subLDC, System Control Officers use this data to monitor.

APPLICATION OF SCADA IN TRANSMISSION LINE1 Automatic Switching

Emergency Load shedding. Re-routing services for station maintenance. Automatic transfer schemes. Load sectionalizing. Custom, automatic reclosing schemes. Automatic service restoration. Circuit breaker control and interlocking. Feeder automation and fault recovery.

Protection and Control Circuit breaker lockout. Protective relay interface/interaction. Dynamic protective relay setting for dynamic station topology.

Voltage Regulation Management Load Tap Changer (LTC) control. Voltage regulator control. Capacitor control. Transformer Management Parameter monitoring and alarming. Real-time modeling. Interface to existing transformer monitors.

Automatic System Diagnostics Power apparatus health monitoring. LC and communications self monitoring. Report and alarm on IED self diagnostics.

Maintenance and Safety Kirk Key interlocks management. Maintenance 'Lock-out/Tag-out management. Automatic circuit isolation control.

Station MMIs – Graphical User Interface (GUI) Interface real-time single-line displays. Interactive real-time breaker and switch control display. On-line operation and maintenance logs. Sequence of events recording. IED detail displays. Parameter trending displays.

Advantages of SCADA system in power sector Increased reliability, lower costs. Forecasting accurate demand supply management. Faster restoration of power in case of a break down. Better active and reactive power management. Reduced maintenance cost, conditioning monitoring. Reduce human influence and errors. Assists operator for faster decision making. Automated meter reading.

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Easy fault diagnosis.

Additional advantages of SCADA system in power sector

Analysis of information.

Decision making.

Optimized system operation (competitive environment).

Equipment condition monitoring (ECM)

Equipment parameters are automatically tracked to detect abnormalities.

Timely action, extended life.

ECM IEDs available.

V. CONCLUSION

This paper has presented a brief description of SCADA systems and has outlined some of the capabilities of such systems over and above supervisory control. 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. Such systems have greatly increased the ability of system operators to maintain complete and timely information on system conditions and to rapidly take appropriate action during trouble periods.

Thus with the use of SCADA system the problems faced by the operators in power system can be solved. Thus benefits one can expect from adopting a SCADA system in electrical engineering can be summarized as follows:

A rich functionality, extensive control and supervision facilities.

Reliability and robustness. These systems are used for mission critical industrial process where reliability and performances paramount. In addition, specific development is performed within an well-established control center that enhances reliability and robustness.

Technical support and maintenance are made easy in any power system process.

The application of SCADA in electrical engineering results in reduction of complexity for the operators to handle the electrical components.

By using a SCADA for automation process we can reduce the complexity occurring in the industrial processes.

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