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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 theoretical values.**

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. 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. The Load Dispatch Centre monitors these operations and keeps the account of quantity of electricity transmitted through a grid. SCADA is a part of it. Supervisory Control and Data Acquisition System (SCADA) is a high tech computer system which consists of supervisory control and data acquisition. Supervisory control of equipment's 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 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. Power system supervision is carried out by Operators and maintenance engineers. Control refers to sending command messages to a device to operate the I&C and power system devices.

III. WORKING

The figure shows the single line diagram of SCADA system in load dispatch Centre. It 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 is sensed 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 auxiliary terminal of current transformer and potential transformer. The Transducers are two types, one is Analog Transducer and the other one is Digital Transducer. The Analog current Transducer is used for measuring the current and the Analog voltage Transducer is used for measuring the voltage. If we have to measure the Reactive power and real power of the line then both current and potential transducers are used. The Digital Transducer is used for observing the status of the circuit breaker and isolator and it transfers the signal in binary form or 0's and 1's. If the circuit breaker and

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isolator is open, then the value of signal is zero and vice-versa, the signal is transmitted from transducer to RTU

The output +/- 10mA indicates that the SCADA system is bidirectional. The RTU sends a message to the master unit, after receiving the message the master unit sends the acknowledgement signal to the RTU .If the message is not displayed in proper manner due to any reason then at this instant the master unit sends the request signal to RTU. The RTU consists of three units. They are:

1) AE (analog input card)
2) DE (digital input card)
3) FWP (frequency width pulse).

The analog input card collects the analog data like Load current, Voltage, Reactive power, Real power and Frequency while the digital input card collects 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 controlled by FWP; the frequency width pulse maintains the pulse at 0 to250 binary value. This binary value is transferred to the variable frequency telemetry which increases the frequency level from 2.5KHz to 4KHz.It transfer the signal at 4KHz and receives the signal at 2.4KHz.This signal is transferred to the power line carrier communication. The PLCC is a communication media which depends 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 converts the signal in spectrum form. The MMI (man machine interference) is continuous data on the monitor, which is helpful for the dispatcher to take the decision as per system requirement.

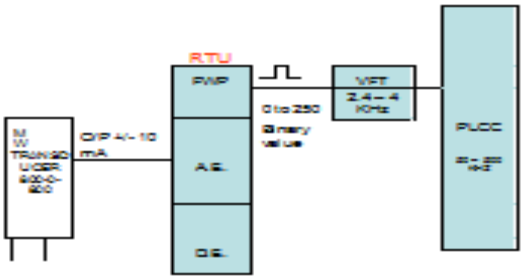

Figure.1: RTU Protocol

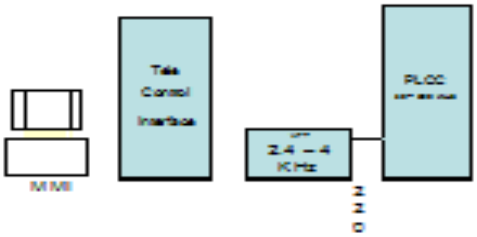

Figure.2: PLCC Communication Media

IV. SCADA PROCESS

This process consists of 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). 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.

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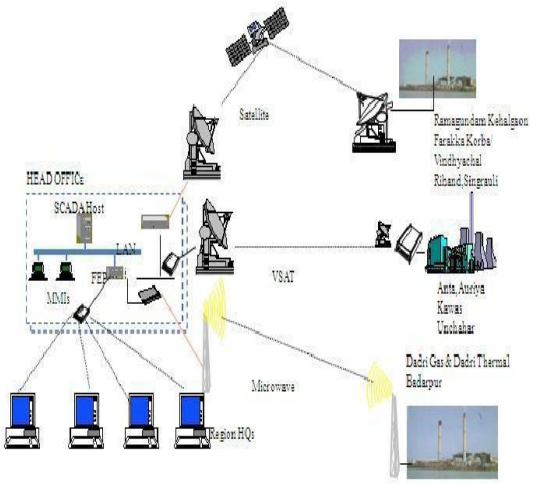

Figure.3: Acquisition of generation of all plants of NTPC at head office.

Transmission of Data

Below figure shows the main equipment from substation/power house to its sub LDC in a very simple form.

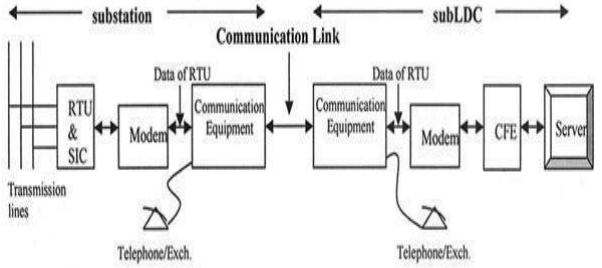

Figure.4: Transmission of Data from substation/Power house to sub LDC.

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 & sub LDC, 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 fiber-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 polled by Server of sub LDC to obtain each data of repeats at least once in 10 sec and is stored in the database of sub LDC. 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 sub LDC, System Control Officers use this data to monitor.

V. APPLICATION OF SCADA IN TRANSMISSION LINE1

Automatic Switching

Re-routing services for station maintenance Automatic Transfer schemes Load sectionalisation 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

Advantages Of Scada System In Power Sector

Increased real ability, lower costs. Forecasting accurate demand supply management Faster restoration of power system in case of a break down Better active and reactive power management Automated meter reading Analysis of information Decision making Optimized system operation

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VI. 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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