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Fault Detection in Switch Yard and Transmission Lines Using PLC and SCADA

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Abstract -- Power management is an important constraint in the design of various loads in industries for automation. So if power consumption increases then the substation monitoring is very important for the purpose of controlling the hardware and software optimization with the help of PLC ladder logic system and SCADA were used. This technique in order to reach strong conclusion about their actual impact on the power grid monitoring and control without manpower. The basic idea behind substation control project is to monitor the switchyards in substation. In substation many relays and circuit breakers are used. When any one breaker is trip because of the problems, we can monitor and control through SCADA windows. In power management project, the computer is used for assigning the priority for various loads. The signals are given to the computer of the electricity board where there is the electronic control unit which controls the sequence of disconnecting the load. On basis of controls from the computer the breakers are managed and in computer the SCADA system is installed which is used for monitoring and control. If there any problem occurs in plant, we can easily identify which part is trip. After that we can troubleshoot the problem through manpower and monitor the substation.

I. INTRODUCTION

In power distribution system, transmission lines are the most imperative part, as they play a key role in the transmission of power from generating station to load centers. Transmission lines function at distinctive voltage levels from 69kV to 765kV, and firmly interconnected for consistent operation. Various factors akin to de-regulated market environment, right of way, economics, environmental and clearance necessities have forced utilities to operate transmission lines near to operating limits. It is necessary to detect the faults; otherwise it will cause disturbances in the system which further led to extensive outages in the firmly interconnected system working within its limits. The design of transmission protection systems is in such a way so as to locate the fault location and segregate only the faulted part. It is a very challenging task to identify and isolate the faults in order to have a very reliable transmission line protection.

Most of power distribution or utility companies rely on manual labor to perform the distribution tasks like interrupting the power to loads & all parameter hourly checking. SCADA implementation in distribution reduces the manual labor operation & cost. The PLC & SCADA allows detecting the exact location of fault & without waiting SCADA.

II. FAULTS

- Faults:

Electrical fault is the deviation of voltages and currents from nominal values or states. Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in a safer operation of the system. But when fault occurs, it causes excessively high currents to flow which causes the damage to equipment and devices. Fault detection and analysis is necessary to select or design suitable switchgear equipment, electromechanical relays, circuit breakers and other protection devices.

- Types of faults:

There are mainly two types of faults in the electrical power system. Those are as following:

I. Symmetrical
II. Unsymmetrical faults.

- Block Diagram:

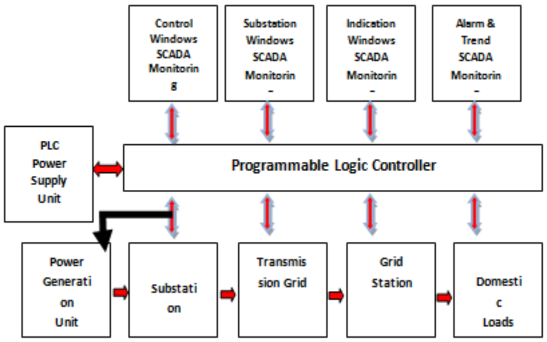


Fig. 1: - Block Diagram of Fault Detection

Gives an alarm system to the operators for identifying & prevent it. This technique is used to reach a strong conclusion of the power grid monitoring & controlling without manpower is SCADA.

a) Symmetrical faults:

These are very severe faults and occur infrequently in the power systems. These are also called as balanced faults.

There are mainly two types namely

1) Line to line to line to ground (L-L-L-G) and

2) Line to line to line (L-L-L)

Analysis of this fault is easy and usually carried by per phase basis. Three phase fault analysis or information is required for selecting set-phase relays, rupturing capacity of the circuit breakers and rating of the protective switchgear.

b) Unsymmetrical Faults:

These are very common and less severe than symmetrical faults. There are mainly three types namely

1) Line to ground (L-G),

2) Line to line (L-L) and

3) double line to ground (LL-G) faults.

III. WORKING

The collection and storage of data by itself yields little information; thus, an important function established within all SCADA systems is the ability to monitor all data presented against normal values and limits. The purpose of data monitoring varies for the different types of data collected and the requirements of individual data points in the system. Particularly, if it is a status indication change or limit violation, it will require an event to be processed. Status monitoring requires that each indication be compared with the previous value stored in the database. Any change generates an event that notifies the operator. To expand the information content, status indications are assigned a normal condition; thus, triggering different alarm with an out of normal condition message. Status indication changes can be delayed to allow for the operating times of primary devices to avoid unnecessary alarm messaging. The need to continually provide the operator with information among a multitude of collected data has resulted in the idea of applying quality attributes to data, which in turn invokes a method of flagging the data either in a particular color or symbol in the operator's display console. Event processing is required for all events generated by the monitoring function or caused by operator actions. This processing classifies and groups events so that the appropriate information can be sent to the various HMI functions to represent the criticality of the alarm to the operator.

IV. SOFTWARE REQIREMENTS

- Programmable Logic Controller:

A programmable logic controller, PLC, or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many machines, in many industries. PLCs are designed for multiple arrangements of digital and analog inputs and outputs, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. A PLC is an example of a "hard" real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

V. PROGRAMMABLE LOGIC CONTROLLER

a) Features:

- Compact PLC
- Configurable LED display
- Window based software
- Program for configuration
- Size:48mm*96mm

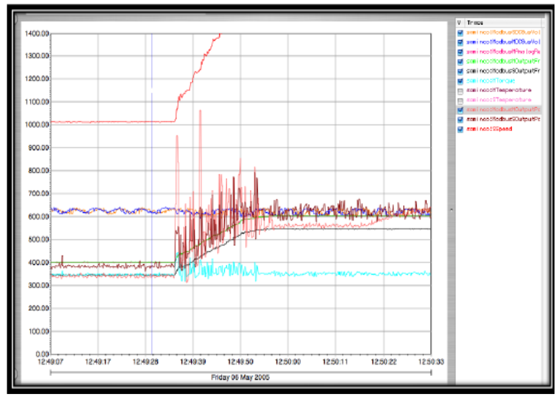
Control panel with PLC (grey elements in the center). The unit consists of separate elements, from left to right; power supply, controller, relay units for in- and output The main difference from other computers is that PLCs are armored for severe conditions (such as dust, moisture, heat, cold), and have the facility for extensive input/output (I/O) arrangements. These connect the PLC to sensors and actuators. PLCs read limit switches, analog process variables (such as temperature and pressure), and the positions of complex positioning systems. Some use machine vision.[4] On the actuator side, PLCs operate electric motors, pneumatic or hydraulic cylinders, magnetic relays, solenoids, or analog outputs. The input/output arrangements may be built into a simple PLC, or the PLC may have external I/O modules attached to a computer network that plugs into the.

b) Real-time Trends:

All Parameters which are being measured can be monitored in real time trends.

Trends can be standard as well as customized. Data can be exported to various formats.

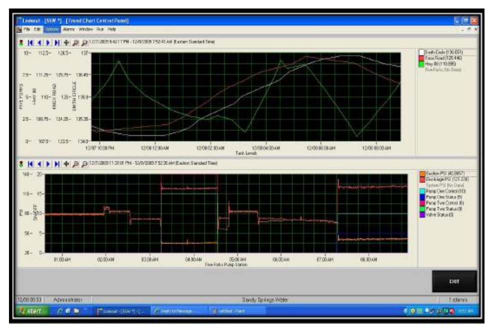
User can select parameters to be displayed in live trend for monitoring



VI. SCADA SOFTWARE SCREEN REAL TIME TRENDS

- Historical Trends:

Historical trends provide you with a "snapshot" of data from a time and date in the past. They are not dynamic. Unlike real-time trends, historical trends are only updated when they are instructed to do so either through the execution of a Quick Script or an action by the operator, for example, clicking a button.



Up to eight tag names (pens) can be trended at one time with no limit to the number of trends displayed. You have complete flexibility in designing the interface to your trend. You can create "scooters" that the operator "slides" over the trend to access a variety of data based on the scooter's current location. For example, when the operator positions the scooter over an area on the trend that has visible data, the time and values at that location for all databases.

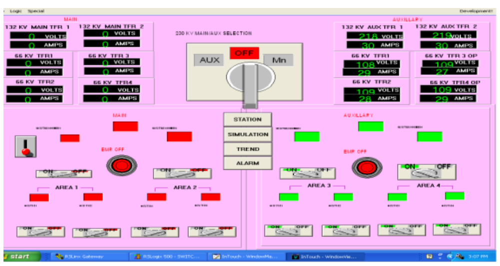
VII. SCADA SOFTWARE SCREEN HISTORICALTRENDS

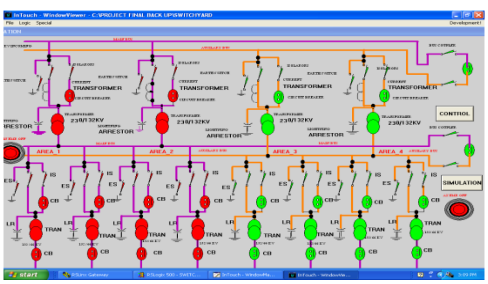
- Alarms:

If any parameter exceeds normal range of value then alarm will be generated.

User can select low and high set point of alarms and customize alarm.

VIII. PROJECT IMPLEMENTATION





IX. RESULTS AND DISCUSSIONS

A considerable amount of effort is necessary to maintain an electric power supply within the requirements of various types of consumers without failure of system.

- Proper voltage

One important requirement of a transmission system is that voltage variations at consumer's terminals should be as low as possible. The changes in voltage are generally caused due to the variation of load on the system. Low voltage causes loss of revenue, inefficient lighting and possible burning out of motors. High voltage causes lamps to burn out permanently and may cause failure of other appliances. Therefore, a good transmission system should ensure that the voltage variations at consumer's terminals are within permissible limits. The statutory limit of voltage variations is ± 6% of the rated value at the consumer's terminals. Thus, if the declared voltage is 230 V, then the highest voltage of the consumer should not exceed 244 V while the lowest voltage of the consumer should not be less than 216 V.

- Availability of power on demand:

Power must be available to the consumers in any amount that they may require from time to time. For example, motors may be started or shut down, lights may be turned on or off, without advance warning to the electric supply company. As electrical energy cannot be stored, therefore, the transmission system must be capable of supplying load demands of the consumers. This necessitates that operating staff must continuously study load patterns to predict in advance those major load changes that follow the known schedules.

- Reliability:

Modern industry is almost dependent on electric power for its operation. Homes and office buildings are lighted, heated, cooled and ventilated by electric power. This calls for reliable service. Unfortunately, electric power, like everything else that is -made, can man never be absolutely reliable. Providing additional reserve facilities.

X. CONCLUSION

With the help of Switchyard and transmission system Automation we can improve reliability, Power Quality & power handling and distribution capacity/management. The implementation of automation is very costly & complex procedure with increasing use of power electronics & electronics equipment, for implementation in practical existing field. After investing more equity for automation we can achieve a lot from the system. Total 60% to 65% of existing substation's age is more than 25 years. According to its age government has started renovating and improving towards system automation. This improvement should be IEC 61850 instead of distinctive Substation Automation. At present in INDIA knowledge of IEC 61850 & implementation technology is only with private sectors. This standard is worldwide accepted. So, government should try to train engineers to get enhanced output.

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