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Testing Circuit To Analyze Parameters Of Circuit Breaker

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Abstract—The automated circuit breakers monitoring system described in this paper which is used for minimizing switching transient on power system to make or break current flow through the power system. The action of circuit breakers changes the topology of a system. Reliable operation of circuit breakers is not possible by regular inspection and maintenance. An automated circuit breaker on-load monitoring system is proposed to monitor circuit breaker control circuit. An automated system consist of signal processing module. The module process the current and voltage signal recorded by the device. It makes possible to track the circuit breaker switching sequence and make conclusion about their performance and outcomes. The data recorded in a substation has been used to test the power system

Keywords—Circuit Breaker, Monitoring, Parameter extraction, Signal processing, Switching time.

I. INTRODUCTION

The circuit breaker is an electrical device which is automatically operated, design to protect an electrical network from damage caused by short circuit and over-current. The basic function is to halt current flow after a fault is detected. Circuit breaker are made in varying size, from small device that protect low current circuit or individual switchgear design to protect high voltage circuit feeding an entire city.

In addition there have been very significant improvement in condition aspect, with most of circuit breakers now providing intrinsic condition on-load monitoring sensors which are able to give data, a breaker has no its own intelligence it is operated by the relay which detect the fault on the system and identifying the particular circuit breaker that need to be opened. Otherwise the may operate through a manual command either remotely by power system operators or locally be personnel maintenance. Sometimes breaker may not close or open on command which leads to an interruption in the switching operator action leading to an unsuccessful fault clearing from the system. The miss-operation of circuit breaker causes the system to go into an abnormal state leading power loss.

Different monitoring system have been design to monitor the status of circuit breakers and predicts the optimal maintenance schedules based upon the following measurement. The phase voltage, phase current and switching time, temperature. Normally the major and minor failure of circuit breaker in service are caused by control circuit failure. Some of the data acquisition system currently available for measuring signal for on-load monitoring of circuit breaker performance.

Most of the breaker failure that have been observed in field can be attributed to mechanical problem and difficulty related to control circuits. Normally near about 25% of the major and minor fault of breaker in service are caused by control circuit failure. Observing the control circuit failure, it is possible to make result about breaker health. Beside this control, circuit signal helps to make conclusion about the parts of breaker devices such as moving mechanism and mechanical contact.

To improve the system operation, the data obtained by the on-load monitoring system should not be limited to evaluating the condition of the breaker. It is used to control the sequence of breaker operation and changes in topology of the system. It may be used to enhance the accuracy of control for constant operation. More reliable assessment of the system topology can be achieved by integrating redundant data from monitoring system. It may be also possible to adjust initiating the opening or closing operation to compensate for variation in the breaking or making times that are influence by the parameters being mentioned. Additional monitoring parameter may not directly reflect as an improvement in the system operation but it may help to increase the reliability of power system and equipment.

The data collected from circuit breaker in substation helps to deduction about the system switching state and increase the reliability of operation. The application of data used for maintenance purpose on the breaker which synchronized in time. Substation and system wide application helps to increase reliability by providing information about topology and the sequence of event of power system. Architecture and function of the system is described in the first and second section. In third section the hardware design its role in the system.

II. CIRCUIT BREAKER OPERATION

All circuit breakers system having prevailing features in operation but in details vary essentially depending on the current rating, voltage class and type of circuit breaker .The circuit breaker contact must be carry the load current without overheating and also withstand the heat of the arc produced

when interrupting the circuit .Contact are made of copper alloys, silver alloys and other conductive materials..

A circuit breaker essentially consist of fixed and moving contact called electrode during normal operating condition, these remain closed and will not open automatically until and unless system become faulty. The contact can be opened manually by remote control whenever desired. When a fault occurs on the system the trip coil of the circuit breakers get energized and the moving contact are pulled out by the mechanism.

When the circuit breaker contact are separated under fault condition an arc is struck between them. The current is thus able to continue until the ceases. The production arc act only delay the current interruption process and produce enormous heat which may cause damage to system or to circuit breakers. Therefore the main problem in a circuit breaker is to extinguish the arc within the shortest possible time so that the heat generated by it may not be reach a dangerous value

When a high voltage or current is interrupted, an arc is produced. The length of arc is proportional to the voltage and heat is proportional to the current. This arc must be contained, cooled and extinguished in controlled way so that gap between the contacts can again with stand the voltage in the circuit.

III. ANALYSIS OF CIRCUIT BREAKER

The circuit breaker switching operation analysis is divided into the two section where one section is control the operating sequence and another section control the closing sequence.

When the circuit breakers is in the close state, the operation begins with a trip initiate signal being with a trip initiate signal being send to control circuit from an operator. The closed contact allow the signal to travel along the line. The voltage and current being travel through the line. If the faulty may occur the voltage may increase or decrease suddenly and the circuit may trip up to that time the circuit breaker is in operating mode. When the circuit breaker is in the open state from that time up to which the supply towards the other side is on or the circuit breaker is in the closed state. From that operating state to closing state the time and data may recorded and being send to control circuit.

The availability of new data from circuit breaker brings possibilities for the new type of analysis. Detailed analysis of single circuit breaker behavior is of great importance for the maintenance groups. Other utility groups like protection engineer and maintenance engineer or more interested in sequence of event associated with group of circuit breaker. They are interested in knowing when the sequence started, what caused the operation and faulty whether the sequence executed correctly.

In order to meet the above requirement it was necessary to provide automatic retrieval of the digital data from a group of circuit breakers to the central respiratory: the given data helps to comparing control circuit signal from different circuit breaker on the same time scale. Circuit breaker monitoring architecture is design to upload the features like voltage, current, closing/opening time.

IV. CIRCUIT BREAKER SWITCHING TRANSIENT

Sometimes the circuit breakers may not open or close on command which leads to an interruption in operation switching action leads to an incomplete. Control action which allow the fault to exit longer time leading undesired changes in system functioning that many cause the system to go into an abnormal condition.

Switching over-voltages in all the levels of power system are having relatively common occurrence even switching of standard ballasted fluorescent light will generated and over-voltage because of inductance in the ballast. Main problem occur with circuit breaker operation in high voltages system the voltage amplitude can be higher than the power frequency value and this may cause exceeding the insulation strength of power system components such as power transformer, large rotating machine, transformer etc.

Most of the obvious source of over-voltage are lightning generated transient, but for very high voltage it is the switching transient or internally generated that are of most concern, because they have last longer and stress the system for longer.

Current chopping can occur when the circuit breaker are interrupting small inductive current such as magnetizing current in transformer or when high rupturing capacity fuses of low rating interrupt very high fault current with substantial current limitation. The result can occur that the current can be interrupted before a current zero and as a result the inductance still contains stored energy and the dissipation of this energy will cause an enhanced and additional voltage transient at the circuit breaker terminals.

V. ANALYSIS OF SEQUENCE OF OPERATION

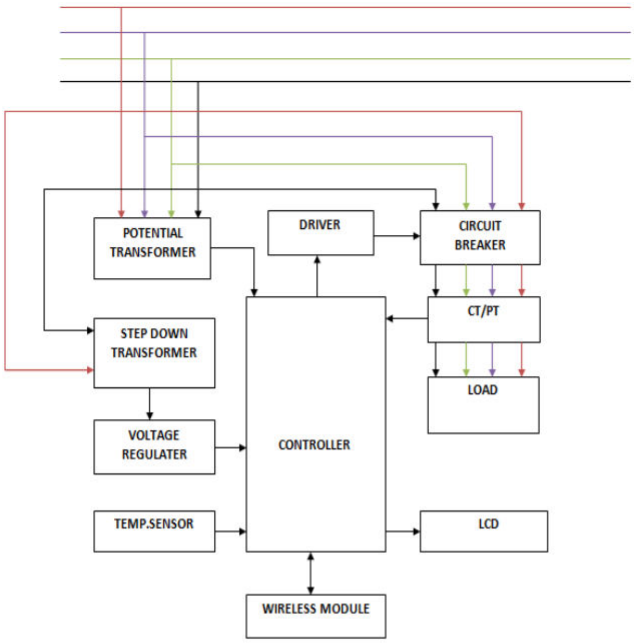
The purpose of power system is to generate and distribute electrical energy to customers, A power system consists of diverse equipment, which is expensive. In order to build reliable protection system it is important to sense or detect fault and disconnect vulnerable element of the power system fast.

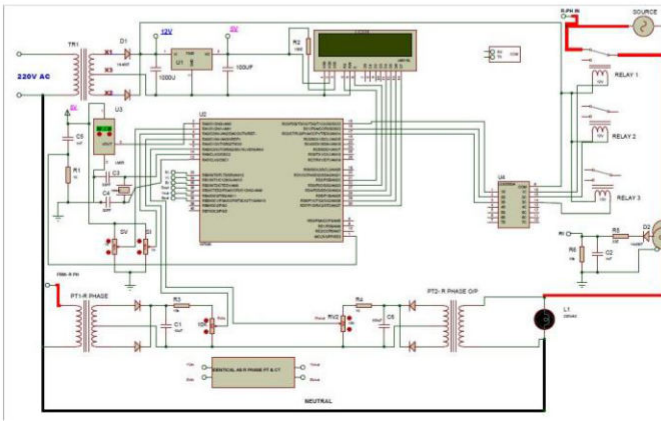
Circuit breakers have the purpose to automatically connect or disconnect different parts of the power system in order to isolate fault. When there is a fault on an element in power system, it is necessary to open all circuit supplying fault current very fast. In order to disconnect all the circuit that supply fault current, more than one breaker typically react. Bus arrangement is used to reducing the number of circuit that must be opened in case of fault. Depending upon the bus arrangement of power system network and status of circuit breaker, different circuit breakers will automatically react in case of different fault.

Power system may have to be expanded to meet growing demand for electrical energy. In order to fulfill the increased

demand new substation are built and old ones are upgraded. It is common that bus arrangement vary widely from substation to substation. In practice many different solution can be found, most of the common arrangement in high voltage system are breaker-and-a-half and ring bus arrangement. In the case of any fault on line3, corresponding circuit breakers from both ends of line3 the breaker1, breaker2 and breaker3 will open and de-energized the line to get rid of temporary fault. During action to disconnect an element, various circuit breakers will react differently depending upon the bus arrangement and type of fault such as permanent or temporary. Purpose of the proposed analysis should be finding out whether the sequence of event executed correctly according to bus arrangement and cause of the action.

VI. HARDWARE STRUCTURE





The circuit breaker monitoring system is design to perform following function

- Data acquisition system having input and signal must be captured and converted in to digital form when circuit breaker monitoring triggered.
- The data gathered by circuit breaker monitoring unit at breaker must be transferred to central location for further processing. .

A. Temperature sensor :(LM35)

Temperature sensors measure the amount of heat energy generated by an object or system, allowing as to detect or sense any physical change to that temperature producing either analogue or digital output. LM35 temperature sensor provides output voltage in centigrade (Celsius). It does not required any external calibration.

B . Wireless Communication Module:

The concentrator PC gathers data from all slave unit through wireless communication. The wireless transmission system unables data transfer from multipal point to the central storage system.bluetooth is one of the most wireless communication protocol in internet of things specifications, mainly advantages of this standard is its extremelly a low power consumption, can helps making of full battery power boards with working time longer than one or two years in some of cases. The another features management protocol directly at kernel level without requesting any intervention by the user. Such type of facilities the sateup of a mess network of bluetooth device with lower latency and higher range respective standard bluetooth.

C Microprocesser Module (16F886)

Microprocessor module performs the following functions:

- Detect event and record the data for specified duration in memorey.
- Set the signal sampling freqencey and the scaling factor for digital signal.
- Transmit the data to consentrator PC using communication protocal and wireless transrceivers.
- Receives and execute cammands send from the consentrator .

D. Signal Conditioning Module:

The input signal must be scaled appropriately before converting them into digital form for processing and storage. By using rectifier converting the input signal in DC in the +5 volt a signal conditioning circuit must be scaled the signal to be in the range required by rectifier. This signal conditioning board protect rest of the device from high voltage transient generated during closed or trip coil operation.

E. Analog to Digital Converter

Analog signals must be converted to digital signals with a resolution high enough to allow an accurate analysis. A resolution of 12 bits to 16 bits sufficient for most of the application. Digital signal are easy and reliable for observation and future study. To make sure that recorded data may be combined with data from other circuit breakers monitors in a system all signal must be sampled synchronously and then converted to digital form.

VI. TOPOLOGY OF SEQUENCE OF EVENT ANALYSIS

On load monitoring circuit breakers data has more information available to estimate the circuit breaker status then what is available through existing tools. Since circuit breakers tracts the topology change with more details. Knowledge about current status of the system topology is important for power system application like fault location and alarm processor which demonstrates the importance of proposed architecture for future improvement of existing tools.

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VII. CONCLUSION

The on-load monitoring circuit breaker is described in paper and present requirement is that the system should satisfy to enable cost effective and efficient breaker monitoring function. It should be design for status monitoring purpose for the medium and high voltage breakers. By the following these requirement, it should be enable to realize low cost and efficient monitoring and provide the data that could be used to improve several power system analysis function. It gives generic system architecture that enable minimum cost realization of the system. Hardware architecture should be modular to enable effective upgrade, easy and obsolete part exchange in future.

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IX. REFERENCES

[1]. CIGRE Working Group A3.12, “Failure survey on circuit breaker control systems: Summary report,” Electra, vol. N-216, Oct. 2004.
[2]. Switchgear and Protection by J. B. Gupta.
[3]. M. Kezunovic and G. Latisko, Automated monitoring functions for improved power system operation and control," presented at the IEEE PES Summer Meeting, San Francisco, USA, June 2005.
[4]. M. Kezunovic, Z. Ren, G. Latisko, D. R. Sevcik, J. Lucey, W. Cook, E.Koch, “Automated Monitoring and Analysis of Circuit Breaker Operation,” IEEE Transactions on Power Delivery, Vol. 20, No. 31910-1918, July 2005.
[5]. C. Nail, “Automated circuit breaker analysis,” Master’s thesis, Texas A&M University, College Station, Texas, Aug 2002.
[6]. Power Circuit Breaker theory and design by C. H. Flurscheim.
[7]. Switchgear and protection by M. V. Bakshi and U. A. Bakshi.
[8]. HVDC Circuit breaker by Saquib Siddiqui.