REVIEW PAPER ON PLC BASED RELAY CO-ORDINATION SYSTEM FOR SMART ELECTRICITY DISTRIBUTION

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***Abstract*: Power distribution system consists of various load lanes. Suppose these distribution system consist of three load lane which is attached to the same distribution line. If due to some problem load lane1 is off but other load lane also connected to the same line so that these two load lane also become off if there is no problem in these load. So that main of our project is to "PLC Based Relay Co-ordination System for Smart Electricity Distribution using PLC for stand by supply arrangement". In this project when one load lane is off the other load lane which is attached to the same line will be automatically on through relay.**

***Keywords*: Programmable Logic controller (PLC), Current Transformer (CT), Instrument Transformer (IT), R.**

Introduction

In last few years so many techniques are developed in field of relay co-ordination. The main concern of this project is to rescue the distribution transformer in power system network against the internal and external faults. Overloading of transformer beyond the rating can cause a rise in temperature of both transformer oil and winding overloading is nothing but it is an over current fault occurring on secondary side of distribution transformer or rise in the load. Increase in the winding temperature will increase the stress on the insulation and then insulation deteriorates and may fail. Power system faults external to transformer can increase or decrease the voltage of the transformer which leads to overvoltage or under voltage fault. When fault occur current increases and hence a comprehensive transformer protection scheme needs to include protection against overvoltage, under-voltage, overload, phase to phase fault and over temperature. Following system is a proposed system which consist all this protections.

II. DEVELOPMENT OF SYSTEM

The purpose of this work is to the tool is developed using concept of adaptive protection scheme. Relay setting parameters are set automatically in response to changing systems. Furthermore this proposed tool is suitable for the complex future radial distribution system. The block diagram of PLC Based Relay co-ordination System for Smart electricity distribution is as shown in below.

Programmable Logic Controller (PLC)

A programmable logic controller (PLC) or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes such as assembly lines or robotic devices or any activity that requires high reliability control and ease of programming and process fault diagnosis.

POWER SUPPLY

A device is the conversion of available power of one set of characteristics to meet specified requirements. Typical application of power supplies includes converting raw input power to a controlled or stabilized voltage and current for the operation of electronic equipment.

Power supplies belong to the field of power electronics the use of electronics for the control and conversion of electrical power. A power supply is sometimes called a power converter and the process is called power conversion. It is also sometimes called a power conditioner and the process is called power conditioning.

Relay

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive say a fan or an electric bulb. The supply is given to SMPS form converting the 230v to 24v.then 24v is given at input terminal of PLC.PLC has main three parts.

1. Input
2. C.P.U
3. Output

Programmer of PLC is stored into C.P.U all the PLC have the ratio of input and output is 60% and 40%. 2 push button and Voltage Controller is connected at input terminal of PLC. Relay card and loads are connected at output terminal of PLC.

When we start the system the load is connected through relay (24V DC) card. As load (230 V A C) increase and reach at Set point of Voltage Controller. Voltage Controller gives signal to PLC and PLC is cut the load with the help of programming.

III. Ladder Programming Development

In the design of automated machine and control system for process programmable logic controllers are often used. For the controller to carry out its intended task, a control program is necessary. Therefore a formal and structured approach to software design must be adopted in order that the program can be easily understood debugged and documented. In terms of design methodology ladder programming is no different from the conventional computer programming. Thus considerable attention must be given to:

1) Task definition
2) Software design techniques
3) Documentation
4) Program testing

The time of failure detection and negation of output circuit is depending on application diagnostics parameters. Application Diagnostics is performed in the application program of S-PLC (safety program) and its possibilities are limited by the Properties of S-PLC resulting from the processing means of the application program and the input and output signals of S-PLC.
The properties of S-PLC have primarily a limiting effect on the duration of testing pulses, on the ability of S-PLC to render the Change of contactor's state evoked by a testing pulse and affects the time between testing procedures.
Processing of safety program, similarly like processing of a standard program, is based on an operational cycle (the most Utilized programming language for S-PLCs is the LD - Ladder Diagram language). Usually, in standard PLCs, there exists one Program task (continuous task), which is started in the operational cycle directly after finishing the previous Operational cycle, while reading inputs and update of outputs can be (but must not be) bound on the operational cycle. On the Contrary, in S-PLC the operational cycle is executed in a defined period and reading of inputs and update of outputs is always Bound is the operational cycle. Periodic execution of operational cycle also affects the response time of S-PLC therefore we have to ensure that the operational
Cycle will be executed in each period. Non-execution of operational cycle in the defined period has to Be detected and a safe reaction has to be issued.

1.3 Types of fault

There are mainly two types of faults:
1. Symmetrical faults
2. Unsymmetrical faults

1**. Symmetric fault**

A symmetric or balanced fault as name indicates affects each of the three phases equally. Transmission line faults Normally, 5% are symmetric.
There are of two types namely
a) Line to line to line to ground (L-L-L-G)
b) Line to line to line (L-L-L).
2. Asymmetric fault
An asymmetric or unbalanced fault which does not affect each of the three phases. Common types of asymmetric Faults and their cause there are mainly three types namely
a) Line to ground (L-G)
b) Line to line (L-L) and
c) Double line to ground (LL-G) faults

TYPES OF FAULT DETECTION

The fault occurs in the power lines and cable can be classified into four main types: short circuit in the cable Or transmission line, short circuit to earth, high resistance to earth and open circuit.
Power system protection performs the function of fault detection and clearing it as soon as possible, and Isolating whenever possible but only the faulted component or a minimal set of the components in any other case. Since The main protection system may fail (relay fault or breaker fault), protections should act as backup either in the same Station is the neighboring lines with time delay according to the selectivity requirement. The determination of the time delays for all the backup relays is known as coordination of the protection system.
Coordination of protective relays is mainly necessary to obtain selective tripping in the relays. The first rule of protective relaying is that the relay should trip for a fault in its zone. And the second rule is that the relays should not trip for a fault outside its zone, except to back up a failed relay or circuit breaker. To coordinate this backup Protection with the primary relay characteristic will ensure that the backup relay must have sufficient time delay to allow the primary relay (and its breaker) to clear the fault.

Working of Power System

In Normal Condition the power is generated by generator acting as a source. This voltage is stepped-up with the help Of step-up transformer up or higher to reduce transmission Losses. Then that power is transmitted over the transmission lines. Again the voltage is stepped down to a level, as it is desired by the loads, with the help of step-down transformer. In Abnormal Condition or

fault is nothing but a defect in electrical circuit of the electrical equipment due to which current is diverted from intended path. If the fault impedance is low, then the fault currents are relatively high. During the time of faults, the power flow is diverted towards the fault and so the supply to the neighboring zone is affected. Therefore to isolate the faulty section from the healthy part and by this we can maintain the continuity of supply, circuit breakers are employed in power system.

2.3 Need for Protection of Power System

The Modern power systems are growing with more equipment such as generators, transformers and large network in the systems. For the system protection, a high degree of reliability is required. In order to protect the system from damage, due to fault currents and/or abnormal voltages caused by the faults, needed for reliable protective a device, such as relays and circuit breakers arises. The most common electrical hazard is the short circuit for which protection is needed. Also the protection is required against the overloads, over-voltage, under-voltage, open-phase, power swings, under and over-frequency, instability etc.

Primary and Back-up Protection

For attaining higher reliability, quick action and improvements in the operating flexibility of the protection schemes and separate the elements of a power system, in addition to main or primary protection, are provided with a back-up and auxiliary protection. First in line of defense is the main protection which ensures quick action and it is selectively clearing of faults within the boundary of the circuit section or the element it protects. Main protection is the essential one it is provided as a rule. Back up protection which provides back up to the main protection, and when the main protection fails to operate or is cut out for repairs etc.

RELAY COORDINATION

Relay co-ordination plays an important role in the protection of power system. For the proper protection, we must have proper co-ordination of relays with appropriate relay setting is to be done.

Relay settings is done in such a way that the proper co-ordination is achieved along various series network.

Coordination of relays in a modern power system is a challenging task for the protection engineers. However the review of Co-ordination is always essential since various additions / deletion of feeders and equipments will occur after the initial commissioning of plants. As the power can be received from the generators of captive power plant, the analysis becomes complex. Lager the systems, more will be the chances of the fault occurrence and disturbances due to the faults.

Stages for fault clearance:

1) Occurrence of fault
2) Measurement by instrument transformer
3) Analysis by protection relay for initiating selective tripping
4) Switchgear to clear the fault
5) Relays are installed not to prevent the faults but to isolate the faults and to minimize the damage.

Relay co-ordination it can be done by selecting a proper plug setting and the time multiplication setting of the relay, considering maximum fault current at the relay locations. After the selection of plug setting and time multiplier setting, the co-ordination can be checked graphically. When plotting co-ordination curves, certain time intervals must be maintained between the curves of the various protective devices in order to ensure the correct sequential operation of the device when co-coordinating inverse time over current relays. For a given fault current, the operating time of relay is jointly determined by its plug and time multiplier settings. Thus theses type of relay which is mostly suitable for proper coordination. Operating characteristics of this relay are usually given in the form of a curve with the operating current of plug setting multiplier along the X axis and operating time along Y axis during representation.

Calculation of the relay operating time:

To calculate the actual relay operating time, the following parameters is needed

1) Time / PSM Curve
2) Plug Setting
3) Time Setting
4) Fault Current
5) Current Transformer Ratio

The process for calculating the actual relay operating time is as the follows:

1) Convert the fault current into the relay coil current by using the current transformer ratio.
2) Express the relay current as a multiple of current setting, i.e. calculate the PSM
3) From the Time/PSM curve of the relay, with the calculated PSM the corresponding time of operation can be obtained.
4) Determine the actual time of operation by multiplying the above time of the relay by time-setting multiplier in use.

Problem Definition

- The most common problem is overhead condition which creates fault in operation and it may damage system.
- As fault analysis became important requirements of the electric power system to become more accurate.
- So as to avoid such cases we designed simple and economical equipment which will give a solution to the above mentioned problems.
- Types of fault may be depending atmospheric parameter and component property.

APPLICATION

- On feeder line to disconnect the faulty section In substation.
- On DP Structure for disconnect the load.
- For load shedding purpose of one of the section.
- In railways and Industries.
- Any other place where AB Switch is used.

FUTURE SCOPES

- The modifications to be done in this project are addition of voltage sensor or voltage comparator to detect voltage fault or fluctuation in transmission line.
- This system can be more accurate in term of timing and data recording with the help of PLC.
- We can use GSM module to receive information.
- This system can be used in DC parameter fault analysis.

CONCLUSIONS

In this paper implementable primarily focuses the electric energy produced at generating stations is transported over high voltage transmission lines to utilization points. In the early days electric systems were operated as isolated systems with only point-to-point transmission at voltages that are considered low by today's standards. To improve the power quality of the transmission lines compensation circuits are integrated. In order to increase the reliability of the system and reinstate the power supply in time it is of immense important to classify and locate the fault rapidly and to isolate the faulty section precisely.

REFERENCES

[1] Poonyapa Sookrod and Paramet Wirasanti Dept. of Electrical Engineering Fact. Of Engineering Chiang Mai University Chiang Mai, Thailand "Over current Relay Coordination Tool for Radial Distribution Systems with Distributed Generation". 2018 5th International Conference on Electrical and Electronics Engineering 2018 IEEE PP.13-17

[2] Karol Rastocny, Juraj Zdansky, Jozef Balak, Peter Holecko University of Zilina, Faculty of Electrical Engineering Department of Control and Information Systems Univezitná 8215/1, 010 26 Zilina, Slovak Republic, "Effects of Diagnostic on the Safety of a Control System Realised by Safety PLC" IEEE Trans.. Power Electron. IEEE 2016. PP. 462–467.

[3] Ajit B. Bachhav, Nikhil S. Sarode, Ms. Harshaddha Gagre, Ms. Dipti Shirsath,Rajashree S. Kadam, "OVERHEAD LINE PROTECTION WITH AUTOMATIC SWITCH BY USING PLC AUTOMATION," International Research Journal of Engineering and Technology (IRJET) ,Volume: 05 Issue: 03 | Mar-2018 PP 2613–2616.

[4] Mohammad khan J.Yusufjai1, Chintan H.Vekariya2, Rajat A. Joshi3, Manan M. Desai4 Students, B.E - Electrical Engineering, 4 Assistant Professor Dr. Sub hash Technical Campus, Junagadh, Gujarat, "PLC And SCADA Based Load Security System," International Journal of Engineering Development and Research , 2017 IJEDR | Volume 5, Issue 2 | ISSN: 2321-9939 PP 115–119.

[5] Akansha Dubey and Dr. Jyoti Shrivastava M.Tech (Power System), Shuats, Allahabad, India Assistant Professor , Electrical Engineering Dept. , Shuats , Allahabad, India, "REAL-TIME MONITORING, CONTROL &PROTECTION OF TRANSFORMER USING PLC AND SCADA" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 05 May 2017 PP 2250–2252.

[6] Awadallah Sulieman Rahama and Dr. Dalia Mahmoud Department of Control, Faculty of Engineering, Al Neelain University, Khartoum, Sudan, "Control of Induction Motors by Using Programmable Logic Controllers (PLC)," International Journal of Science and Research (IJSR) Volume 5 Issue 5, May 2016 PP 1923–1926.