Auto-Reclosing Scheme with Adaptive Dead Time Control

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Abstract— These paper present the implementation of the fast adaptive three phase auto-reclosing scheme is based on the measurement of current value at transmission line. The main objective of this scheme is to ensure the application of the three phase reclosing after the transient fault extinction and perform the tripping of three phase for permanent fault. System will also check whether a fault is transient or permanent in nature, for the transient fault system being restored to supply after predefined time. This system is implemented with arduino-controller, current transformer and commercial relay the proposed system will ensured successful reclosing enhancing the system reliability.

Key words: Arudino-Controller, Auto-Reclosing, Dead Time, Current Transformer, Transmission Line Protection

I. INTRODUCTION

Protection of power system is the most important necessity in the domestic or industrial electrical to preclude equipment from detriment occur by leakage current. The circuit breaker consisting the automatic tripping system must be installed at every place where the power supply is needed. For example at each of house, hospital, factory, or at any other electrical load.

According to different studies from 70%, to as high as 90%, faults on most overhead lines are transient. A transient fault is a type of fault which is cleared by the instantaneous tripping of one or more circuit breakers to clear the faults in the electrical system. The example of transient fault is like insulator flashover. When the line is again re-energized the transient faults does not reoccur [2]. At lower distribution voltages faults tend to be less transient (near the 80% range of sub transmission and transmission voltages.) and at higher distribution voltages faults tend to be more transient (near the90% range of sub transmission and transmission voltage). The most common cause of transient faults is lightning; partway consequences like insulator flashover because of high transient voltages generated by the lightning stroke. Swinging wires and temporary contact with foreign objects might be the cause of transient faults. Thus, by de- energizing the line for a short time transient faults can be cleared. Service to the line can be recreated by instant auto reclosing. The abide 10% - 30% of faults in electrical system are semi- permanent or permanent in nature. A semi-permanent fault can be effectuated when a small branch of tree falls on line. In such case of permanent fault, the fault can't be cleared by an instantaneous de-energizing of the line and subsequent auto reclosing. If there is a compeered time-delayed trip then system would let the branch to be burned away without any harm to the existing system. In highly wooded areas Semi-permanent faults of such type are likely to be customary and by aggressive line clearance programs faults can be significantly controlled [4]. By tripping and reclosing of circuit breaker type of permanent faults can't be cleared. On an overhead line, a broken wire or conductor making a phase open, or a broken pole making the phases to short are the example of common and most often occurring permanent fault. Faults on underground cables are also the example of permanent fault. Without using the auto reclosing system the cable faults can be cleared easily and the repair of affected cable must be done before the cable is used for power supply. Some exceptions may exist to this, as in the circuit designing of both underground cables as well as overhead lines. Though, success rates of auto reclosing may differ from one company to another company, but the results reveals that the most of the faults can be successfully cleared by using the appropriate tripping and auto reclosing mechanism[3]. Proper tripping can de-energize the line for enough time period to pass the fault source and to de-energize the fault arc, then the system automatically recloses the line to maintain the power supply. Thus, auto reclosing mechanism can substantially decrease the outage time because of faults and gives a significant level of service consistency to the consumer and reliability of power system. On transmission circuits, desired high-speed auto reclosing plays a vital role to achieving and maintaining power system stability. When the permanent faults occur in system, auto reclosing system recloses the circuit still a fault that has not been cleared is present in system, which can arise the threatening condition for system stability (mainly at transmission levels)[5].

In the present scenario of power systems, automatic reclosing system has a very wide area where it can be applied. To affect fault clearance and posterior re-closure, it is often compulsory to make them sequentially several equipments of switchgear. Recently, Control of auto re-closer switching sequences is done by logical design principles in the large substations. The main advantages of auto re-closer system are consistent supply except for short time duration when tripping and re-closure actions are done by circuit breaker, so there is no need to attend the substation by any human operator. The speed of operation of the protection equipments is the most important factor which affects the success of rapid re-closer system. The reason behind the dependency is high speed operation of protection system decreases the amount of damage occurred and thus maximizes the possibility of successful operation. With the help of automatic reclosing system a very simple but high speed protection of the lines can be achieved with the reliable operation of power system. With instant protection being applied assorted tripping of several circuit breakers may occur but the application of auto-reclose system makes it a selective operation is indispensible that the system dead time is to be set for a few cycles so that the generators do not drift apart. The application of High speed protection is used to obtain operating times of one or two cycles such as pilot wire carrier. So to attain that the re-closure must be of the single shot type. To enhance the

stability to a better extent on single-circuit ties high speed re-closure scheme must be used in high voltage circuits.

A fault in a power system is any failures which interface with the normal flow of current. The cause of electric power system faults is insulation breakdown. This breakdown can be due to a variety of different factors such as[8].

- Lightning stroke
- Spray on Insulators
- Trees coming in contact with wires
- Equipment Failure
- Human Errors

Types of faults:

The faults can be classified into:

- Symmetrical faults
- Unsymmetrical faults

The Shunt faults are characterized by increase in current and fall in voltage and frequency. The Shunt faults can be classified as:

- Single Line to Ground (LG) fault
- Line to Line (LL) fault
- Double line to ground (LLG) fault
- Three Phase fault

A. Objective of Project

- To reduce de energizing time
- To increase reliability
- To increase stability
- Reduce switching of capacitor bank
- To increase continuity of supply
- Automation

B. Advantages

- Using of Arduino the circuit become compact.
- Automatic operation.
- Cost is reduce.
- Using of Arduino accurate fault detection is achieve.
- Faster operation
- Use of auto reclosing system minimize the interruption of supply at consumer side
- Employing a high speed auto reclosing system on long extra and ultra-high voltage lines increases system stability as well as synchronism
- Use of auto reclosing system restores system capacity and reliability
- In modern power system some of the loads are very critical and continuity of power supply is extremely important. From auto reclosing we can get continuous supply
- If the auto reclosing scheme is employed then there is a higher probability of recovery of continuity of power supply
- Use of high auto reclosing scheme reduce the duration of fault it also eliminates most temporary faults. Hence, damage due to persistence faults for long duration reduces
- Employing delayed auto reclosing scheme increase the chances of clearance of semi-permanent faults in distribution system where fuse is used

C. Applications

- Used in Sub-Stations
- Used in Generating station
- Used for protection
- Used in Industries
- Used in Government bodies

II. BLOCK DIAGRAM

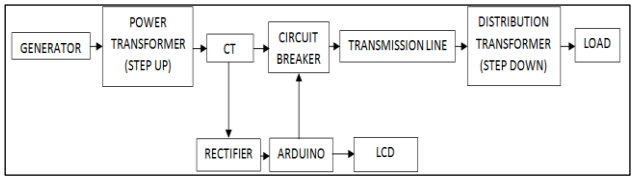

Fig. 1: Block Diagram

A generator is a machine which produce voltage. Generated voltage from the generator is applied to the power transformer (step up transformer). Power transformer (step up transformer) step up the applied voltage for transmission purpose. Current transformer is connected between Power transformer (step up transformer) and circuit breaker. Current transformer is used for the measurement of line current of the system. Current transformer step down the current for measurement then step down current is applied to the rectifier circuit in rectifier circuit first resistor converts the current into voltage then it is applied to rectifier which converts the ac voltage into dc voltage. Rectified dc voltage is applied to arduino for measurement purpose. Arduino measure the voltage and this measure value is displayed on the LCD. Circuit breaker are used for protection purpose. Circuit breaker isolate the faulty part from the system when tripping signal is applied to the circuit breaker. Tripping signal is generated by the arduino when the current is exceeds the pre-stored value of current. Transmission line is used to transmit the power from generating stations to substations. Distribution transformer is used at the substation is connected to transmission line which step down the voltage for the distribution purpose.

III. FLOW CHART

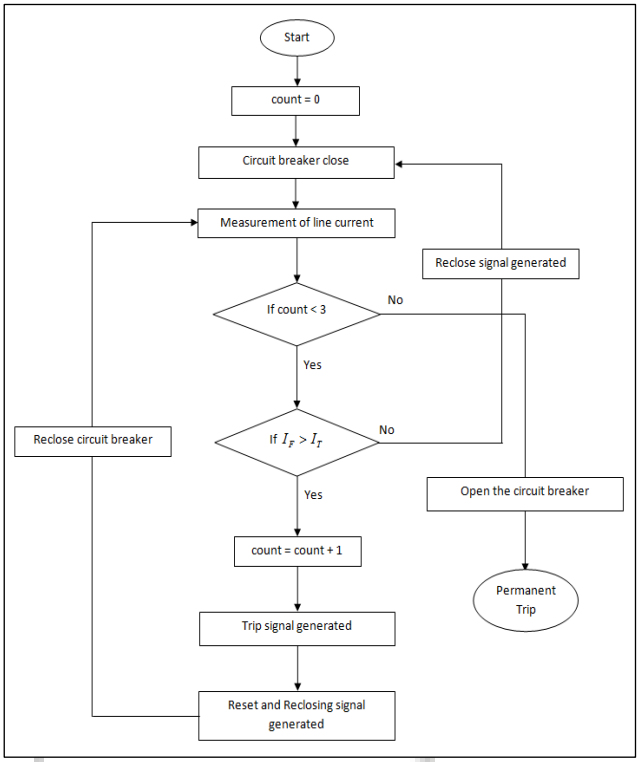

Fig. 3: Flow Chart

Fig.2 shows the flow chart for three shot auto-reclosing. First count is set to 0 value. At starting initially circuit breaker remain in close condition. At close condition Arduino continuously measures the current of all lines. It will check for the value of count is less than 3 this limit is set to operate for 3 shot reclosing scheme. If fault current exceeds threshold value of current then it will increase the count by 1 and it generate trip signal and circuit breaker tripped. After predefine dead time Arduino will generate reset and reclosing signal reclose the circuit breaker and again check for count value this processes is repeated until the value of count become 3. If value of count is 3 then Arduino gives trip command to circuit breaker and circuit breaker opens and isolates the transmission line and circuit breaker permanent trip. We can use different auto-reclosing scheme by changing the value of operations.

IV. IMPLEMENTATION

Auto-reclosing scheme with adaptive dead time control is implemented by using current transformer, Arduino, contactor, relay, LCD, rectifier circuit, step-up transformer and step-down transformer.

Fig. 4: Implementation

In this proposed system supply of 3-phase 215 volt, 50 Hz is given to step-up Transformer (215/440V) which step up the voltage to 440 volt then it feed to bus bar from the bus bar three phase transmission line transmits the power to step- down transformer (440/215V) which step-down the voltage to 215 volt for supplying load at the end of line.

To developed auto-reclosing system for designed system current measurement at the transmission line is done using current transformer of rating (400/5) an it will provide the step-down value of current. step-down value of current is converted into voltage form using resistor value of 10kohm this ac voltage is converted into dc voltage using rectifier circuit output of this rectifier circuit is pulsating dc voltage is filtered using capacitors of 1000micro farad to reduce the ripple from dc voltages and then using voltage divider circuit we are measuring current at Arduino controller this measured value of current is displayed on the LCD similarly system are developed for all three phases of transmission line separately for measurement of current. Arduino continuously measures the current of the all phases.

When fault occurs on transmission line arduino generate tripping signal which is applied to the contactor and contactor contacts open and isolate the faulty part from the system. Then auto-reclosing signal is given to the contactor by arduino which checks the fault clearance in pre-defined time interval for 3 times if fault is clear by the auto-recloser then contactor is closed and if fault is not clear by the auto-recloser then the system is going to be tripped.

V. CONCLUSIONS

This paper presents that the auto-reclosing scheme for power system can give high rate of successful reclosing by adaptive variable dead time control. The proposed system analyze measurement of current at the point accurately and classifies whether the fault is transient or permanent in nature and by controlling the dead time it auto-reclose the circuit breaker of transmission line. An adaptive auto-reclosing scheme for improving system stability has been implemented by use of Auto-reclosing control methodology. Protection system for transmission and distribution network can be made Automated which is capable enough to operate and isolate only the faulty part of system as early as possible without affecting the remaining system to maintain reliable power.

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