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Power Line Conductor Breakage Accident Avoidance using Wireless Communication

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Abstract **– Many times we read in newspapers that Humans & Animals die due to electrical shock in remote areas or in agricultural areas as contact with broken & hanging live supply wires. Safety circuitry of Distribution Company is inadequate and due to this line remains live with broken wires.**

This paper describes a modification to existing power distribution system with remote telemetry unit for wire break detection and a power supply breaking mechanism.

Circuit breaker with shunt trip mechanism breaks the supply and avoid damages from electrical accidents due to overhead transmission lines conductor breakage problems which will operate on open circuit principle rather than short circuit.

Keywords **– Transmission Lines, Remote Telemetry System, Open Circuit Detection, Breaking Mechanism, Accidents, Short Circuit, Wireless Communication.**

I. INTRODUCTION

At present overhead power transmission and distribution system is not sufficiently safe for any disaster of physical breakage of overhead transmission lines and due to this many peoples die due to electric shock hazards.

Medium voltage 440 volts line is distributed through 11kv/440v transformers which are not governed for any centralized protection. Any fault over these M.V. lines is only governed by fuses and if any short circuit occurs then only line is disconnected by fuses. We propose remote telemetry system with a wireless communication link and a remote controlled breaking mechanism which breaks the power supply and avoid damages from electrical accidents due to over head transmission lines breakage problems. Integration of Supervisory control and data acquit ion (SCADA) based distributed monitoring & control system with Remote Telemetry Unit (RTU) with open circuit detection can be a solution to this problem.[2]

II. PRESENT THEORIES AND PRACTICES

Presently there is no any power supply breaking mechanism for distribution transformers. Substation comprises of distribution transformers of 33kV/11kV and 11 kV line is transmitted up to max. 6km, distribution transformers 11kV/440V are used for end customers and can be 1km to 1.5km length from distribution transformers as shown in Fig.1.

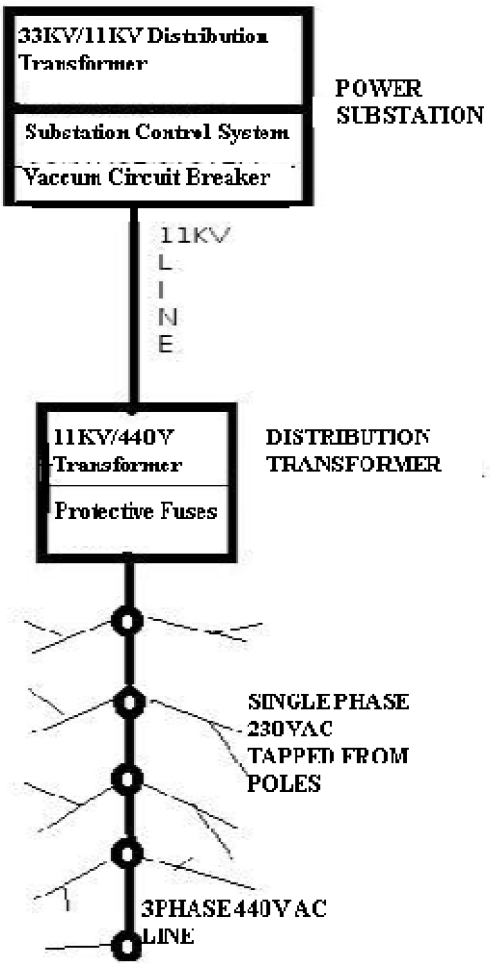

Fig.1. Existing Power Distribution System

When any short circuit fault occurs over 11kv line substation Vacuum circuit breaker (VCB) trips by earth fault. And when earth fault gets cleared then only vacuum circuit breaker (VCB) can be charged. In case of short circuit occurs over medium voltage (MV) 440 volts line only fuses of distribution transformer are blown[5].

At present there is no any tripping/breaking mechanism for live open circuited hanging wires, and fuses operates only when supply get ground path after short circuit (heavy flashover) and can cause accidents and fires. Also any mishaps on medium voltage (MV) line are not indicated to substation, and operator had no control over faulty line.

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III. DESIGN

Short circuit breaking mechanism (fuses) for safety for transmission lines operates mostly after accidents and mishaps. We propose modification to existing distribution system as shown in Fig. 2. Which will operate on open circuit of transmission line and will prevent electrical accidents of wire breaks and live hanging wires[7].

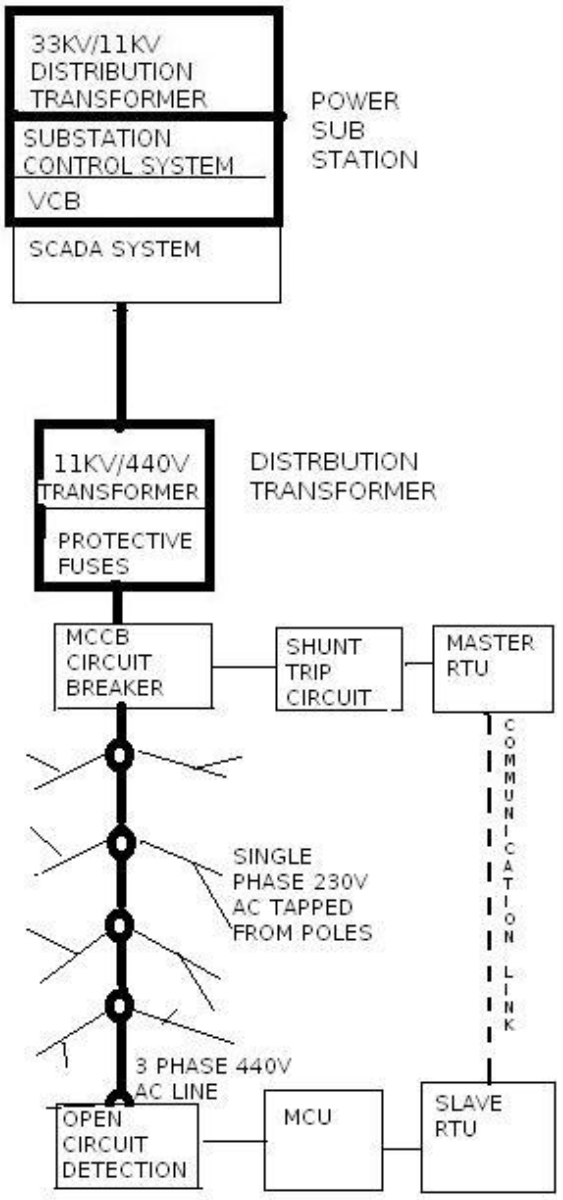

Fig.2. Proposed modification to power distribution system

For this we will use following components blocks

1) Remote controlled breaking mechanism moulded case circuit breakers (MCCB) with shunt trip after distribution transformer (440V side).

2) Open wire Detection circuit continuously monitors 3 phase supply voltage at the end of distribution system pole.

3)When any one phase voltage of three phase supply is not getting it immediately signals to the remote controlled breaking mechanism molded case circuit breaker (MCCB) through remote telemetry slave unit (RTU) .

4) Remote telemetry unit (RTU) slave is connected to RTU master through a wireless communication link.

5) RTU master connected to MCCB shunt trip mechanism and it gives trip command to MCCB when it gets faulty line signal from RTU slave to trip faulty line.

6) RTU master informs to substation SCADA system about problem notification.

Details of Blocks Used

Sensing method–single phase preventer basic circuit technique is used for wire break detection, as it will continuously monitor three phases and if any phase voltage is missing then it will signals to the slave remote telemetry unit.

Communication link– slave remote telemetry unit triggers TRIP command through communication channel to the master remote telemetry unit, this communication link will be power line communication link.[1]

Remote Controlled Breaking Mechanism– Presently only fuses are used for transformer protection on low tension (LT) side and fuses blown only in case of overload and short circuit condition. We propose modification to distribution system as placing remote controlled molded case circuit breaker (MCCB) for every 11kV/440V distribution transformer [9] .

Centralized SCADA control– Substation will have centralized computer system which will continuously monitors master remote telemetry unit and informs substation operator about any fault location and time.[3]

All these above blocks when totally integrated
Will be looks like as shown in Fig.3.

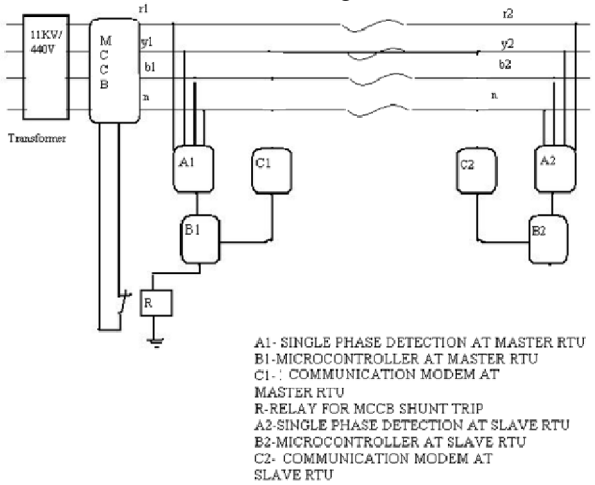

Fig.3. Block diagram of total integration of RTU and wireless link

IV. STRUCTURE OF THE PROGRAM

Microcontroller program

Master RTU algorithm
A input r1
A input y1
A input b1
= Q output Power Healthy

A Q power Healthy
A input Trip Signal from remote RTU
=Q output Shunt trip relay

Slave RTU algorithm
A input r2
A input y2
A input b2
= SF Healthy

ANF Healthy
A input Power Healthy
=Q Trip signal to Master RTU

V. Wireless Communication Link

Wireless communications systems operate by a modulated carrier signal on the radio waves. Different types of wireless communications use different frequency bands, depending on the signal transmission characteristics of the wireless channel.

Wireless communication is used for control and telemetry of electrical equipment such as meters, switches, heaters and domestic appliances over many years [12].

There are some interference issues with radio users or electromagnetic radiation. This allows end-end communications from substation to substation with/without repeaters. Wireless Modem used for this project is shown in Fig.4.

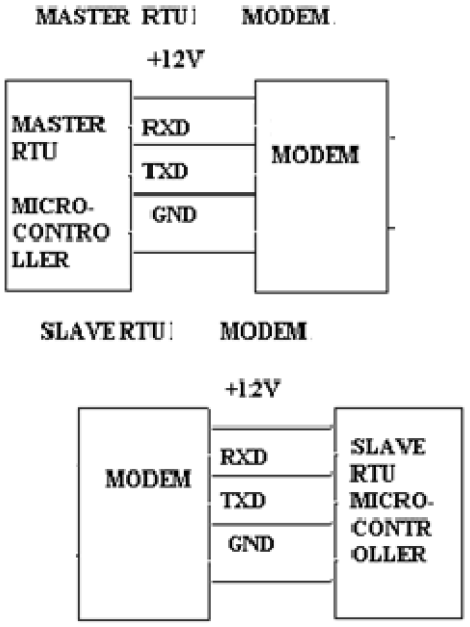

Fig.4. Wireless Mode

VI. Conclusion

Open circuit detection of power line system at the last mile pole is very useful to avoid transmission line breakage mishaps compared to short circuit fuse blowing mechanism which is now used in practice. Also Wireless communication RTU technology can be used over years without any maintenance.

Breaking mechanism technology now is so much advanced with microprocessor based and compact, also they can be controlled remotely by using a shunt trip mechanism signal.

This integration of breaking mechanism + Wireless link + open circuit detection will give an excellent result and avoid any electrical accidents due to open hanging wires.

Future Scope

To complete project we need integration of sensing circuit, breaking mechanism, and communication channel, we will use available open source technology. For shunt trip MCCB breaker and MASTER RTU with a microcontroller is connected to shunt trip circuit, also this microcontroller provides all protocol conversion of input data and transmit it to wireless modem. At receiver end (final end pole) SLAVE RTU and its microcontroller will continuously monitors the communication link and transmits trip command in case of open circuit of supply wires detection, and MASTER RTU thus trips the MCCB and breaks supply, and also informs to substation centralized SCADA control system[13]. The work is in progress for obtaining patent.

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