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"Protection of Distribution Feeder using Directional Overcurrent Elements"

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***Abstract*: -- Distribution system holds a very significant position in the power system since it is the main point of the link between bulk power and consumers. It usually has radial configuration and has an unbalanced operation. Equipment in distribution protection consists of fuses, recloses, and sectionalizes. The main priorities are to prevent further damage to utility equipment, as little of the system is taken down as possible, reliability and power quality. The problems associated with protection devices operation and coordination require special review since they may affect the system security and dependability. In order to avoid misoperations in the system, directional elements are needed to be added. Non-directional relays may not provide sensitivity and security for faults on remote points of the circuit. Directional supervision is necessary to set overcurrent pickups with adequate sensitivity for remote faults. Here, an effort is proposed to protect distribution feeder using directional overcurrent elements [1,2]. In the said research work, the standard IEEE bus will be used to verify the effectiveness and performance of the model. The simulations will be carried out on standard IEEE bus test system under the MATLAB environment. IEEE-13 node feeder will be used and directional overcurrent relay is to have meshed with the standard system and protection will be implemented.**

Keywords: - Power system, distribution feeder, overcurrent, directional relay, feeder protection

I. INTRODUCTION

Overcurrent relays are widely used for protection of power systems, directional ones for transmission side, and nondirectional ones for distribution side The normal power flow being from source to the grid, the fault direction may be forward (between relay and grid), or reverse (between relay and source) The fault direction is determined by judging the current phasor against the reference voltage phasor measured at a measurement location on the power line. In this paper, the case study will be carried out on the standard IEEE-13 node system. The simulations will be carried out on standard IEEE bus test system under the MATLAB environment. IEEE-13 node feeder will be used, co-operation of directional overcurrent relay with the standard system will be shown and protection will be implemented.

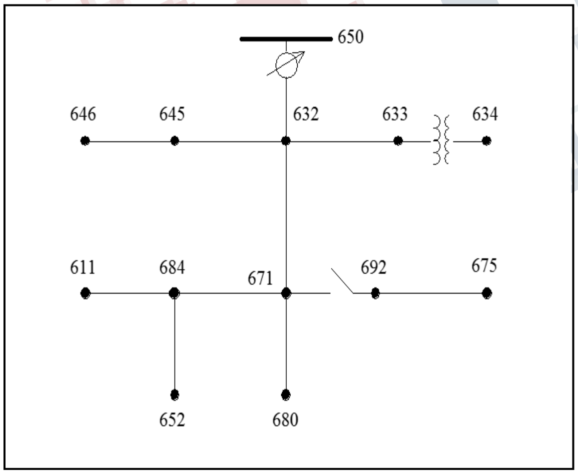
II. LITERATURE REVIEW

References [3,4] suggests that, faults generally results in high current levels in electrical power systems. These currents are used to decide the occurrence of faults and require protection devices, which may differ in design depending on the complexity and accuracy necessary. The ordinary type of protection devices are thermo-magnetic switches, moulded-case circuit breakers (MCCBs), fuses, and over-current relays. Amongst these types, over-current relay is the most common protection device used to counteract excessive currents in power systems. References [3,5] dealt with protecting system which not only dependant on over-load but also on overcurrent circumstances. It also suggests, an over-current protection relay is a device able to sense any change in the signal, which it is receiving normally from a current and/or voltage transformer and carry out a specific operation if the incoming signal is outside a predetermined range and usually the relay operates at closing or opening electrical contacts, as for example the tripping of a circuit breaker. Limitation of overcurrent relay in sensing the direction of fault, is mitigated by adding a directional element along with it, is specified in references [6, 7, 8]. Directional overcurrent relays are commonly used for the protection of distribution systems and also as a secondary protection of the transmission system [9,10]. References [11, 12, 13] dealt with the concept that each relay in the power system must be coordinated with the other relays in the power system. A relay must trip for a fault under its primary zone of protection. Only if, the primary relay fails to clear the fault, the back-up relay should take over tripping. If backup relays are not well coordinated, the relay may get mal-operated. Therefore, relay coordination is a major concern for power system protection. Reference [14] put forward the theory of the major problem with this type of protection is the complexity in performing the relays coordination, mainly in multi-source networks. New relay settings are implemented as load, generation level or system topologies changes. Changes in the system are detected by identifying the operation scenario.

III. METHODOLOGY

The IEEE 13-Node test feeder model has characteristics listed as follows:

1. The 13-Node test feeder is relatively short (8200 ft) and highly loaded for a 4.16 kV feeder. The longest line is 2000 ft long.
2. There is one substation voltage-regulator consisting of three single-phase units connected in wye. This regulator has capability to change secondary voltage in steps of 0.00625 per-unit (pu).
3. There are overhead and underground lines with variety of phasing in this feeder.
4. There are two shunt capacitor banks. One at node-675 with 200 kVAr each phase and the other one at node-611 with 100 kVAr.
5. There is one in-line transformer between node-633 to node-634. The transformer is 500kVA 4.16 kV/ 480 V in wye-ground configuration.
6. There are unbalanced spot and distributed loads, which are of Constant PQ, I, or Z type connected in delta or wye configuration
7. One of the other reasons for selecting this test feeder is that, it is verifiable from the available test data and it is relatively smaller with 13 electrical nodes making it conducive to simulate on a reasonably sized real-time platform. Figure (a) shows single line diagram for 13-Node distribution model [15,16,17].



Figure(a) : The IEEE 13-Node test feeder

In the progressive work of this paper, SIMULINK model of IEEE-13 bus standard system will be designed with addition of directional overcurrent relay and the performance of the system before occurrence of fault and after occurrence of fault will be analyzed.

IV. CONCLUSION

In the unstable and radial distribution system, there is need for the efficient protection of protection equipments. To avoid misoperations in the system, directional elements are needed to be added. Directional supervision is necessary to set overcurrent pickups with adequate sensitivity for remote faults. This paper will offer an effective means for explaining the functionality of directional overcurrent relay on standard IEEE-13 bus under various operating scenarios.

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