ADAPTIVE COORDINATION FOR POWER SYSTEM PROTECTION: ISSUE & BENEFITS

JASPAL SINGH
Panjab University SSG Regional Centre Hoshiarpur (Pb)

Abstract: This paper deals with protection of power system network using adaptive relaying system. A number of protective relays and equipments are required to protect a power system network. Each protective relay in the network needs to be coordinated with relays protecting the adjacent equipment. The coordination of protective devices in power system network is very complicated. It is almost impossible to obtain a protection setting that can satisfy the coordination between all adjacent relays in a power network. Adaptive relaying means changing relay settings and relay pick up currents in online mode as operating conditions of the system changes. The system changes may be load and generation level changes or line and transformer outages. Advancement in technology using microprocessors have led to many improvements in protection systems like lower installation and maintenance costs, better reliability, improved protection and control, and faster restoration of outages.

Keywords: Adaptive Relaying, Offline Coordination, Online Coordination.

I. INTRODUCTION

Power system protection performs the function of fault detection and clearing as soon as possible, isolating whenever possible only the faulted component or a minimal set of components in any other case. Since the main protection system may fail, protections should act as backup either in the same station or in neighboring lines with time delay according to the selectivity requirement. The determination of the time delays of all backup relays is known as coordination of the protection system [2].

The protection system must have following objectives [4]:

- Protect the system components such as lines and machines from excessive currents or voltages, and
- Selectively isolate the faulty section of the system from the rest so that supply in the remaining section remains unaffected. Moreover this helps in fault clearance and resumption of normal service.

Setting the relay parameters for proper detection and clearing of faults is a complex operation. Relay coordination is based on static representation i.e. assuming steady state conditions. It can be classified as offline coordination and online coordination.

II. OFFLINE COORDINATION

The offline coordination means predetermined settings. Analysis of all faults, abnormal operating conditions and system contingencies are determined in advance. The coordination is done in following steps [2]:

a. Fault calculation: calculation of fault currents, voltages and impedances.

b. Determination of reach point of each protection zone: using short circuit magnitudes, current settings for instantaneous or delayed operation of over current relays and impedance values for the protection zones in distance relays are determined.

c. Building up an ordered sequence for all possible pairs Principal/Backup (P/B) of the network. To reduce the number of iterations, a sequence of all P/B pairs is determined on the basis of an analysis of the network topology.

d. Setting of time dial: According to the sequence of P/B pairs, time characteristics of backup relays are set, so that their operating times result in greater than equal to a previously defined coordination time interval.

Offline settings and coordination can only consider a limited number of network states. For each of them the above procedure should be repeated. Optimal results would be obtained if all P/B pairs were correctly coordinated for all possible states of network. Since this is not possible, a group of settings which satisfies the coordination requirements for those states considered is selected.

Drawback of this method is inability to determine relay response for a condition not previously included in the analysis. It is practically impossible to handle all operating conditions of concern in advance. At some instances, this method may fail.

III. ONLINE COORDINATION

Online coordination is the ability of protection system to change relay parameters online depending on present operating conditions. The online coordination is required because it is becoming difficult to have a distinction between normal heavy loads under alert system conditions and abnormal faulty system conditions with increasing loads every day.
IV. ADAPTIVE RELAYING

The terminology describes the ability of the protection system to adapt to the current operating condition of the power system. This technique is more relevant to the modern digital relays, which have automatic settings. Digital relays are based on microprocessors and are allowed to adapt their settings and functions to the actual state of the system in real time. An adaptive protective system is required for the protection system. The objective of the adaptive protection is to change the relay settings to match them with the prevailing power system conditions. An adaptive protective system is more complex than the non-adaptive protection, so a better knowledge of interactions between the power system & relays is required. Further digital relays provide technical improvements and cost savings in several ways [3]:

a. The relays use programmable logic to reduce and simplify wiring.
b. The relays provide protection for bus faults, breaker failure, and high-side transformer blown fuse detection at no or minimal additional cost.
c. The relays have metering functions to reduce or eliminate the need for panel meters and transducers.
d. The relays reduce maintenance costs by providing self-test functions and high reliability.
e. The relays provide remote targets and fault location information to assist operators in restoration of electrical service.

V. BENEFITS OF ADAPTIVE COORDINATION

Adaptive coordination has following advantages [1]:

a. It is necessary to consider only one state of the network for each coordination case.
b. Faster operation of the protection system can be obtained since no other states are considered. A comparison shows faster relay acting in approximately 20% of their acting time when no other states are considered.

c. A smaller number of miscoordinated pairs are obtained after the coordination process. It means that fewer component outages, due to miscoordination are to be expected.

VI. ADAPTIVE RELAYING SYSTEM SOFTWARE

The adaptive relaying can be achieved by using appropriate softwares and relays that collect information, and communicate with other relays and control devices. The three major software’s required for implementing an adaptive relaying system are Relay modeling software, relay coordination software and communication software. A relay characteristic at a selected TMS is stored in the relay memory in relay modeling software. The relay coordination software considers the system changes and determines the most appropriate relay settings. The communication software allows the relays to exchange information between them, with the station computers and between the station computer and master computer. The adaptive relaying system functions in two modes. One mode is for operation when the system operating conditions changes and the second mode is for operation during faults and other transients.

CONCLUSION

In this paper coordination procedures of protecting relays are discussed. In offline coordination, it is difficult to identify and analyse all conditions in advance. The chosen relay settings are sometimes insensitive to a few operating conditions. With the microprocessor based relays adaptive relaying is possible. Adaptive relaying continuously monitors the state of a power system, analyzing and change the relay settings to those which are most appropriate for the state of the system. Adaptive settings have significant advantages compared with the fixed settings. With adaptive settings, operating times and number of erroneous coordination can be significantly reduced. Adaptive relaying is possible by using microprocessor based relays and appropriate softwares, and communication aids.

REFERENCES

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