Chapter 43
Fuzzy Logic Based Approach for Power System Fault Section Analysis

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ABSTRACT

In this chapter, a fuzzy expert system is developed to assist the operators in fault detection. It requires much less memory to store the database (power system topology and the post fault status of circuit breakers and protective relays). The fuzzy expert system identifies two basic network section sets, $S_{healthy}$ for the healthy sub network and S_{island} for the fault islands, using the post fault status of circuit breakers and relays. It then calculates membership function for each possible fault section. The objective of this calculation is to determine the likelihood of each candidate fault section as the actual fault section. Moreover membership functions provide a convenient means of ranking among possible (or candidate) fault sections, and are the most important factors in decision making. During decision making, the most possible fault section is determined by maximum selection method. In this method most possible fault section is the one which is having highest membership grade. MATLAB code for the proposed scheme is developed and the results obtained in four cases for a power- system network.

1. INTRODUCTION

Power distribution reliability has a high impact on the service restoration cost when a fault occurs and on customer satisfaction and is therefore an important topic in an electric power industry. To reduce the outage time and to enhance service reliability, it is essential for operators to locate the fault sections as quickly as possible. Fault section location aims to identify fault components in a power system using the post fault status of protective relays and circuit breakers and diagnose the cause of a fault that has occurred. Accurately identifying a fault location and cause can significantly reduce the restoration cost.

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After a fault has been detected and located, it becomes easy to restore the service. Today's in highly complex power systems Supervisory Control and Data Acquisition (SCADA) systems are in use for efficient operation of power transmission and distribution networks.

But, many false alarms are triggered in a SCADA system due to inaccurate operation or maloperations of the system's relays and circuit breakers in the post fault state (Srinivasan, Ruey, Young, Albert & Chwee, 2000). When a breaker fails to operate, the fault is then removed by back- up breakers. In such cases, the outage range is very large and it is difficult for the dispatchers to judge where the fault is located. However, the relay time settings in power transmission systems are much smaller. Consequently, difficulties may arise in setting the time delays with sufficient accuracy and failure would have serious implications. Moreover, occasionally multiple faults may take place, with many breakers being tripped within a short time. In these circumstances, so many alarm messages pour into the dispatch centre that it is impossible for the dispatchers to analyze the situation satisfactorily (Zhu, Yang, Hogg, Zhang, & Gao, 1994).

2. LITERATURE REVIEW

Over the last ten decades a larger number of papers have published in the area of fault section identification in power network. Here in this chapter, an attempt has been made review some of major contribution in this area.

(Zhu, Yang, Hogg, Zhang & Gao 1994) have described the development of an expert system for estimating fault section in control cEnter based on protective system simulation. They have presented as a principle for stable power supply, any fault sections in a power system must be disconnected quickly, to meet this principle, utilities are making effort to educate and train their operators for recovering power supply in proper manners. System operation and protective relay actions, but also accurate and extremely quick judgment based on the knowledge. Because of the importance of system restoration, development of an expert system efficiently supporting operators is eagerly awaited. Therefore, fault section judgment has been studied a some of the major themes in the field of artificial intelligence application to electric power systems .In many studies in this field, knowledge about cause and effect between the fault section and relay action is represented. There are many devices in power system and therefore, in order to describe a power system and its protective system accurately, a great numbers of consistent rules are required. This makes acquisition and verification of the knowledge difficult.

To overcome this problem, they proposed a method for estimating fault section including protective system simulation; the authors have developed a practical expert system which infers the protective coordination of relays on the bas is of the protection zone and time setting of the relays.

They proposed expert system features

- Relay operation functions are represented by protection zone and time setting with numerical figures, which service as database provided outside the expert system.
- The explanation facility of many other expert systems displays only the inference chain of rules applied, requiring the operators to comprehend the rules and their knowledge representation structure totally.
- Separating teleological knowledge and non-teleological knowledge