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Wavelet Transform Based Fault Detection Method - A Review

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Abstract: Electrical power system consist various component. From this component Transmission lines are designed to transfer electrical energy from source locations to distribution networks. Therefore these are vital component of electrical power system. Most of time transmission lines are exposed to various faults in overhead transmission line system. Hence various protective scheme and devices such as protective relay and fault recorder systems, based on fundamental power frequency signals, are installed to separate the faulty line and provide the fault position. However, the error is high especially in transmission lines, so to provide a good quality of electricity as well as to prevent accidents, a study of protective scheme is very important. This paper provides a brief review of various faults and wavelet based fault detection methods used for their detection.

Keywords: Wavelet transform, fault detection, power system, ANN.

I INTRODUCTION

The population of India is expanding day by day, thus the demand of electricity also increasing proportionally, so it is necessary to provide a good quality of power supply , the maximum power with the minimum losses and high stable power system for securing the stability of the power system. Its is necessary to maintain the constant transmission lines parameters. The most important disadvantage which decreases the efficiency of transmission lines is the faults. All has to clear as early as possible within short period of time. There are various faults occurring in transmission lines such as L-G, LL-G, LLL, and LLL-G. So it is also important to detect, classify and clear these faults as early as possible. So various techniques along with the switchgear are incorporated in this view. Large amount of advanced techniques for faults analysis, detection, classification, locations has been done and found great accuracy and efficiency.

II.VARIOUS TYPES OF FAULTS AND THEIR CALCULATION

There are various methods for calculation of these faults such as Z-bus matrix method. No doubt there are circuit breakers and relays which comes in the category of switchgears but the major and transient faults cannot be clear. The most important parameter which vary and to be controlled when fault occurs is the fault current .The various mathematical manual methods for calculation of fault current such as Bus impedance matrix and fault current calculation using Z bus shown in fig.1. These techniques found to be complicated for solving large networks of transmission lines and maintaining the parameters of transmission lines which are not constant and calculations becomes difficult as the length of network increases calculation becomes more complex .Also fault classification and detection is carried out by using various techniques which are advanced and very accurate by means of various software such as Mat lab, PSCAD EMTDC. In this paper we have discussed various techniques for fault classification, location and detection.

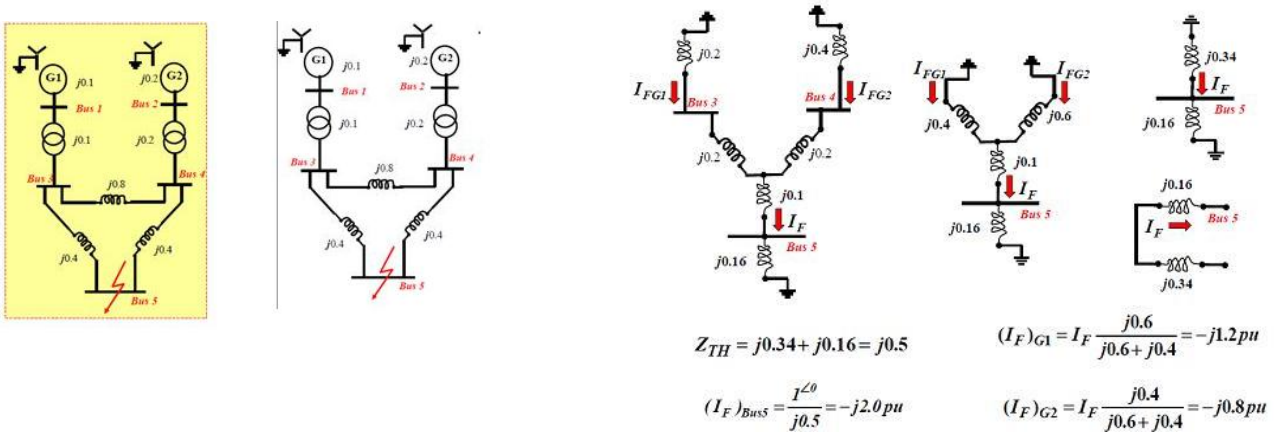

fig.1 .Z bus calculation.

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A. Wavelet and statistical pattern based high impedance fault detection.

The another method for fault detection and classification based on Wavelet and statistical Pattern Recognition. It's a novel method for High Impedance Fault (HIF) based on pattern Recognition. The insulator leakage current (ILC) and transients such as capacitor switching load , ground fault , inrush current and no load line switching. Wavelet transform is used for the decomposition of signals and feature extraction,

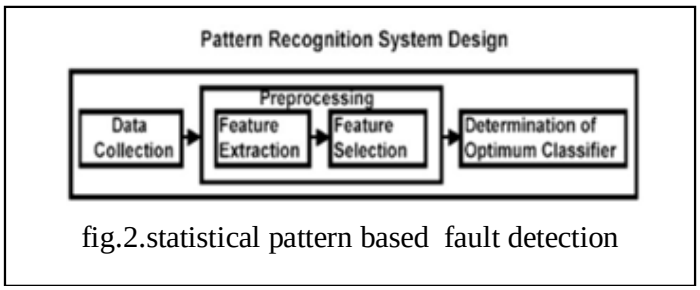

fig.2.statistical pattern based fault detection

Selection component is done by principle component analysis and Baye's classifier but this technique is not so accurate and found problems in result analysis.

B. Combined SVM – wavelet technique for detection of fault zone

After that a method called SVM technique for a fault zone detection in a series compensated transmission lines is undertaken. This method has a combined wavelet support vector machine (SVM) technique for fault zone identification in high voltage transmission lines we can consider it as series compensated transmission lines. The features of the line currents are extracted using decomposition levels of DWT that is discrete wavelet transform. These features are given as input to SVM for testing and determining the fault zone. This method can detect up to 1000 fault cases with varying fault resistances, inception angles and source impedances. But however this technique is limited upto series compensated lines but not on all categories of transmission lines.

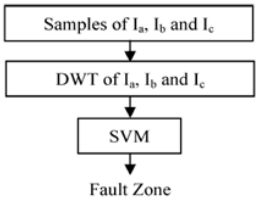

fig.3. DWT with SVM Technique

Classification and detection of transmission line Faults using Discrete wavelet transform with combination of ANN.

The most promising and universal method for fault detection , classification and location is the wavelet transform using ANN. The DWT is a powerful tool for extracting the features of waves using the multi resolution analysis. The wavelet can also identify the very minute disturbances occurring in a normal wave and decompose it to get samples. There is much information in the transient components. So it can be used to identify the abnormality of the equipment or the power system. There are various power wavelets which works in power system and there accuracy and computation time is very less. Also ANN is artificial neural network is the best classifier which works as human brain neurons. It first trains itself with the extracted results by setting the iterations and working on it again and again, and by the hidden layer synthesis get the results at the most accurate level. So the combined wavelet and ANN technique is found to be most world wide for all types power system disturbances whether they can be power quality issues or transmission line faults

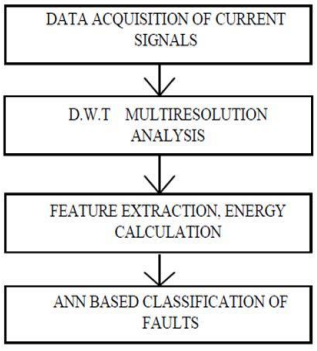

fig.4.DWT with ANN Technique

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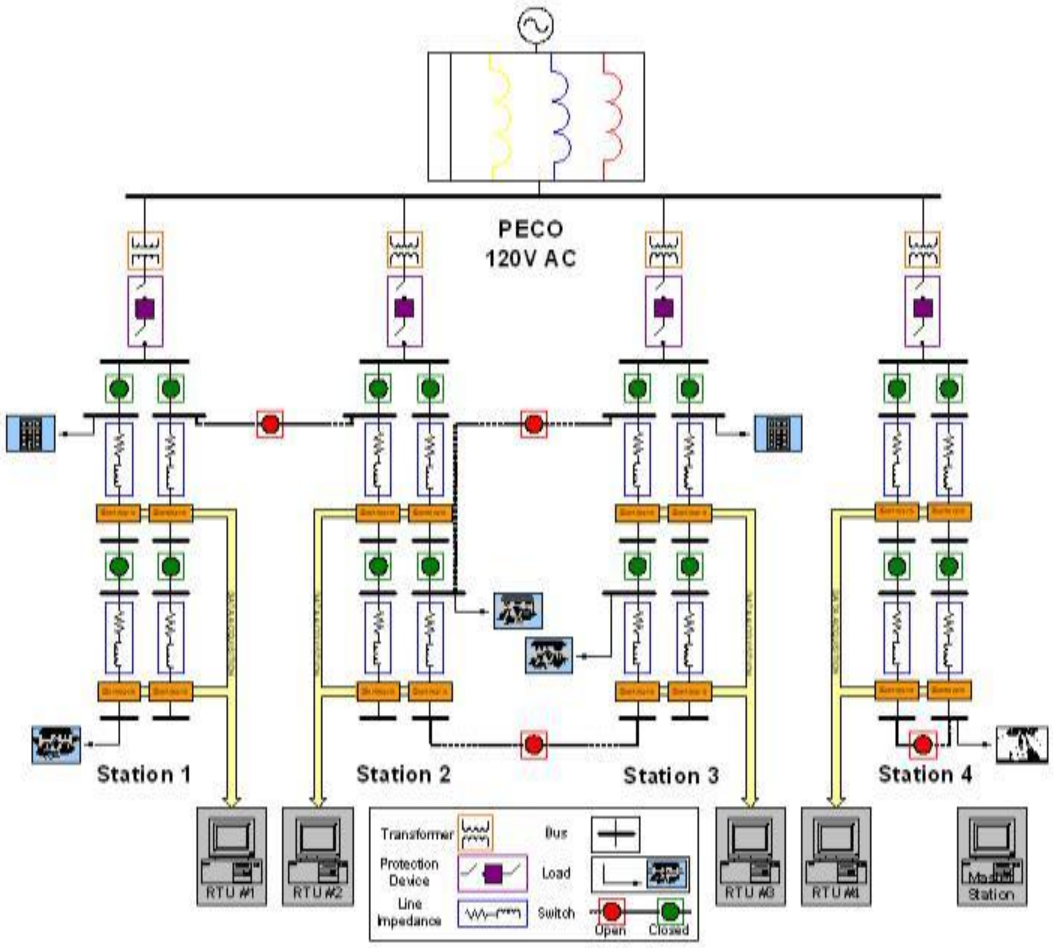
D. Wavelet Based Fault Detector Algorithm

In this method an algorithm is used to detect the fault in system.A 36-bus radial unbalanced distribution system with 4 feeder buses and 8 lateral feeders shown in figure. The line segments of each lateral have the same impedances ratings, although due to slight differences in manufacturing, create a slight unbalance between phases. Four solid-state voltage relays act as normally closed switches and can be controlled remotely. Measurements are acquired from Hall-Effect Devices (HED) on three phases as well as the neutral wire and can be taken at any four buses at one time. This current limiting device was connected between the variable autotransformer and the distribution feeder box. The device utilized two 40mH inductors connected in parallel per phase and limited the current to 15A, approximately 5A below the maximum current rating of the system components. Another inductor box was also created in order to test RL loads, which contained two 40mH inductors per phase that could be connected in series or parallel. Incorporating motors loads into the fault experiments would further add to voltage and current dynamics during fault conditions and was therefore of special interest. Although, four 5-hp induction motors were available in the adjacent laboratory it was uncertain whether they could be safely connected because of their electrical characteristics. Therefore, before an actual induction motor could be connected to the system, an RL equivalent circuit model of an induction motor during steady-state operation was required to be proposed and tested. The upper three relays are responsible for switching phases A, B and C to ground, whereas the owner three connect phases A to B,B to C and C to A respectively. Several relays can be used in unison to create 11combinations of LG, LL, LLG and three-phase faults. This method includes adaptive fault protection scheme for transmission lines using synchronized phasor measurements. The fault detection, direction discrimination, classification, and location. Both fault-detection and fault-location indices are derived by using two-terminal synchronized measurements, incorporated with distributed line model and modal transformation theory. The fault-detection index is composed of two complex phasors and the angle difference between the two phasors determines



whether the fault is internal or external to the protected zone. The fault types can be classified by the modal fault detection index. This scheme also combines online parameter estimation to ensure protection scheme performance and achieve adaptive protection. Extensive simulation studies show that the proposed scheme provides a fast relay response and high accuracy in fault location , classification under various system and fault conditions. The proposed method responds very well with regards to dependability, security, and sensitivity (high-resistance fault coverage).

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IV CONCLUSION

This paper provides a brief review of various fault detection methods which uses wavelet transform technique for transmission line fault detection. The current study shows that application of wavelet transform increasing in protection schemes from electrical power system and also it has wide application area in power quality control.

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