Review of Modeling and Simulation of Numerical Mho Relay for Distance Protection

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Abstract – With the development in science and engineering the power system protection field also get advanced which includes the development of relays .the relays journey started by electromechanical then solid state and now digital and numerical relays .An economical and feasible solution to investigate the performance of relays and protection system offered by modeling of protective relays . Distance relay is one of the effective protective relays that are used for the protection of extra high voltage transmission lines. Distance relays are considered of the high speed class and can provide protection. To detect the fault on transmission lines many distance relays are used but for long transmission line mho relay is most suited. This paper overview the methods proposed for modeling the numerical mho relay for distance protection of transmission line and different solution for enhancing the performance of power system.

Index Terms – Distance protection; Mho characteristic; Impedance relays; Numerical relays, Matlab/Simulink.

1. INTRODUCTION

Protection relays are one of the key components in power systems that give very high impact on power system's stability and reliability. The field of protective technique gets transformed in its advance form by the development in new technology. Distance relay is among the protection relays used in power system which used in transmission system. Distance relay provides main or backup protection. Transmission line or power transformer can be protected by distance relay. Power transmission lines are connected with number of different components of electrical power system. Power transportation and to keep healthy operation continuously becomes very difficult task to Maintaining system reliability and to maintain voltage control and other factor also. Hence prevention of transmission system is very necessary.

Nowadays, the electromechanical and static distance relays are replaced by numerical distance relays. The first numerical relays were released in 1985.Numerical relays are based on the use of numerical devices or digital devices like microprocessor, microcontrollers, DSPs etc .are the development in area of power system protection. Many different methods techniques are there which help to modify numerical mho relay but these techniques are unable to fulfill the entire requirement and contain some limitation or drawbacks. So we are developing a new model of numerical mho relay to overcome such limitations. With the help of such methods modeling of power system in different fault conditions are made and tested. Such methods of modeling numerical mho relay makes it more feasible and flexible as it can be tested with different fault conditions so that its performance can be checked. This paper work gives the overview of various topologies, methods used for modeling the numerical mho relay.

Research Objective:-

[1] To study several distance protection schemes in power system protection.

[2] To compare conventional and modern distance protection relaying system in power system.

2. LITERATURE REVIEW

Authors suggested the new positive sequence direction element to use in numerical distance relay, which is based on the incremental positive sequence signals, has been implemented on a numerical distance relay. They performed the experiment of numerical distance relay with positive sequence direction element on Manitoba hydro network and get the successful result on numerical relay. The test is also performed on real time digital simulator (RTDS) and they get the expected results. This gives the accurate relay model to extend or to explore relay operation in complex networks which are beyond capability [1].

The research work shows the use of relay in past time and in coming time, on that basis to developed software model of relay various models required data is checked which helps to develop such model of relay. The software model performance is checked against the performance of actual relay. Software model can be used iff required assumptions are made. [2]

Authors suggest the protection scheme based on wavelet transform. This detects the descrete frequency band which contains transient fault current wave. This detected signal is being checked by the mother wavelet and check if the fault is internal or external. This approach gives good selectivity and sensitivity. It is reliable and feasible to the time .This scheme

of protection is the improved version of traditional protection systems. [3]

This Author suggested a new technique of impedance's trajectory after faults represents numerical output of the impedance calculation. The output results show the behavior of the developed model under various fault locations and at different arc resistances. The simulation study presented in this paper assist in demonstrating the importance of and need for accurate dynamic modeling of distance protection relays. For the particular system studied it was found that the three-zone protection would not see a fault at the reach setting, resistive fault causes the relay to under-reach. The exact and misjudgment of the fault location in the cases demonstrated in this paper reflects the accuracy of the developed model. The distance relay model may be used as a training tool to help users understand how the relay works. The distance relay model offers an inexpensive alternative to evaluating a relay on a test set and generally will involve significantly less time and effort. [4, 5]

The authors describe comparison of two different methods for phasor estimation of numerical relaying. The protective relays based on different protection principals require that the phasor of current and voltage can be extracted .Here authors take Wavelet Transform and Fourier Transform methods for comparison. By comparing it was found that DWT method performed better in absence of dc offset, in terms of speed of measurement. With the existence of DC offset, the amplitude of the fundamental frequency component calculated by both DFT and DWT methods, deviated from the normal value. However, DWT method performed not so well in presence of dc offset and harmonics. Therefore, though wavelet analysis has many other useful applications in power system protection, it has limited role in phasor estimation. So the limitation of DWT method can be overcome by using DFT method though it not as fast as much as DWT method. [6]

Here author presents the detail model of series capacitor used in power system power system. Here the procedure of calculation of apparent impedance of series capacitor is explained. This work shows the change setting mho distance relay protection with different point protection on transmission line High voltage such as sending end line and mid point line series compensation. The effect of series capacitors on distance relay is more critical for capacitors located at line ends than for mid line capacitors.[7]

Here the authors presents the performance study of distance relay using MATLAB .this is tested under fault conditions and mho characteristics was used to study the performance of the developed relay with trip time calculation. Here the effect of fault resistance on relay performance is checked. It shows that the variation in fault resistance affects the performance of distance relay system. [8]

This research presents a detailed effect of a fuzzy-logic-based scheme or system in conjunction with STATCOM for the operation of generator-phase backup distance protection. Here the Electromagnetic transient simulations were used for the studies. The combination of the simulation and fuzzy system is performed and the results are calculated. It is found that in presence of STATCOM the mho relay can be mal operate while the adaptive fuzzy mho relay could issue the correct trip signal.[9]

Authors proposed modeling of distance relay using MATLAB/SIMULINK. By considering the mho type distance relay a graphical user interface was created Using GUI package inside MATLAB. The GUI provides user friendly interface to help and enhance their understanding of distance mho relay. The distance relay model was developed successfully and verified. [10,15].

Authors proposed MHO Characteristics and Frequency Dependent (Phase) model.Model type transmission line is modeled and simulated using PSCAD/EMTDC software.To study the performance of the relay characteristics, single line to ground fault at different zones with and without fault resistances are considered. The developed rely can be used to train the engineers. Different fault condition can also studied with the help of developed relay model.[11]

Author shows the new way to design mho relay in MATLAB which is based on fast Fourier transform algorithm which have ability to estimate and exact the quantities like magnitude of and DC offset component during fault and also can filter out noise from it by using filters. This new algorithm has ability to classify the faults and it allows fast tripping It is more sensitive and accurate. [12]

Here the new way of developing Mho relay by using LabVIEW software presented by authors. Firstly the model of mho relay is developed in PC using LabVIEW,then tested.Therelay is tested under different fault conditions, and it was able to recognize the fault type correctly.It can identifies the fault location as required.[13]

A Mho distance relay is developed by using MATLAB/SIMULINK. Here design and modeling of distance mho relay is done .The voltage and current s signals contains DC offset values and higher order harmonics which are unwanted. These unwanted components can be eliminated by using discrete Fourier transform technique.The distance relay can be verified by data generated by R-X diagram with the help of this data alltypes of faults can be drawn and it can observed that measurement of impedance is done properly.[14]

3. PROPOSED MODELLING

The proposed strategy of operation is mainly to design the numerical distance mho relay by using proper modeling method or strategies so that to enhance its performance to

protect the transmission line. A standard system is considered where the developed different models are tested for different fault conditions. the method which gives best result are selected for transmission line protection .

3.1 Distance Protection:

Distance relays, as the name suggest us , should measure distance. Number of distance relays is mounted on transmission-line-which measures the impedance between the relay point and the fault location. The measured impedance is proportional to the length of the conductor that is between relay and point where fault occurs As the measured quantity is proportional to the distance along the line relay is called distance relay. There are various types of distance relay used for the protection of transmission line. Here we are using numerical mho relay for advanced protection of

3.1.1. MHO Relay :-A mho Relay is a high-speed relay and is also known as the admittance relay. In this relay operating torque is obtained by the volt-amperes element and the controlling element is developed due to the voltage element. It means a mho relay is a voltage controlled directional relay. A mho relay using the induction cup structure is shown in the figure below. The operating torque is developed by the interaction of fluxes due to pole 2, 3, and and the controlling torque is developed due to poles 1, 2 and
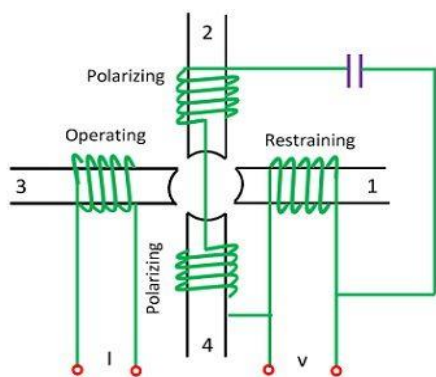

Figure 1. MHO Realy

3.1.2. Numerical MHO Relay: - Since their introduction on 1920, Classic distance relays based on electro-mechanical and then on static technology are still in wide use. However due to the booming in digital techniques, microprocessor–based relays were introduced. It is quite common to use term digital relay instead of numerical relay as the distinction between both rests on fine technical details. Others see numerical relays as natural developments of digital relays as a result of advances in technology. However, the term (digital distance protection) has always been used in the meaning of (numerical distance protection) A general view of the typical digital relay is shown in figure below .The generalized numerical relay concept is

directly derived from open system relaying Different relay functions can be obtained from the same hardware just by modifying Microprocessor programming.
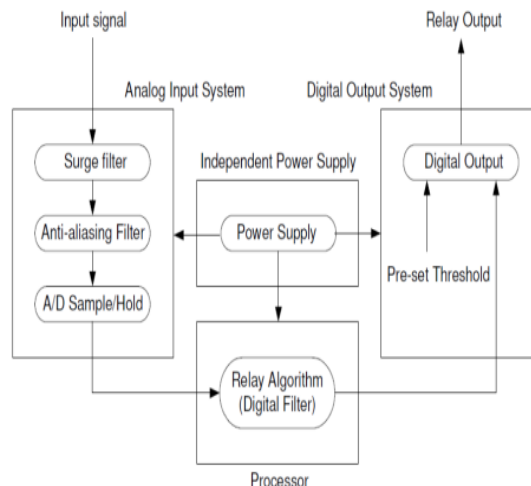

Figure 2. Numerical MHO Realy

4. CONCLUSION

As many research and experiments made in designing and developing the different methods, techniques for the protection of transmission lines by different experts starting from development of electromechanical relays to digital protection of transmission lines using computers and microprocessors are reported. In this proposed implementation various methods schemes to modulate the numerical mho relay are discussed. Every result varies from each other and time required is also different. Various topologies were used to model and simulate the numerical mho relay, but they are different in their operation and have their own advantages on overall system. But by over reviewing all the methods in most of the paper the researchers used MATLAB for modeling which gives best results.

REFERENCES

[1] P.G. McLaren SM, G.W. Swift SM, 2. Zhang, E. Dirks, R.P. Jayasinghe, I. FernandoUniversity of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2.” A New Directional Element for Numerical Distance Relays” *IEEE Transactions on Power Delivery*, Vol. 10, No. 2, April 1995.

[2] P. G. McLaren, K. Mustaphi, G. Benmouyal, S. Chano, A. Girgis, C. Henville, M. Kezunovic, L. Kojovic, R. Marttila, M. Meisinger, G. Michel, M. S. Sachdev, V. Skendzic, T. S. Sidhu, and D. Tziouvaras” Software Models for Relays*” IEEE transactions on power delivery*, VOL. 16, NO. 2, APRIL 2001.

[3] Shailendra Kumar Saroj, Harish balaga, D. N. Viswakarma (Banaras Hindu University), Varanasi, India ” Discrete Wavelet Transform Based Numerical Protection Of Transmission Line ”, Department of Electrical Engineering Indian Institute of Technology

[4] Li-Cheng Wu, Chih-Wen Liu, Ching-Shan Chen,Member, National Taiwan University, Taipei, Taiwa, “Modeling and Testing ofa Digital Distance Relay Using MATLAB / SIMULINK ,IEEE transaction on power delivery,2005.

[5] Eng. Abdlmnam A. Abdlrahem , Dr.Hamid H Sherwali Modelling of Numerical distance Relays Using Matlab ”, “*IEEE Symposium on Industrial Electronics and Applications*”,Octobe,2009.

[6] V.S.Kale S.R.Bhide P.P.Bedekar, " Comparison of Wavelet Transform and Fourier Transform based methods of Phasor Estimation for Numerical Relaying " ,Internation confereance on science and Engineering 2011.

[7] Mohamed zellagui abdelaziz chaghi"Mho Distance Relay of Transmission Line High Voltage using Series compensation in Algerian Networks"Mediamira science Publisher 2011.

[8] DibyaDarshiniMohanty, Ashwin Sharma, Ashutosh Varma M.S.I.T ." Performance Assessment of Distance Relay using MATLAB" International Journal of Engineering Research & Technology (IJERT)Vol. 2 , December – 2013.

[9] Sivaramakrishnan Raman, Ramakrishna Gokaraju,, and Amit Jain,Member, " An Adaptive Fuzzy Mho Relay for Phase Backup Protection With In feed From STATCOM" IEEE transactions on power delivery, vol.28, no.1, january 2013.

[10] Muhd Hafizi Idrisa, Surya Hardia, Mohd Zamri Hasana "Teaching Distance Relay Using Matlab/Simulink Graphical User Interface", Published by Elsevi Selection and/or peer-review under responsibility of the Research Management & Innovation Centre, Universiti Malaysia Perlis 2013.

[11] M.P.Thakre, V.S.Kale" Distance protection for long transmission line using pscad" International Journal of Advances in Engineering & Technology, Jan. 2014.

[12] Auday A.H. Mohamad1 and Essar Gafar Ahmed, "Design a fast digital protective relay algorithm for high voltage transmission line" Sudan Engineering Society Journal, , Volume 60; No.1, March 2014.

[13] Ayache MATI, Merouane BEGBAGUI, and Hamid BENTARZI "A New Framework of Numerical Distance Relay Using LabVIEW ", IEEE trasaction , 2015.

[14] J. N. Rai, Ajit Kumar Singh Delhi, " Modeling and Simulation of Distance Relay for Transmission Line Protection" National Conference on Emerging Trends in Electrical and Electronics Engineering, Feb 2015.

[15] Mr. Kunal K. Joshi , Prof. M. R. Hans," of Mho Type Distance Relay for Protection of Long Transmission Line using Matlab / Simulink Environment" International Journal of Engineering Research & Technology, Vol. 5 Issue 04, April-2016.

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