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PERFORMANCE ANALYSIS OF NUMERIC RELAY FOR 400KV LINE UNDER DIFFERENT LOADING CONDITIONS

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ABSTRACT: An electrical power system comprises of generation, transmission and distribution of electric energy. Transmission lines are used to transmit electric power to distant large load centers. The rapid growth of electric power systems over the past few decades has resulted in a large increase of the number of lines in operation and their total length. These lines are exposed to faults as a result of lightning, short circuits, faulty equipment, mal-operation, human errors, overload, and aging. The uninterrupted power and reliable power is the backbone of any growing economy of any nation. Where protection schemes are used to ensure safe and uninterrupted power supply. Various relays are used for the protection of power system which includes bus –bar , motor, generator etc. Modern relays most popularly used for distance protection is numeric relay. Numeric relay has numerous advantages over conventional electromagnetic and micro-processor based relay. This paper aim at performance evaluation of the numeric relay under different loading conditions at 400kV switch yard.

Keywords :*Numeric relay, Transmission line, fault, Distance protection.*

I. INTRODUCTION

On a transmission system the protective relaying system is incorporated to detect the abnormal signals indicating faults and isolate the faulted part from the rest of the system with minimal disturbance and equipment damage to ensure regular ,uninterrupted power supply. Transmission lines are among the power system components with the highest fault incidence rate, since they are exposed to the environment. Line faults due to lightning, storms, vegetation fall, fog and salt spray on dirty insulators are beyond the control of human being. The balanced faults in a transmission line are three phase shunt and three phases to ground circuits. Single line-to-ground, line-to-line and double line-to-ground faults are unbalanced in nature. The other faults occurring in power system are unbalanced in nature mainly contributed by various transient occurring in power system due transformer ,alternator, frequent load switching . Due to un predicted nature of fault several times mal operation of relay takes places.

II PROTECTION SYSTEM AND FAULT ANALYSIS

Electrical power system operates at various voltage levels from 415 V to 400 kV or even more. Electrical apparatus used may be enclosed (e.g., motors) or placed in open (e.g., transmission lines). All such equipment undergo abnormalities in their life time due to various reasons. For example, a worn out bearing may cause overloading of a motor. A tree falling or touching an overhead line may cause a fault. A lightning strike (classified as an act of God!) can cause insulation failure. Pollution may result in degradation in performance of insulators which may lead to breakdown. Under frequency or over frequency of a generator may result in mechanical damage to it's turbine requiring tripping of an alternator. Even otherwise, low frequency operation will reduce the life of a turbine and hence it should be avoided.

Faults usually occur in a power system due to either insulation failure, flashover, physical damage or human error. These faults, may either be three phase in nature involving all three phases in a symmetrical manner, or may be asymmetrical where usually only one or two phases may be involved. Faults may also be caused by either short-circuits to earth or between live conductors, or may be caused by broken conductors in one or more phases. Sometimes simultaneous faults may occur involving both short-circuit and broken conductor faults (also known as open-circuit faults). Fault analysis is usually carried out in per-unit quantities (similar to percentage quantities) as they give solutions which are somewhat consistent over different voltage and power ratings, and operate on values of the order of unity. Different types of protection in power system are namely Transmission Line Protection and feeder protection

Transformer Protection ,Generator Protection, Motor Protection, Busbar Protection etc

III RELAYS:

Relay are sensing device which senses the inputs (mostly voltages and currents) from the system/apparatus and issues a trip decision to the circuit breakers, if a fault within the relay's jurisdiction is detected. Different generation of relay in use are Electromechanical Relays,Statice Relays and Numerical Relays.

IV. NUMERIC 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 advancement 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, in US the term (digital distance protection) has always been used in the meaning of (numerical distance protection) (Ziegler, 1999). A general view of the typical digital relay is shown in figure 1.

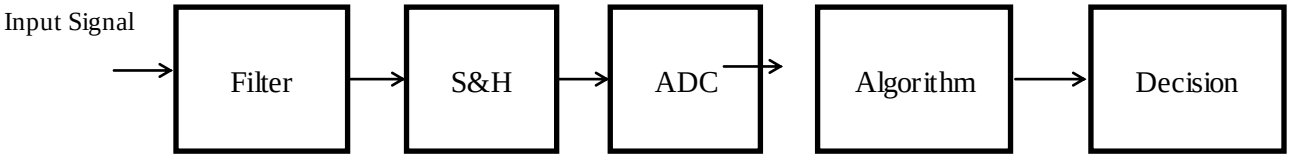

Figure 1 : Schematic diagram of Numeric relay

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) (Sandro, 2006). The following hardware modules and functions constitute the generalized numerical relay.

Current and Voltage Signal During Faults

The voltage and current signals in resistance-inductance behavior of power network are as usual sinusoid with exponentially decaying offsets. The offsets can severely affect the currents but seldom affect the voltage. Figure 2, shows the shape of the fault current at the terminal of a synchronous machine (Nasser, 2008)

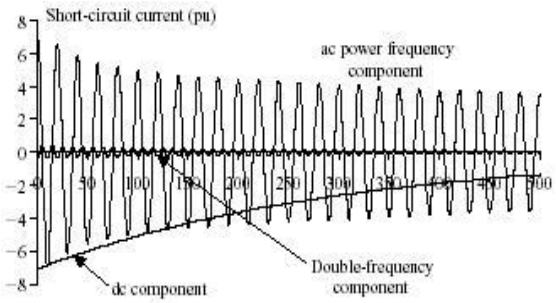

Figure 2. Three-phase short-circuit fault at a synchronous machine terminals

Reasons for transients in power system: Non-linear loads, power transformers and instrument transformers can produce harmonics. In addition to that, capacitive series compensation introduces subsystem frequency transients. This transient depends on the percentage of capacitive compensation. Attention has to be given to filters, no matter how they are built, they should have the following characteristics:-Band pass response, about the system frequency, because all other components are of no interest. Dc rejection to guarantee decaying- exponential are filtered out .Harmonic attenuation or rejection to limit effects of nonlinear loads. Reasonable bandwidth for fast response.

V. METHODOLOGY

Different model of Numeric relay by different manufacturer has been studied theoretically and for the physical verification of the same relay the real time data was collected from the different organization where such relays are in use.

Collecting data from an organization was not enough to come to any conclusion regarding the performance behavior of Numeric. The discussion with engineer`s (both commissioning and operating) was an important basis of the conclusion made in this paper. Some of the data collected under different fault conditions are summarized in table -1

The analysis is made on the basis of observation made at 400 kV switch yard . The power is transmitted using double circuit 400 kV line. The distance between two switch yard is 250 km

VI.RESULT

Table-1

S.N.	Circuit	Date	Fault time	Charging Time	Whether	Indication by relay	Type of fault	Remark
1	Circuit I	24.08.2012	02:05 Hrs	02:47 hrs	-	-	Unknown	direct trip received from sender`s end
2	Circuit II	24.08.2012	02:05 Hrs	02:47 hrs	-	-	Unknown	
3	Circuit II	04.10.2012	17:30 Hrs	17:53 Hrs	Stormy and cloudy	-	Unknown	direct trip received from sender`s end
4	Circuit II	03.09.2012	05:26 Hrs	-	Dry and Clear	-	Unknown	Auto – Reclose operated successfully at both ends
5	Circuit I	06.09.2013	02:44 Hrs	-	Dry and Clear	-		Ckt–I was already dead SOTF operated
6	Circuit II	06.09.2013	02:44Hrs		Dry and Clear	-	Unknown	No elements have been shown by relay
7	Circuit I	13.04.2013	19:48 Hrs	21:02 Hrs	Cloudy ,stormy ,heavy lightning	-	Unknown	Distance protection relay operated
8	Circuit II	13.04.2013	19:48 Hrs	01:14 Hrs on 14.04.13	Cloudy ,stormy ,heavy lightning	-	Known	Auto Reclosed Executed but again fault occurred in same phase

9	Circuit II	09.07.2013	11:59 Hrs	12:21 Hrs	Rainy with thunder and lightning	-	Known	Tripped Zone-1 distance Protection due to earth fault in R-phase

VI. CONCLUSION

1. However many a times the incorrect settings in the numerical relays have also become a cause of unwanted tripping .
2.Multple tripping has been observed in many cases even after fault clearing.
3.Numeric relay automatically captures and stores 23 most recent eleven-cycle, oscillographic reports detailing containing current, voltage, contact I/O, and protection element conditions during events. Sequence-of-events recording captures, time tags, and stores 512 latest state changes of contact inputs, contact outputs, control points, and protections elements.
4.Distance protection scheme show good results.
5. The charging time of the system varies from 20 minutes to 2 hours (normally) in exceptional case time may be as large as 12-24 hours.

REFERENCE

[1]. Agrawal V.K., Porwal Rajiv, Kumar Rajesh., Pandey V., 2011,Study Committee B5 Colloquium , Lausanne, Switzerland
[2]. Barry W. Kennedy, Power Quality Primer, McGraw-Hill Company,2000 (Barry, 2000) Craig Marven& Gillian Ewers, A simple approach to digital signal processing, TexasInstruments, 1993, ISBN 0 904 047 00 8.
[3]. Dong X., Kong W. and Cui T. 2009. Fault classification and faulted-phase selection based on the initial current travelling wave,*IEEE Trans. Power Delivery*, vol.24, No.2, pp.552-559.
[4]. Dr. Hamid H. Sherwali and Eng. Abdlmnam A. Abdlrahem (2009) Modeling of Numeric Distance Relay using MAtlab, Proceedings of IEEE, Symposium on Industrial Application ,ISIEA,2009, October , Kuala Lumpur, Malaysia
[5]. Electricity Training Association, Power System Protection, Volume 4: Digital Protection and Signaling", The Institution of Electrical Engineering, IEE, London 1995, ISBN 0 85296 838 8
[6]. 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. 12, April 2001, pp. 238-45.
[7]. GEC Alsthom ,Protective Relays Application Guide, GEC Alsthom Measurement limited, Erlangen, GEC England, Third edition, 199
[8]. Gerhard Ziegler, Numerical Distance Protection, Publicis Corporate Publishing, Erlangen, Siemens, second edition, 2006, ISBN 3 89578 266 1.
[9]. Nasser Tleis, Power System Modeling and fault analysis, Elsevier Ltd, 2008, ISBN 13 978 0 7506 8074 5
[10]. Rockefeller G.D., 1969. Fault protection with a digital computer, *IEEE Trans. Power App. and Syst.*, vol. 88, no.4, pp.438-464.
[11]. SandroGiannyAquiles Perez, "Modeling Relays for Power System Protection Studies", Thesis Submitted to the College of Graduate Studies and Research, Department of Electrical Engineering University of Saskatchewan, Saskatchewan, Canada, July 2006

